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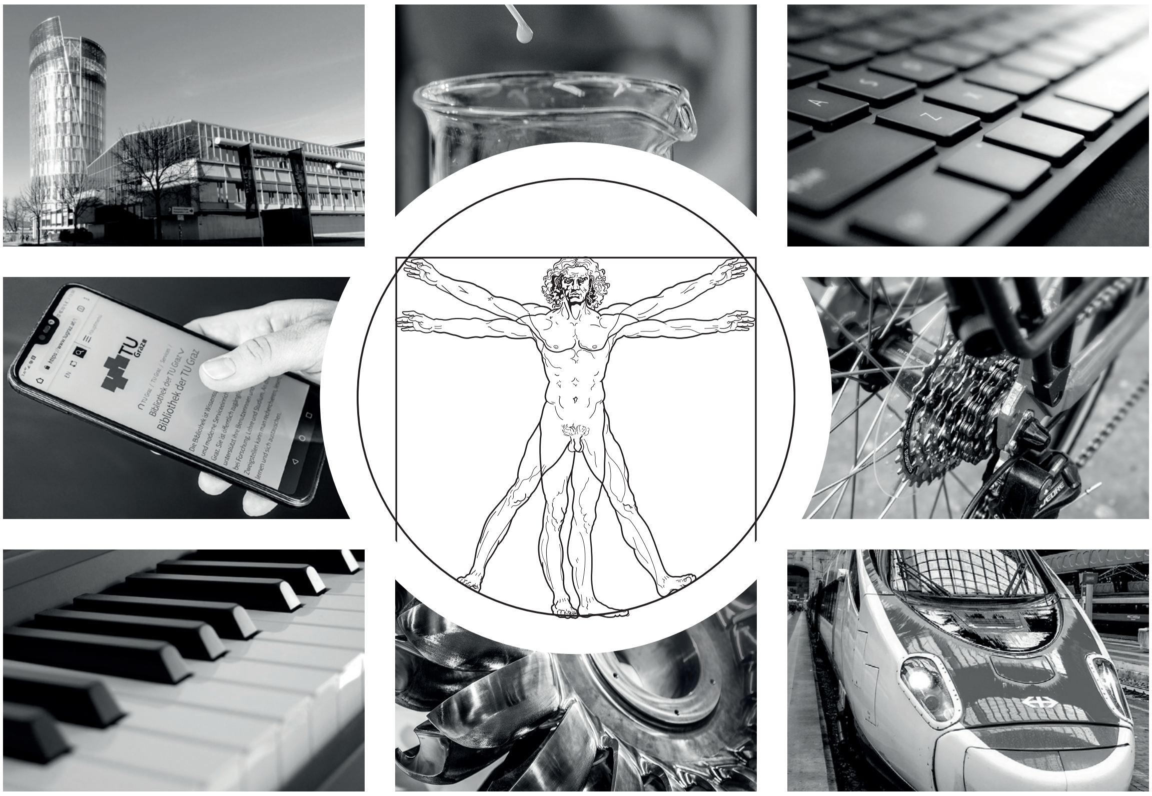

Nicki Lisa Cole | Michaela Jahrbacher | Günter Getzinger (eds.)

Conference Proceedings of the STS Conference Graz 2021

Critical Issues in Science, Technology, and Society Studies

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Preface

Critical Issues in Science, Technology and Society Studies

Conference Proceedings of the STS Conference Graz 2021, May 3rd–5th

The annual STS Conference Graz provides a space for scholars from all parts of the world to present and discuss their research with peers. In their papers, the conference participants address the complex ways in which science, technology and society co-evolve and mutually shape one another. Without exception, the participants of the conference aim to provide a better understanding of the world(s) in which we live. This includes the assessment of emerging technologies, the scrutiny of ethical, legal and social aspects of contemporary scientific practices as well as the transition to environmentally friendly and socially desirable techno-scientific futures.

This volume of proceedings documents part of the work that has been presented at the 19th STS Conference in Graz in 2021. It presents the wealth of ideas discussed at this occasion and fosters collaboration. The STS Conference Graz is the joint annual conference of the Science, Technology and Society (STS) Unit at Graz University of Technology, the Interdisciplinary Research Centre for Technology, Work and Culture (IFZ) and the Institute for Advanced Studies on Science, Technology and Society (IAS-STS).

Find the **Programme of the Conference** at https://sts-conference.isds.tugraz.at/event/14/attachments/11/66/STS_Conference_Graz_2021_Program.pdf
and the **Book of Abstracts** at the DOI: http://dx.doi.org/10.3217/978-3-85125-821-9

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Well-being Gender Budgeting in Academia

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Abstract. This paper focuses on the implementation of gender budgeting to tertiary education institutions with a double focus: well-being and gender equality. The paper starts with the definition of the main steps and objectives of Well-being gender budgeting, where attention is focused on how the approach can be extended to research-performing organizations. This approach has been embraced by the Leading Towards Sustainable Gender Equality Plans in research performing organisations [LeTSGEPs] project, funded by the European Union's Horizon 2020 Research and Innovation program. The paper then proceeds with a case study on how this approach can be applied to a specific higher education institution in Italy. Methodological issues are specifically addressed in the paper, making the different phases for well-being gender budgeting implementation clear, within two preparatory steps (stakeholder mapping and the selection of capabilities) and four phases that include: Context analysis, Planning Analysis, Budget Reclassification and Implementation. The case study of the Gender Budgeting implementation at the University of Modena and Reggio Emilia provides a practical example of the outlined methodology and allows reflection upon the evidence and determinants of gender inequalities in academia on different dimensions of well-being. A clear interaction emerges between the context analysis and the analysis of costs by means of expenditure reclassification and analysis of the earnings composition by level, gender and fixed and variable part of pay.

Keywords: gender budgeting, well-being, university, gender wage gap, capabilities

1 Introduction

This paper seeks to analyse the role that gender budgeting can play in Academia, starting from methodologies and the steps that are involved. It then proposes a case study showing the results of its implementation in an Italian University by following the well-being gender budgeting approach. This case study aims to show how the gender reclassification of expenditures in the capability approach leads to detecting how the University affects the different dimensions of stakeholders' well-being as well as to what extent gender inequalities in the distribution of resources occurs.

2 Gender Budgeting in Academia in the Capability Approach

The general objective of gender budgeting, that is to say gender equality, has also been set forth in specific goals that have been achieved over the years.

1. Promoting equity, efficiency and effectiveness (the 3 Es) in planning and policy implementation (Sharp, 2003);
2. Favouring transparency in the allocation and redistribution of public resources;
3. Raising awareness through information and stakeholders' involvement;
4. Increasing the development of human capabilities from an equality perspective.

The human development perspective is a strategic choice of the United Nations in the framework of the Human Development Program, following the Aristotelian tradition that appraises social systems according to their capability to promote what is good for human beings. The capability approach was first developed by Amartya Sen. "...Sen uses a particular definition of well-being which avoids reducing it to a mere bundle of goods and services, defined as "standard of living" (Sen, 1987). Following a classical humanist tradition, he refers to the normative experience of a "good life", characterized by a composition of capabilities whereby women and men, individually and in relation to others, can enhance the value of their lives (Sen, 1993) ..." (Addabbo *et al.*, 2011, pp.106-107).

According to Sen, well-being is determined on the basis of capabilities, i.e., an individual's opportunities to achieve certain things (like being well-sheltered, in good health, educated …). For instance, we can refer to the capability of working that can be developed by means of acquisition of skills, education and can be considered as an opportunity that can then be converted in the functioning of being employed. The conversion of a capability into a functioning can also be affected by social and individual conversion factors. In the case of academia, the presence of a dedicated service to placement can ease the process of observing the graduate student employed.

The capability approach was originally applied to gender budgeting in 2002, in the implementation of gender budgeting in the region of Emilia Romagna as well as to the district and municipality of Modena in Italy by the research group in the Department of Economics Marco Biagi of the University of Modena and Reggio Emilia. Addabbo, Lanzi and Picchio (2010) provided the theoretical basis of well-being gender budgets that was then applied in different institutions and at different levels of government. It was applied in the Municipality and Province of Modena, Municipality and Province of Bologna, Province of Rome, in the Regions of Lazio, Piedmont and Emilia Romagna, in ten municipalities in Turkey and in Senegal (Addabbo *et al.*, 2011; Addabbo, 2016; Addabbo *et al.* 2019). More recently this approach has been experimented with in the two-step feasibility plan for the EU Gender Budget.

"The use of Amartya Sen and Martha Nussbaum's capability approach extends the focus of gender budgeting to the impact of policies on wellbeing, with its multiple dimensions and complexity, departing from an evaluation based exclusively on income or commodities. Wellbeing is defined at the individual level, and this, also according to feminist economics, requires investigating what happens inside the family and recognising the possibility of conflicts amongst its members on the construction of wellbeing." (Addabbo, 2016, p.59)

Well-being gender budgets (thereafter WBGB) analyse budgets and public policies under the double perspective of well-being and gender equality.

2.1 Selecting Capabilities

A first important step in its implementation is to define a list of capabilities and, according to the WBGB approach, this can be a list of capabilities that are intrinsic to the institution being analysed on the basis of the functions and sedimented values of the institutions involved in the gender auditing/budgeting process. The intrinsic dimensions of well-being can then be matched with a participatory list of capabilities that can be defined by means of a participatory approach involving stakeholders and bringing them to define and, in some cases, also to order a list of dimensions of well-being that they expect the institution that is undergoing gender auditing/budgeting should contribute to develop. This double method to define the dimensions of well-being has been used in the implementation of WBGB to the gender budgeting of two European RPO's: University of Modena & Reggio Emilia (Italy) and Universidad Pablo de Olavide (Spain) (Addabbo, Gálvez-Muñoz, Paula Rodríguez-Modroño, 2015).

The Capability Approach provides a theoretical foundation to gender budgeting. The implementation of gender budgeting based on the capabilities approach actually makes it possible to highlight the contribution of the institutions analysed on the construction of human development from a gender perspective.

In the context analysis, every dimension of well-being is analysed from a gender perspective, detecting inequalities in its development and different degrees of deprivation by gender.

In this framework, the actions of institutions, including higher education institutions, is then analysed not only according to their ability to offer a suitable system of services for women and men, but also in their role in the development of well-being dimensions.

A possible list of capabilities for universities may include fundamental capabilities, like access to knowledge and the capability to work. By applying WBGB to the University of Modena and Reggio Emilia and University of Pablo de Olavide budgets, Addabbo, Gálvez-Muñoz and Rodríguez-Modroño (2015) show how these two dimensions of well-being result as fundamental both by applying the intrinsic

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capabilities method to detect the universities' capabilities and by using a participatory approach involving students.

However, other capabilities can be placed at the heart of WBGB according to each university's elaboration on gender equality and well-being as well as to the social environment.

The university elaboration on gender equality and well-being issues can be inferred by the University Statute, Strategic plans, Gender Equality Plan and shows whether the institution has clear gender equality values. As depicted in Figure 1, the University, by providing work opportunities in research or in administration, can contribute to the development of work and research capabilities. Moreover, insofar they can allow researchers and employees to progress in their career without limits linked to gender, sexual orientation, ethnicity or other individual characteristics, universities can develop individual capabilities not only of working and conducting research activities but also of being able to reach apical positions in the institution. However, as the analysis on gender inequalities in career progression can reveal, the observable indicators of this capability of vertical mobility as far as gender is concerned, reveal an under representation of women in apical positions and consequently inequalities in career progression capability or limits on observing this capability translated into an equal distribution by higher academic role in universities. To what extent is this unequal development made visible and addressed by Universities' policies?

Turning to other dimensions of well-being that universities can affect, the way teaching is delivered, as for instance inclusive teaching methods, can allow students to develop their capability of caring for others. Counselling can make it possible for employees and students to whom it is addressed to develop the capability of caring for themselves. During pandemics counselling and psychological listening desks that have been offered by universities can be considered as an important means to develop the capability of caring for oneself. The University management proactive approach to implement work-life practices can affect employees' capability of caring for others.

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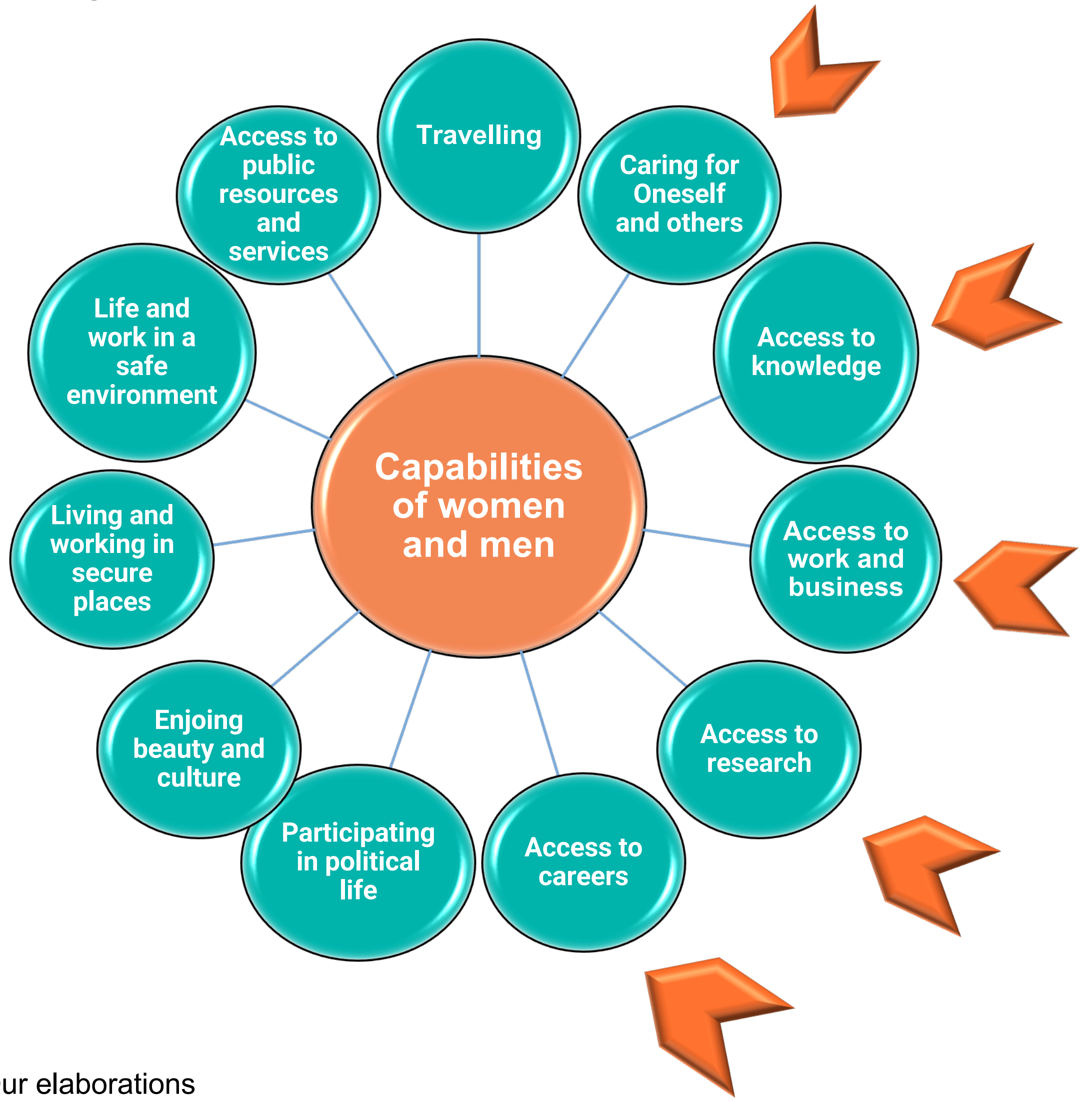
Fig.1. Selecting Capabilities



Source: Our elaborations

2.2 Stakeholder Identification

The first methodological issue to face is the definition of which men and women are involved in the GB analysis. Most of the previous GB experiences, carried out by institutions such as States, Regions, and Municipalities, usually refer to men and women as citizens to comply with their democratic mission. In the case of a university GB analysis, we can identify Students, Researchers, Professors, Administrative and technical personnel as internal stakeholders.

External stakeholders refer to civil societies and institutions in the area where the University is located both in terms of the role of human capital production by the University and in terms of the increasing role played by universities in public engagement. National and European institutions are also external stakeholders contributing with guidelines, funding policies on research and education to the University development and choices. Stakeholder engagement in the gender

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budgeting process plays a crucial role. Stakeholders can contribute to the definition of the dimensions of well-being with respect to which gender budgeting can be performed having an active role in the very process of gender budgeting in the capability approach.

2.3 Context Analysis

The context analysis aims at having an overall picture of the gender inequalities taking into account the stakeholder map.

The EIGE official definition quotes:
"...Gender analysis provides the necessary data and information to integrate a gender perspective into policies, programmes and projects. As a starting point for gender mainstreaming, gender analysis identifies the differences between and among women and men in terms of their relative position in society (RPOs for us) and the distribution of resources, opportunities, constraints and power in a given context. In this way, conducting a gender analysis allows for the development of interventions that address gender inequalities and meet the different needs of women and men..." (EIGE, 2019c, p. 3).

While designing a gender context analysis, the structure of data collection always has to take into account the main gender principles and topics:

- Productive and reproductive work: care activities and paid work
- Horizontal segregation (in education, research, work, etc.)
- Vertical segregation
- Gender Empowerment
- Gender Mainstreaming
- Intersectionality

With regards to intersectionality, it is crucial to be aware of the heterogeneity within the groups of women and men by ethnicity, social class, disability, age in order to be able to address it in the very phase of context analysis. Also a non-binary gender definition should be included by addressing the issues of making visible inequalities and perceptions of discrimination by sexual orientation. Changes that should be supported by a data collection that is sensitive to intersectionality and the very definition of gender. An awareness that needs special attention with dedicated actions.

To decide what to analyse, it is important to adopt a methodology of analysis which systematically goes through the list of the capabilities and decides the level of attention required (high, medium, low), the kind of stakeholders mainly engaged in the capability as direct beneficiaries or agents of change, which other capabilities are indirectly involved, which questions need to be answered, which gender data might be useful, which Department could release them.

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An example on how to plan gender context analysis by capability is given in the following table:

Table 1: How to plan gender context analysis by capability (example: Access to research)

Main Capability Analysed	Access to research
Indirect capabilities	Access to knowledge, Access to career, Caring for oneself and others, Travelling
Level of gender relevance	High for universities and research centres.
F/M Stakeholders beneficiary	Students, doctoral graduates, researchers, professors.
F/M Stakeholders to involve	Students, doctoral graduates, researchers, professors, administration, Members of boards.
Department	Research department.
Questions to be answered	- How many F/M are researchers in our RPO? - F/M In which field of research? - Product of research by gender? - How many F/M in citations? - Do F/M have the same research opportunities and resources? Conditions?
Gender data available	Women among doctoral graduates by field of education. Women among doctoral graduates by narrow field of education (STEM). Women among researchers by field of R&D. Women among researchers by age group. Women among researchers by type of contract.
New Gender data required	Survey: anonymous questionnaire for researchers by sex on gender, stereotypes, obstacles to career, number of citations, co-authorship, relationship with Grade A professors, difficulties in carrying out research activities, time budget.

Source: LeTSGEPs project, RPO's GA&GB Methodology Report (2020)

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2.4 Planning Analysis

Planning Analysis consists in assessing the attention to Gender Equality paid by the University by examining institutional planning and strategic documents.

If the university is engaging in a Gender Budgeting experience for the first time, the analysis aims at detecting some gender equality cues in the University Strategic Plan, that may be directly or indirectly identifiable.

In the capability approach this analysis entails a double focus in terms of the implications on the selected capabilities and in terms of gender equality.

If a Gender Equality Plan (GEP) has already been approved, special attention will be devoted to the policies and indicators set in the GEP in the auditing phase. In this case as well, referring to the capabilities' scheme and stakeholder classification makes it possible to maintain a homogeneous pattern of analysis in every phase, which favours the general evaluation of the report and of the process as a whole.

2.5 Budget Reclassification

The main challenge while approaching a GB analysis is to create a connection between the budget items and their impact on women and men. Budgets are in fact made to account for the means that it is possible to quantify from a financial perspective (i.e. the services and the products that are purchased), and only in few cases do they make it possible to identify the women and men who are involved in terms of stakeholders. In this phase attention should be also paid to intersectionality to be able to detect also differences with regards to other characteristics, within the different groups of stakeholders. For instance, in providing special scholarships for female refugees, stakeholders are not only women but women being refugees with particular needs and experiences and needs that should be taken into account while disclosing the intersections of being refugee and being female.

For this reason, the budget items describe expenditures like, for example, salaries, allowances, services, maintenance, buildings, but it takes a further level of analysis to evaluate their impact on stakeholders, and a further one to assess the gender impact.

In order to link the main groups of stakeholders of the university to the budget and evaluate its gender impact on them, three levels of budget reclassification are required, drawing upon the reclassification methodologies that most Gender Budget projects have experimented so far and which have been adapted to better fit the universities' characteristics.

The Account Based Approach reclassification defines a gender scale of priorities, which represent the intervention areas having a greater impact on gender equality. As suggested, amongst others by Sharp (2003), four areas of "relevance" to gender may be identified. The *areas directly relevant to gender* represent activities expressly aimed

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at equal opportunities and at overcoming inequalities between women and men. The *areas indirectly relevant to gender issues* are the areas of intervention whose impact refers to aspects indirectly connected with gender differences, even if they are not expressly addressed to women or men. *The environmental areas* include areas of intervention in which the gender mainstreaming approach is constantly taken into account with reference to environmental variables that may influence women and men's capabilities even if it is not possible to measure the impact in terms of specific contributors or beneficiaries since they refer to the University in general terms. The fourth area, the *neutral area,* represents Universities' activities which have no evidence of financial items that may be measured with gender impact indicators.

The second level of reclassification concerns the well-being objective and refers to the Capability Approach, and results in reclassification tables that reflect both the stakeholder map and the Capability map as defined above.

A third level of reclassification may be very useful mainly at a technical level for the following implementation phase by defining three levels of order in terms of expenditures gender impact:

The first order concerns budget items whose male-female internal stakeholders directly receive the resources (e.g.: like salaries, pensions, allowances, paid overtime etc.). The following implementation analysis may refer mainly to the inputs gender analysis and the outputs they produce.

The second order identifies budget items whose male-female internal stakeholders (Researchers, Professors) have access to services provided by service providers (e.g.: childcare facilities, languages and computer courses, training, travels, insurance, etc.). In this case the output gender analysis (services' beneficiaries) may be implemented by a gender procurement analysis about services providers.

The third order refers to budget items that provide for external services needed by the RPO for its operation. This order includes people (like male-female external experts) and supplying companies, whose gender impact affects/consists of the human resources they put at the RPO disposal. In this case a gender procurement analysis on gender providers is the main perspective that may be adopted,

All three orders of expenditure, obviously, may be analysed also in terms of the corresponding outcomes with the gender perspective, even if these kinds of research are very rare and difficult to implement.

The double perspective (gender equality and well-being dimension) and the knowledge of the stakeholders involved in each action will allow us to reclassify expenditures and revenues accordingly (Table 2).

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Table 2 – The Budget Classification as a Matrix of Capabilities in a gender perspective

Scale of priority	Example of Capabilities	F/M Stakeholders involved	Department to refer to	Example of Revenues accounting items	€	Example of Expenses accounting Items	€
Direct Indirect Enviromental Neutral	Access to knowledge	Students, Professors	Students' Department Human Resources Department	Grants from public institutions for teaching, University tuition fees and dues due by the students	000	Personnel Costs for Teaching Students support costs	000
	Access to work and business	Students	Outplacement Department	Grants from public institutions for students' outplacement	000	Costs for outplacement activities	000
	Access to research	Doctoral graduates, researchers, professors	Departments in the different research areas, Research Office	Grants from public institutions, private entities and sponsors for research	000	Personnel Costs for research	000
	Access to careers	Doctoral graduates, researchers, professors, members of board	Board, Human Resources Department	Grants from public institutions, private entities and sponsors for gender empowerment and career advancement	000	Costs for the members of board	000
	Caring for Oneself and others	All stakeholders	Board, Human Resources Department	Revenues for projects on facilities for personnel caregivers	000	Caregiving facilities, Expenses for smart working	000

Source: Our processing

2.6 Implementation Analysis

The implementation phase is aimed at detecting how resources, revenues and expenditures, the impact on the stakeholders they refer to, with a gender perspective. The gender mainstreaming strategy, to which Gender budgeting refers to, envisages providing for an overall screening of all the reclassified accounting items and the check of available and related gender disaggregated data concerning them.

In case the RPO already has developed a Gender Equality Plan, the Implementation analysis will be carried out starting from its previously planned measures whose gender impact will be assessed with a specific attention. An overall gender impact evaluation, which goes beyond the GEP measures and focuses on the remaining budget items and related activities, will then be developed in order to offer new ideas and suggestions for the following planning phase.

The results of the context analysis in the implementation analysis will be very useful, even if in this case more attention will have to be paid to specific gender disaggregated

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data concerning beneficiaries specifically related to the budget item under examination.

3 Well-Being Gender Budgeting in RPOs: The Case of the University of Modena & Reggio Emilia

In this Section we present a case study based on the well-being gender budgeting analysis of the University of Modena and Reggio Emilia (Unimore thereafter). A special attention will be paid to: the selection of capabilities (Section 3.1), the definition of stakeholders (section 3.2), context analysis (Section 3.3), planning (Section 3.4) and reclassification of expenditure (Section 3.5).

3.1 Selecting Unimore's List of Capabilities

In order to select the dimensions of well-being, which will be used to analyse the context in terms of gender equality, gender impact and classification of expenditure, we have used both a list of capabilities related to the intrinsic features of the Institution (as suggested by Addabbo, Lanzi, Picchio, 2010) as well as a list of capabilities that have been selected by means of a participatory approach by students as stakeholders (Addabbo, Gálvez-Muñoz and Rodríguez-Modroño, 2015).

The matching of the two criteria detects two capabilities as the most relevant: access to knowledge and work. The list of well-being dimensions will therefore result from a mixed methodology including both intrinsic capabilities and the dimensions of well-being that are the outcome of a participatory process involving stakeholders.

3.2 Defining Unimore's Stakeholders' Map

The University of Modena and Reggio Emilia is located in the North of Italy; it enrolls about 24,000 students with a teaching programme going from bachelor, master and PhD courses in fourteen departments with a wide range of areas of research and education. In compliance with national laws, Unimore established a Unified Committee for the promotion of equal opportunities (CUG) that aims at promoting gender equality and well-being and contrast any kind of discrimination within employee and student populations. A Rector's Delegate for Equal Opportunities is in charge of ensuring the implementation of gender budgeting and respect of equal opportunities in the University.

In the starting phase, Unimore's Stakeholders were identified in keeping with the procedures set out in an EIGE-GEAR tool (EIGE, 2016). Consultations were carried out in order to foster awareness raising about gender equality.

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During the planning phase, meetings with key stakeholders took place in order to exchange experiences and information on gender mainstreaming and gender equality with an active role played by CUG and the Delegate of Equal Opportunities. A dedicated committee for the implementation of Gender budgeting was established.

Stakeholder involvement was crucial in the implementation phase for improving decisions and strategies and integrating gender-specific concerns.

All the identified stakeholders are also targets of the GB reclassification of the expenditures and gender equality accountability process.

In the process leading up to the selection of capabilities, as well as in the implementation phase, those internal stakeholders, which have been involved in gender sensitive consultation for awareness raising and are also targets of the GB reclassification of expenditures, include:

- Academic and technical and administrative staff
- Students
- Governance bodies

External stakeholders include:

- Suppliers (targets of GB reclassification of expenditures)
- External experts (targets of GB reclassification of expenditures)
- Other institutions (Ministry of University and Research, Municipalities, Region, Bank Foundations, NGOs) (Targets of GB reclassification of revenues and in the analysis of the strategic guidelines that can be affected by criteria for funding allocation and laws)

3.3 Context Analysis

A first step of WBGP implementation in universities concerns the analysis of the Unimore gender equality context. We propose here the analysis of the context with special reference to the capability of working and access to knowledge by gender.

Consistently with the results shown in EC (2019), Unimore is characterized by a gender gap, as shown in Figure 2, that widens to women’s detriment in the position of the type B researcher in a stabilization path in which men are more present (62%) than women (38%), a gap of 24 percentage points higher than what can be observed (17 percentage points) on average in Italian universities.

The gap is higher in the highest position of the career ladder where amongst Full Professor positions (Grade A) only 27% are women (25% on average in Italy).

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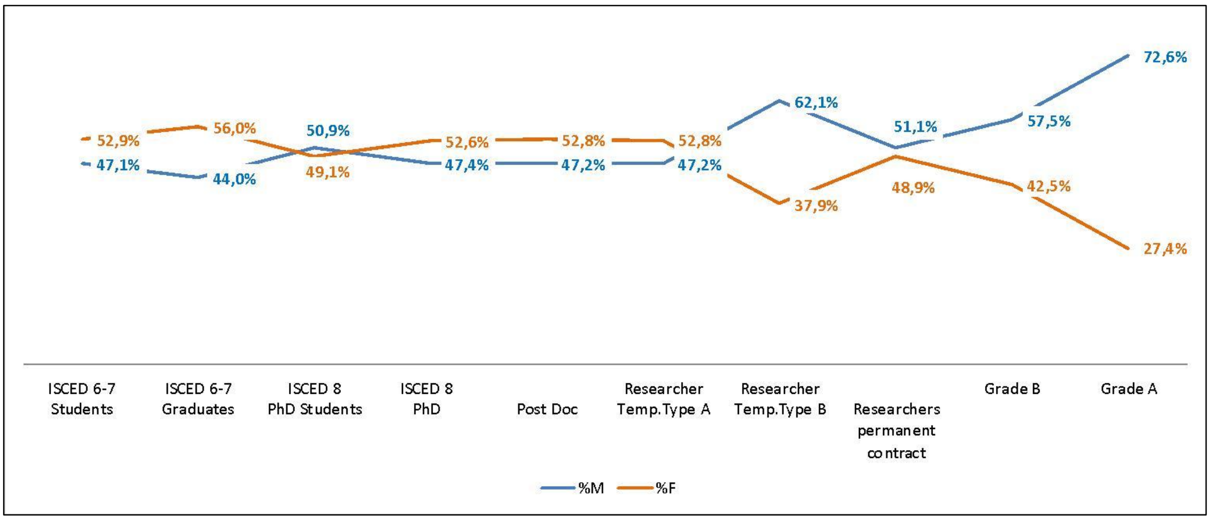
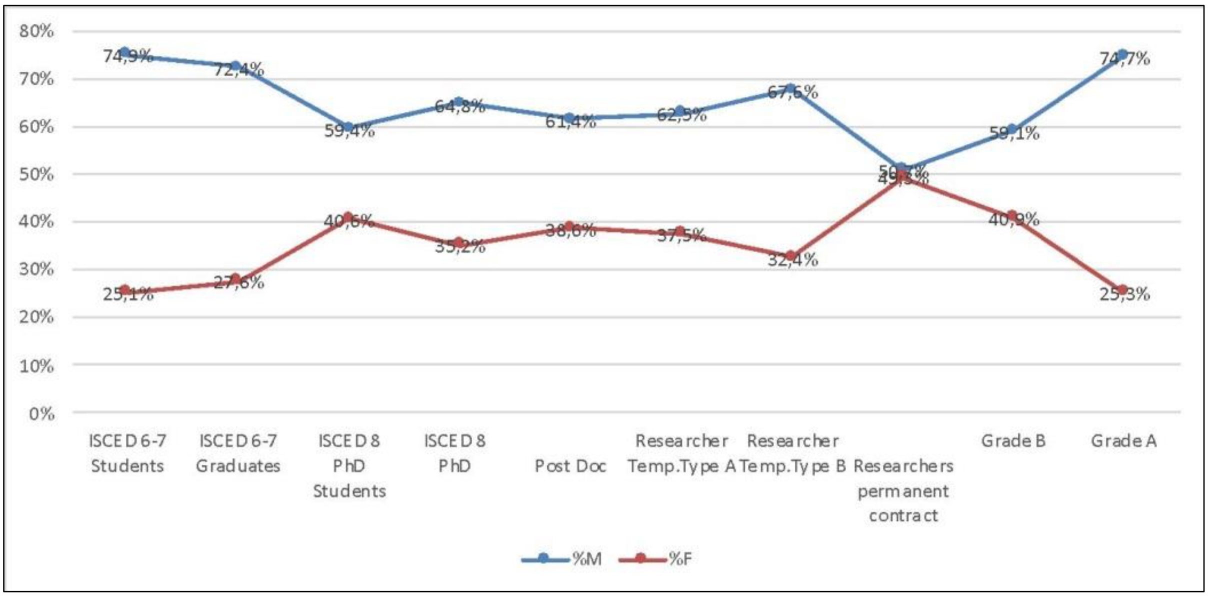
Fig. 2. Proportion (%) of men and women in a typical academic career, students and academic staff, Unimore end 2019



Sources: Our elaborations from administrative data http://dati.ustat.miur.it/ and https://cercauniversita.cineca.it/

The gender gap to women's detriment starts with access to knowledge/education capability in the STEM area (Figure 3), where the gap in attendance at the Bachelor and Master levels is about 50 percent to the advantage of men and about 30 percent points for Ph.D. holders. Gender gaps at the researcher type B and at Grade A role are wider than it has been found for the whole areas in Unimore. Disadvantages that can be found also on average in Italian universities.

Fig. 3. Proportion (%) of men and women in a typical academic career, students and academic staff STEM, Unimore end 2019



Sources: Our elaborations from administrative data http://dati.ustat.miur.it/ and https://cercauniversita.cineca.it/

The Glass Ceiling Index, obtained as a ratio of the percentage of women compared to the total number of teaching staff and the percentage of women in Grade A positions, is higher than one (1.44) and, although lower than the national average (1.55), being greater than 1 point to the existence of a greater difficulty for women in reaching the highest levels of the academic career. Not only is there evidence of a glass ceiling effect, there are also difficulties in the initial phase of stabilization in the academic role and to express this difficulty we use an index proposed in the literature by Ilenia Picardi (2019, 2020): the Glass Door Index which is the ratio of the percentage of women carrying out activities of research in the academy in temporary positions (Type A + Research fellow) to the percentage of women in contracts leading to stabilization (Type B Temporary Research Contract + Permanent researchers). The index assumes a value of 1.17 for Unimore and 1.03 as the average of Italian universities. If other non-stabilized positions were also considered (collaborators in research activities, collaboration contracts in the health area, linguistic collaborators and technologists), the index would take on a value of 1.27 for Unimore. If the comparison is then extended to include those who are in a precarious position and those who are stabilized (including in addition to researchers, associate professors and full professors), the index of precariousness in the position in 2019 (that we have defined as Glass Wall Index) is equal to 1.35, not considering the collaborators, and 1.47 considering them. Gender inequalities have therefore been detected in the access to career.

The gross average earnings (not including committee attendance tokens and income from external contracts) gender gap to women's detriment is about 4% in administrative and technical positions and 11% for academic staff. However, in the higher level of careers, this rises to 22% in managerial administrative positions and also increases for higher grades in academic positions.

When data on external contracts and on committee attendance tokens are taken into account, the gender gap in earnings sensibly increases to women's detriment. This is linked to the different presence of men and women in committees and external contracts. This has been confirmed by analysing Grade A professors showing that the gender pay gap was not only to be related to the lower presence of women in Grade A positions and in their lower seniority in these positions, but it was also related to a women's lower average allowances and other remuneration items not predetermined by a national collective agreement. All the remuneration items not depending on the fixed part but on the variable part related to roles of power, assignments, professional activities reveal a clear gender imbalance to women's detriment. This kind of gender inequality occurs therefore in every activity depending on a certain margin of discretion by decision makers and also in roles and tasks that require the capability of self-proposing and that may be influenced in the case of women by their higher involvement in unpaid care work and care responsibilities.

In 2021 Unimore took part in the survey carried out by the Conference of Equal Opportunities Bodies of the Italian Universities (CEOBIU) on the impact of distance work that during pandemics involved a substantial percentage of Universities' personnel (Ghislieri et al., 2021). This survey makes it possible to identify the activity academic personnel are more involved in, by gender and by role. This analysis made it possible to detect a higher degree of involvement in care work activities for women and greater evidence of a work-family life conflict for women by using an indicator proposed in the literature by Colombo and Ghislieri (2008) and Netemeyer et al. (1996). Moreover, women in academia have a higher score than men in the off-work hours Technology Assisted Job Demand (off-TAJD), an indicator that measures the demand for working hours by using technologies outside of normal working hours (Ghislieri et al., 2017).

3.4 Planning Analysis

Unimore has already developed a Plan of Positive Actions including specific actions on gender equality with special regards to the promotion of work-life balance, activities devoted to raise gender equality awareness (including also a gender sensitive language) and to combat violence against women (also with the interaction with external institutions that are active on this field).

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Unimore CUG has recently approved Guidelines for gender equilibrium in panel composition in scientific events.

3.5 Gender Budgeting Reclassification

As an initial experimentation of Gender Budget Analysis at the University of Modena and Reggio Emilia, its “Economic and Investments Budget 2020” was examined for the expenditures section as represented in the chart of accounts for a total amount of €155,505,534.00.

Its classification in accordance with the gender budgeting methodology described in Section 2.5, returned the following gender budgeting table:

Table 3 – The Budget classification of the University of Modena and Reggio Emilia from a gender perspective

Priority	Stakeholders/Capability	Access to knowledge	Access to research and Academic work	Access to career and power	Access to work	Access to business	Neutral	TOTAL
Indirect Expenses	Students	21.720.572						21.720.572
	Professors and reseachers		80.163.644					80.163.644
	Leaders			269.080				269.080
	Staff and Administration				27.955.520			27.955.520
	External Experts to support Academic activity				577.518			577.518
	External Experts to support Administration					635.519		635.519
Environmental Expenses	Suppliers					17.886.394		17.886.394
Neutral Expenses	Neutral						6.297.287	6.297.287
TOTAL		21.720.572	80.163.644	269.080	28.533.038	18.521.913	6.297.287	155.505.534

Source: Our data processing on Unimore budget data

The gender perspective is then pursued by analysing the resources distribution and impact between men and women identified within the above-mentioned groups of stakeholders and by assessing the different impacts on them.

Gender Auditing of Unimore 2019 Budget

Amongst current expenditure personnel costs represent 51% of the total costs and can be considered as having an indirect impact on the capability of work and disaggregated by gender according to the beneficiaries who can be considered as internal stakeholders. The observed academic career path will imply an unequal distribution of resources of the costs devoted to academic staff (38% of the total costs) and gender gap in earnings to women’s detriment mitigated in permanent research positions by the higher seniority of women in the lower grade of academic career with lower chances of getting promoted and having access to higher wages.

Budget data can then be disentangled by gender and academic or non-academic personnel recovering individual earnings and estimating net gender earnings gap including observable individual characteristics on age, seniority, position, presence of children, type of contract, on-the-job training.

A clear analysis of the gender earnings gap together with the context analysis on the structure of employment by gender can contribute to plan specific actions on how to address observable inequalities by gender amongst personnel.

Costs related to student support (representing 10% of total costs) may also be classified as indirect expenditure and be disaggregated by the beneficiaries' gender. Moreover, in classifying expenditure devoted to supporting students, care should also be given to the actions funded. During pandemics, Unimore funded access to Wi-Fi and computers on lease for students in need. Data should be disaggregated by beneficiaries' gender while context data collected by means of a dedicated survey on students makes it possible to detect to what extent this type of support was more required by women or men students.

4 Conclusions

To what extent can gender budgeting help higher education institutions in detecting gender inequalities in well-being dimensions and in planning gender equality enhancing policies?

The process of selecting the dimensions of well-being that the higher education institutions can affect is a first step in the process that, having identified the stakeholders, proceeds with the analysis of the context under the double lenses of well-being and gender equality.

Budget re-classification is then carried out by classifying each expenditure according to its gender impact with regards to each well-being dimension.

The case study makes it possible to detect the interaction between the context analysis and the expenditure, serving also as background information on which to base new programmes to reduce the observed gender inequalities.

The context analysis shows the widening of a gender gap to women's detriment in the career progression already in the position of type B researcher (a position that is more likely to bring to a tenured position in Academia).

Both in the University of Modena and Reggio Emilia and on average in the Italian Universities, the gender gap to women's detriment calls for policies that could break the Glass door (as defined in Picardi, 2020). Mentoring programs (Dutta et al., 2011,

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Gardiner et al. 2007, Farkas et al. 2019, Picardi and Agodi, 2020) should also be introduced to improve the access of women in post-doctorate or temporary researcher posts to tenure-track positions although more research is needed to identify the long-term effects of mentoring on mentees, and the institution on gender equality (Meschitti and Smith, 2017; House et al., 2021). The observed inequalities in the career progression and the lower share of earnings related to membership of committees or external contracts further widen the pay gap to women’s detriment and call for dedicated actions tackling the glass ceiling and glass door effects.

Further developments of well-being gender budgeting include the recognition of intersectionalities and to also address non-binary gender definitions. This development will also bring about new ways of collecting and classifying data and new indicators to evaluate the programmes.

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Emília RORIGUES ARAÚJO
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Time to PhD: Exploring the Experiences of Doctoral Students and the Persistence of Gender Bias During the Pandemic

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Abstract. This article presents the main conclusions of an exploratory study carried out in Portugal on how women doctoral students have experienced time to PhD completion during the pandemic, drawing on studies of time, gender and academia. It shall do so by carrying out an empirical analysis of data gained from a survey conducted in January 2021 made up of open-ended questions. In line with existing studies, the results reached underline that the pandemic is simultaneously perceived as an opportunity to discipline time and accelerate doctoral work, and an experience of stagnation due to lack of concentration and delay marked by difficulty in finding spare time to dedicate exclusively to researching and writing a thesis. This paper raises some ideas about the relevance of Gender Equality Plans in universities addressing the specificities of doctoral students' experience of time as they complete their degree, indicating the need for them to adopt an intersectional approach to time during and for their doctorate.

1 Introduction

Time to PhD has been a matter of great concern for individuals and higher education institutions over time (Araújo, 2005; Araújo et al., 2019). However, the COVID-19 pandemic brought with it numerous suspensions and additional challenges, significantly affecting scientists' mobility and group work, and therefore academia as a whole, impacting the time to completion of the doctorate itself.

Indeed, a PhD encompasses a typology of research projects that are highly dependent on activities that demand co-presence. These activities include not only classes, supervision and laboratory tests but also meetings, national and international mobility programmes and fieldwork conducted with other people, among other things. A PhD is also an expensive undertaking that impacts both personal and family budgets, especially when students pay independently.

Meanwhile, the COVID-19 pandemic required students and higher education institutions to readapt workspaces and manage different and sometimes conflictual time demands, including personal and family time. In sum, the COVID-19 pandemic is increasing and densifying the already high rhizomatic (Araújo, 2019; Gravett (2021) nature of time during and for PhD studies: suddenly, time and space spent working on Doctoral Projects were subjected to increasing transformations and pulverised with additional interruptions, requests, delays, uncertainties, and waits. As Gravett notes:

> "The concept of rhizome and becoming can be usefully applied in order to disrupt linear narratives of learning and to enhance our understanding of the nuances, fluidity and heterogeneity of all routes of doctoral research. However newer forms of the doctorate, such as the PhD by publication, with its space for a more heterogeneous, non-hierarchical, collation of work on multiple research projects, offers particularly rich potential to surface the fluidity of doctoral study that a rhizomatic conception of knowledge represents" (Gravett, 2021, p.299).

Indeed, the COVID-19 pandemic is suspending and simultaneously demanding new time structures and arrangements, impacting institutions, PhD students' lives, and trajectories. Universities have responded with increasing extensions of deadlines. However, the difficulty in finalising theses remains a significant institutional issue.

Before the pandemic, literature on the matter had noted that doing a PhD imposes different time challenges for different genders, particularly for men and women, specifically for women with children or other dependents (Araújo and Silva, 2020). From an intersectional perspective, an assumption can be made that PhD students face singular time dilemmas depending on whether they are full-time researchers, have to divide their time between a PhD and a paid job, or are full-time students with individual fellowships. Thereby, it is possible to hypothesise that the pandemic may have maintained and exacerbated the implications of these variables, imposing increasing challenges to students with children, other routine family demands, and paid jobs.

Grounded on a literature review of studies on the topic, this hypothesis will therefore be subject to a debate that explores the experience of time during and for PhD studies throughout the pandemic, with two main desiderates: describing the experience of the doctoral period as experienced by students who classify themselves as "woman", on the one hand, and understanding the characteristics of this experience considering the pre-existent gender bias reducing the availability of time and negatively affecting women's temporal perspectives, therefore impacting their ability to conclude a PhD, on the other.

However, to better understand the problem of time in women's experience of a PhD, it is relevant to understand some important features of the institutional contexts that frame the entire experience of PhD studies in Portugal, as shall be discussed in the next point. After this contextualisation, the main concepts in use shall be presented in addition to the methodology adopted for the study. The following point contains a data analysis carried out with a view to reaching the conclusion that the time equity in academia is reliant on people's experiences, and reliant on adequate and participated institutional time frameworks.

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2. Institutional Framework: a Brief Overview

Higher education institutions in Portugal seek a considerable degree of autonomy when implementing national education and science strategies. However, national policies are particularly centralised and managed mainly by the Minister for Higher Education and Science, the Portuguese Foundation for Science and Technology, and the National Agency for Assessment and Accreditation of Higher Education (A3es). This centrality demonstrates the considerable extent to which strategies adopted by Higher Education Institutions in Portugal regarding time to PhD are still highly centred around the need to establish common institutional and national time structures that respond fairly uniformly to PhD time needs.

The COVID-19 pandemic provides ample evidence of the effects of this centrality in general and national policies. Regardless of the specifics of each one, institutions rely on central government laws being passed before any decisions are made regarding PhD deadlines, online thesis presentations, and other relevant changes imposed as a result of the pandemic. Such laws specify the extended timeframes in which PhD students could expect to complete their theses in 2020-2021 (Law 38/2020, which stipulated that an additional six months would be added to thesis deadlines).

So far, Portuguese Higher Education Institutions have been strongly pressured to review PhD deadlines to improve their compliance with international and national evaluation quality indicators. To this end, Higher Education Institutions are mobilised and recommended to analyse selection processes, study plans, supervision processes and evaluation methods, among other factors directly related to writing PhD theses.

Quality, excellence, and focus on research are the three building blocks underpinning these policy guidelines. Using them as guides, institutions have become highly committed to defining and implementing measures that ensure PhD students deliver their PhD theses within the expected deadlines. Some of these measures include supervisor evaluations, constituting thesis monitoring committees, incentivising student participation in academic and scientific activities such as seminars and conferences, and writing for and publishing in relevant journals. An additional effort has also been made to foster student participation in national and international research networks.

Simultaneously, evaluation agencies also emphasise the need to appraise PhD courses based on indicators common to every HE course: goals, quality control, human and material resources, student profiles, study plans, training methodologies, academic outputs and general course organisation (A3Es, 2013, 25º). For PhDs, the focus is on indicators such as the time spent working on a thesis, organisational support, learning and training environments, and the proximity of supervisors. Overall, as stated at the beginning of this section, the overarching policy trend has focused on

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defining and implementing measures that shape institutional time structures, inducing identical PhD paces and trusting that every student estimates the time conditions accurately when working towards their PhD.

In this sense, evaluation agencies appear to be strongly committed to appraising student profiles, mainly considering variables such as previous positions, scientific area, professional situation, and research interests. Aside from an intense valorisation of students with a solid determination to pursue a career in academia or research, current policy guidelines support the representation of a PhD degree as a selective academic degree requiring full-time dedication, making it potentially incompatible with other time demands. Despite increasingly considering nationality as an indicator of internationalisation of the doctoral plan, the concept of the PhD student relies heavily on the hegemonic concept of the male/female student with or without family demands to address.

Additionally, gender is still omitted from Portuguese scientific policy, especially regarding the definition and implementation of Gender Equality Plans in Higher Education Institutions (European Institute for Gender Equality).[1] Moreover, the existing gender equality plans are still strongly oriented towards academic staff, generally involving students only very broadly, applying similar measures to all degrees. As such, this paper also intends to shed light on the specificity required for doctoral students in particular.

3 Theory

The temporal structure of time to PhD is complex due to the nature and multitude of time layers involved. Still, it is possible to assess through means of the theoretical framework developed by Zeruvabel, based on Erving Goffman (1956, p. 83) and Coser's (1974) conception in which time matters as a determinant of social and organisational functioning, which can be observed in the division between private and public time.

Zeruvavel (1981) states that time serves a "major social function" by keeping the personal and public spheres of life separate (1891, p.38). Analysing the differentiation between person and role that has taken place in modern societies, the author declares that time is "a dimension of the social organisation along which involvement, commitment, and accessibility are defined and regulated in modern society,[2] as time segregates the private and public spheres (p. 139). One of the pivotal modes by which

[1] https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/portugal
[2] Italic added by author (Zeruvabel, 1981, p. 139).

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this differentiation occurs, as Zerubavel states, based on Goffman, is through scheduling.

According to the author, the nature and extension of scheduling force people to establish a boundary between private and public, as schedules and calendars define when they are expected to exercise their duty and perform a social role. Thereby, in the author’s understanding, time discipline structured with a basis on calendars and schedules should not only be regarded as a form of institutionalised power and control but also a form of “liberation” of the individual in modern and complex societies insofar as it defines the ethical and legal limits and boundaries between time, much more than between spaces. However, in the author’s view, the delimitation of public and private time should not be thought of as absolutes, since “[one] ought to regard every moment of an individual's time as some combination of both private and public elements, that is, being located somewhere along that continuum” (p. 143-4).

Like Zeruvabel, other authors suggested that some professional activities are more vulnerable to “greedy institutions” (Coser cit in Zeruvavel, 1981, p.166). The temporal nature of the tasks does not allow for them to be sequenced following a rigid, normalised schedule and may involve continuous activities such as those related to management and care. When applied to a PhD, this theorisation enables critical reasoning to be applied to the consequences of the COVID-19 pandemic and the resulting challenges of presenting and defending a doctoral thesis. This is the case of scheduling and calendars that have been suspended and reconfigured to respond to the fear of contagion, therefore completely collapsing already very porous boundaries from the perspective of time to PhD.

Apart from other studies showing that time to PhD is a matter of concern (Parry et al., 1997; Delamont et al., 2000), other analyses state that this academic degree requires an extraordinary capacity to manage uncertainty and time availability (Louvel, 2012, Louvel, 2012; Cardoso et al., 2020, Araújo and Silva, 2020, Gravett, 2021). The pandemic forced substantive changes in the pace at which PhDs are conducted (Aydemir and Ulusu, 2020). Ashton and Pintor-Escobar (2020) suggest that the pandemic has created severe difficulties in the progress of doctoral projects due to the difficulty of collecting, storing, and processing information impacting doctoral students’ assessments of the quality of their doctoral theses. They anticipate difficulties being faced in terms of doctoral students’ mental and emotional health, mainly relating to their ability to assess and use time during the pandemic (Windsor & Crawford, 2021).

According to Aydemir and Ulusu (2020), researchers and doctoral students have been negatively affected in these terms; however, these authors also see the COVID-19 pandemic as an opportunity for institutions and students to evaluate their trajectories and develop other approaches that allow them to produce doctoral theses that are less time-consuming in the long run. This practice could answer some queries

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raised by Hlongwa (2020), who considers that the pandemic has introduced and reinforced difficulties for people developing their careers. Wang & DeLaquil (2020) say that pandemic demands that institutions provide more personal support to PhD students, including support from a supervisor, creating informal and formal contexts for debating, and enhancing publications. Authors (Corbera, Anguelovski, Jordi, & Ruiz-Mallén, 2020) focus on the need to review teaching and learning practices, making them more sustainable, as well as reorganising care work.

Heng and Jeong (2020) speak of the adverse impacts registered on student productivity with the number of publications reduced and the pace with which doctoral theses are written slowed. Orendain and Riyanti Djalante (2020) consider that work and distance learning at a doctoral level during lockdown introduced more difficulties in conducting work plans and increased student frustration where deadlines were concerned. Kee (2021) underlines the challenges of digitalisation, stating that many of the delays and problems faced cannot be attributed to the inexistence of quantitative time but rather to the difficulty of dealing with uncertainty, frustration, and fear which define the context leading up to anxiety. In this case, Kee (2021) notes the relevance of what could be referred to as “relational time”: the portion of time that can be shared or negotiated within groups, fuelling persistence. Similarly, other authors (Börgeson et al., 2021) declare that the proximity of supervisors during the pandemic is a variable that affects the doctoral experience of time, as supervisors can have a role in managing emotions. Nonetheless, some authors say that too much emphasis on the need to discuss the uncertainty and ambiguity of the pandemic can be perverse (Eigege & Kennedy, 2021), leading to more time being spent than gained.

Gender is a crucial variable to be problematised from an intersectional point of view when referring to academia and time, along with other variables such as social class, scientific area, race and ethnicity. In Portugal, nationality is also a very relevant variable to consider, as a number of doctoral students come from other Portuguese speaking countries, mainly Brazil.

Cardel and others (2020) say that despite a greater representation of women in PhD degrees, they still face many obstacles to their progress in academic careers. Additionally, broad literature (Castañeda-Rentería, 2020, Araújo et al., 2021) suggests significant gender differences in the impact felt as a result of the pandemic (Oertelt-Prigione, 2020), as women have taken on much more work than men at home. Furthermore, they are more vulnerable to loss of employment, university and company closure, and to be affected by the general economic drawbacks caused by COVID-19 worldwide (OECD 2019; 2020). Having children, the conditions to carry out their research project at home, migration and professional circumstances (being a full-time student, holding a research contract, or working outside the university with a payable contract) are core variables affecting time availability, mainly when most of the work is

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conducted at home using multiple information and communication technologies (Nadal, 2020). Apart from this, one can also mention the fact that PhD students hold a particularly vulnerable position in academia, often having to accomplish invisible work, that is, “academic housework” (Conesa, 2019, p.43).

Viglione (2020) argues that women’s productivity has dropped when working from home, stating that women do more housework than men and have more responsibilities where their dependents are concerned, whether they are children or the elderly. The author also draws attention to the fact that the existing gendered nature of academic work impacts women’s and men’s lives differently. Women are more susceptible to being involved in activities directly linked to managing the pandemic, giving them less time to devote to writing and publishing, in general. According to Rabia et al. (2021), this need to simultaneously respond to different time demands is a crucial issue that adversely impacts the trajectories forged by women in academia. The authors argue that academic women are stressed, frustrated, and lack time for sports and other self-care, though when analysing the context further, they also state that academic women usually have more support from their partners than other women. In the authors’ view, the pandemic negatively affected women's ability to be promoted in the short term as it caused a period of stagnation. Similar ideas are shared by Huang, Gates, Sinatra, & Barabási, (2020). Gender issues in academia, particularly in PhDs, must also be regarded considering the general neo-liberal time framework that affects people's choices regarding their chances of pursuing academia at this level (Abdellatif & Gatto 2020).

As noted, pre-existing literature provides an account detailing the persistence of gender bias in academia. Despite the increasing need to tackle broader gender conceptualisations, a firm conviction that a “female” and a “male” PhD trajectory still remains, connected to a gendered vision of time in academia.

This paper therefore serves to argue that these differences need to be unpacked and problematised, especially at a time of crisis and rupture when traditional, conservative cultural patterns that box both women and men into fixed roles and expectations find broader ground on which to flourish. An analysis of the experience of women completing PhDs will therefore be conducted with a particular focus on examining how several variables, particularly whether they have kids or not, may permeate and affect their experience of time and time perspectives, unveiling the complexity of the time elapsed throughout a PhD.

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4 Method

Studying the experience of time is a complex exercise because most of the questions asked by individuals are circuitous, requiring indicators to be identified from which to explore the valuation of time and the variables that affect the uses and passage of time. The concept of doctoral time as a (time) rhizome also increases the need to use research techniques of a qualitative nature, which facilitate understanding of the phenomenon and its contextualisation.

Though qualitative methods such as ethnographic research and interviews are often preferred given the difficulties in accessing and recruiting people for interviews during the pandemic, for this specific study, a survey was sent out via the websites of various associations. The survey included the question “what is your gender” (providing the options: woman, man, other) and sought to obtain comprehensive information that would allow for a more detailed analysis to be carried out of subjects’ circumstances and experiences. As such, the survey also included open questions to allow respondents to base their answers on personal experience and share how they have coped with the constraints imposed by the pandemic.

Answers to closed questions on the survey were analysed using SPSS software. Answers to open questions were entered into a database and later analysed using thematic content analysis, in which themes and categories were determined that allowed for trends to be detected in the answers. Through this analysis, links were established between variables considered relevant to deepening the gender bias in doctoral careers, the links found being having children, age and scientific area. The categories determined derive from the analysis dimensions established for the research, which are as follows: i) experience of time during a PhD; ii) concerns about the PhD; and iii) perspectives for the future. The survey was sent to PhD students online, through associations and social networks, was available for 15 days and was accompanied by a message stating the ethical commitment of the request.[3]

An epistemological statement is necessary at this point: the purpose of this survey was not to equate women with carers, therefore crystallising traditional gender norms. From the offset, the intention was to discern more clearly who the PhD students were and how gender bias affects their experiences of time during the pandemic, taking into account the variables vulnerable to gender bias and related to living conditions, including scientific area and the existence of children (Castañeda-Rentería, 2020).

The majority of respondents considered themselves “women”. From all the answers received (152), only 27 listed themselves as “man”, one as “other”, and 124 as

[3] A Portuguese version of the survey is here: https://forms.gle/gFYJcUJJ6HGfVyWJ8

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"woman". As this paper only intends to analyse the experience of PhD students who identify as "women", only the answers provided by these 124 women were analysed.

It may be noted that the sample used for this study is small (124 women and x men who were not considered in this analysis), making the study exploratory in nature and helpful in shedding light on how women experienced PhD studies during the pandemic, providing food for thought about how higher education institutions can now accommodate and address time and gender issues. In this sense, results need to be considered cautiously, stressing the need for further research with a broader focus, both in terms of gender and institutional time frameworks.

4.1. Sample

As mentioned previously, 126 responses were received from women in PhD programmes, with two subsequently removed from the database having been rendered invalid (repetitions). Of the total respondents, 78% did not have children. The percentage of women with children was globally much lower, and most were studying social sciences (53.8%). Student age groups were relatively well-distributed, with a predominance of students aged over 30, and women without children tended to be younger, aged between 23 and 35 (38% and 46%, respectively). About half were pursuing doctoral degrees in Life Sciences, Engineering, and Science and Technology, with the other half pursuing Social Sciences and Humanities across several Portuguese universities. Despite the sample being limited, it essentially reproduces the circumstances of doctoral students detected in Portugal, who are increasingly female with higher completion rates in the areas of Health and Life Sciences.

Table 1. Female respondents* living with children

Children at home	No.	%
No answer	1	0.8%
No	97	78.2%
Yes	26	21.0%
Total	124	100.0%

Source: PhD student Survey (2020-Portugal)

5 Findings

As stated previously, the main objectives of this paper are: to describe the experience of the doctoral period as experienced by students who classify themselves as "woman" on the one hand, and understand how they relate to the future and their many worries on the other, by also exploring how such conceptions relate to gender. Following the

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themes determined for content analysis, this section is therefore divided into two main themes: i) student experience of time and ii) time perspectives.

5.1 Student Experience of Time

5.1.1. Theme 1: Perception of the impact of the pandemic

A central theme addresses the consequences of the pandemic on PhDs, as experienced by PhD students. Overall, women doing PhDs declare that the pandemic has negatively influenced the time available to dedicate to their PhD project. Only a small percentage of answers reported that the pandemic did not affect their studies.

Table 2. The influence of the pandemic on time to PhD

The influence of the pandemic on time to PhD		No.	%
No answer	*Very influential*	1	100.0%
Total		1	100.0%
Without children	*Not at all influential*	7	7.3%
	Slightly influential	9	9.4%
	Somewhat influential	23	24.0%
	Very influential	33	34.4%
	Extremely influential	24	25.0%
Total		96	100.0%
With children	*Not at all influential*	5	19.2%
	Slightly influential	1	3.8%
	Somewhat influential	2	7.7%
	Very influential	12	46.2%
	Extremely influential	6	23.1%
Total		26	100.0%
	Not at all influential	12	9.8%
	Slightly influential	10	8.1%
	Somewhat influential	25	20.3%
	Very influential	45	36.6%
	Extremely influential	31	25.2%
Total		123	100.0%

Source: PhD student Survey (2020-Portugal)

5.2. Theme 2: Difficulties During the Pandemic and Time Availability

When asked about the difficulties faced during their PhDs, most women without children talked about stress, anxiety and lack of concentration (38%), also highlighting difficulties in dealing with family demands. However, while women without children more often pinpointed difficulties in separating work/family time and space (18%), women without children noted their difficulty as “living with family members” (46%), which connected to difficulties in managing time, as exemplified:

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"Difficulty accommodating my child's schedule and daily routines with work. I need to work on my thesis at night, taking advantage of calmer times of day to concentrate",

They also say that:

"At home, it's easier to get distracted, and I am less able to concentrate. This is probably also due to the circumstances I am facing".

For them, more intensive use of their house reduces the availability of time and space at home, due to the "lack of peace" and "tranquillity", as "when at home with the family, it's almost impossible to do my job and help my kids with schoolwork". Women without children firstly highlight the lack of social contact and isolation and secondly insufficient conditions and technical means to dedicate themselves to their projects, stating that "working at home is very difficult". Still, childless women also often talk about the difficulty of space and time at home and in dealing with interruptions from neighbours and family members, as seen in the following excerpts:

"I had no one to ask when I had questions. As my place of work and rest overlap, they do not allow for psychological rest and major interruptions from family members break my work rhythm".

Women without children mention overlapping activities in the same physical space, often in the bedroom or living room, increasing the difficulty of separating leisure time from time spent writing their thesis.

"I saved time commuting and had everything I needed. However, I work in my bedroom, and sometimes this means that there is no separation between leisure and work".

Women with children drew more deeply on valuing the demands made on them at home by other family members in their answers, while women without children primarily based their answers on the physical conditions affecting their research.

Most also mentioned that lockdown itself was when most of the changes and variations in the pace of work took place, altering their routines and therefore affecting the time available to work on their thesis.

5.3. Theme 3: Opportunities and Endeavours

Consistent with the results presented above, the doctoral students surveyed tend to state that the pandemic has not significantly altered time, as the time available to them to complete their PhD continues to be dominant.

However, in health sciences, science, and technology, PhD students without children emphasise the possibility of having used the pandemic and lockdown as an opportunity to focus on their thesis and publications while also highlighting reduced progress in their research, explaining this reduction by the fact that the university was closed and laboratory activities reduced, therefore impacting on methodological pathways:

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"A period of uncertainty and anxiety about fieldwork that was entirely interrupted. A period of rethinking used to restructure the initial project".

"An opportunity to read a lot. However, a period of blockages to experiments and results".

"A period of uncertainty and anxiety about fieldwork that was completely interrupted."

"A period of rethinking used to restructure the initial project. However, the period was dedicated to writing".

"A period used to focus on finding a healthy balance between my thesis, personal life and hobbies".

Female PhD students with children who work in social sciences emphasise the fact that the pandemic has favoured separation from scientific advisors, leaving them feeling isolated on the one hand, and the need for family care, on the other:

"The most difficult thing was managing my PhD with two small children at home. I was on an exclusive PhD scholarship, but I really should have been on leave to support children under 12".

"A difficult period of work. I practically had no support from my advisor and started to have a lot more housework and less peace of mind, making it difficult to get everything done at once".

"A period in which my pace of work slowed down, supervision was considerably reduced, and difficulties faced managing writing my thesis and family demands meant it was not easy".

5.2. Time Perspectives

5.2.1 Theme 4: Concerns and worries during the pandemic

Along the same lines, most women with children who responded to the survey say that their concern about the productivity and progress of their PhD thesis increased during the pandemic (69.2%), as the time available to work on their PhD decreased. In contrast, women without children said that the time available to work on their thesis increased during the pandemic (38.1%), while others stated that it remained unchanged (35%). Though the pandemic and subsequent lockdown produced adverse conditions increasing the emotional charge and uncertainty already dominant in doctoral careers, both respondents with and without children claim that concern surrounding the completion of their doctorate continued during the period analysed (41%).

Concerns relating to productivity as well as lack of concentration are reported to have increased during the pandemic and lockdown, consistently registering as slightly higher for doctoral students with children, though high for both groups (80% and 70%, respectively). In this specific sample of respondents, a very high percentage (67%

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without children and 65.4% with children) reveals that concerns about finishing their theses on time have increased.

30% state that the pandemic caused them to feel more concerned about family expenses and paying fees. This concern is more salient for women with children mainly working in social sciences and humanities, while women without children (26 out of 124) primarily work in health sciences, sciences, and technologies.

Doing a doctorate is not an automatic way in which to improve professional circumstances or gain employment in research and science. In most cases, vacancies are scarce, and those that do exist are very precarious, subject to temporary employment contracts. Some women did not answer the question on this matter. However, most of those who responded said the more significant difficulties could be put down to their professional circumstances: uncertainty about what will happen once they have presented their PhD work and maintaining their financial circumstances. Beyond the uncertainty characterising the overall PhD process and the uncertainty and ambiguity brought by the pandemic, it appears that these PhD students are also dealing with the uncertainty of knowing whether their PhD will bring tangible rewards to their professional careers. Thus, for these women, far greater than the concern surrounding finishing their doctorate is the subject of employment once it has been completed (33.1%).

"And of course, unemployment after the PhD, not being good enough, but that was already a concern prior to the pandemic."

Even so, differences were noted between women with and without children. The former placed a greater emphasis on finishing, finances, and children (23% and 11.5%), while the latter responded with a greater focus on employment and finishing their PhD (33%), as noted in the table below.

Table 3 Main concerns during the PhD

Main concerns during the PhD		**No.**	**%**
No answer	No answer	1	100.0%
Total		1	100.0%
Without children	No answer	32	33.0%
	Finishing PhD	16	16.5%
	Employment post PhD	33	34.0%
	Financial conditions	8	8.2%
	Other	2	2.1%
	Health	5	5.2%
	Not sure	1	1.0%
Total		97	100.0%
With children	No answer	3	11.5%
	Finishing PhD	6	23.1%
	Having kids at home	3	11.5%
	Employment post PhD	8	30.8%

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	Financial conditions	3	11.5%
	Other	1	3.8%
	Health	2	7.7%
Total		26	100.0%
Total	No answer	35	28.2%
	Finishing PhD	22	17.7%
	Having kids at home	3	2.4%
	Employment post PhD	41	33.1%
	Financial conditions	12	9.7%
	Other	3	2.4%
	Health	7	5.6%
	Not sure	1	0.8%
Total		124	100.0%

Source: Survey of PhD students, 2020

Half of the doctoral students surveyed talk about anguish, anxiety, and insecurity (about 60%), with no significant disparities between women with children and without or scientific area worked in. Only 8% (similar between women with and without children) indicate optimism and confidence. Most of the students stated that they had never considered postponing their thesis before the pandemic. However, in September 2020, 31% were considering postponing, and only 41% believed they would deliver their thesis within the preestablished deadline. Notably, the primary source of uncertainty pinpointed related to financial conditions after the PhD, which were chiefly referred to by women with fellowships and precarious work contracts.

6 Discussion

As stated initially, it is essential to clarify that the main conditions taken into account for the study of this paper are the stories and experiences of PhD students who classify themselves as “women” during the pandemic, drawing conclusions about how they value their period of study and finding strategies that can be employed to overcome the difficulties connected to gender bias, which is demonstrably still prevalent.

Under these assumptions, differences when compared to men (which have been explored in other publications by the author) or other genders, including queer and transgender, are left out of this analysis and can be expanded upon in the future. These results do not serve to crystallise differences, as comparisons have not been made; rather, they allow for the subject of female identity in academia to be expanded upon, and the assumption that these students tend to give more time than they do receive it from others confirmed.

The issue of time and academia has been debated by many authors, especially in recent years. This discussion has mainly focused on the debate around the neo-

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liberalisation of the time spent in education and on research, which is highlighted by the increased industrialisation of academic and research work. Thus, one can say that conditions have changed for everyone in academia, regardless of gender, as time in education and research has essentially become a resource, a matter of money valued both now and, potentially, in the future.

Research shows that the increasing linearisation of time in academia combined with an increased number of women in lower research positions (PhD students and research assistants) is prompting and reconfiguring many of the pre-existing selection processes that exclude people from an academic trajectory who, for gender reasons, have less "time capital" to invest in the linearity and continuity that academic work increasingly requires. Differing genders, particularly women and men, can be pinpointed as a factor in this debate since they constantly display features that may distract them from the rules of practice that govern academic life across the globe today.

Various studies have explicitly demonstrated that nowadays, academic activity builds on expectations created by players within the system, keeping them waiting for an opportunity for a steadier work contract, which will, in turn, provide them with better living conditions. A PhD degree is one of the “stages” people need to overcome to aspire to career opportunities further up the ladder. As authors of the sociology of the time state, time perspectives refer to how one relates to the future and understands one's role in shaping that temporal horizon. Therefore, they can shape the present, distil important reasons behind (in)action and hold responsibility for psychological states, producing substantial social consequences.

When applied to PhDs, this theorisation provides critical reasoning behind the consequences of implications of the COVID-19 pandemic in exacerbating the hardships faced in completing a Doctoral Thesis. These hardships are particularly applicable to women for fundamental reasons. Firstly, women's time remains socially indivisible, unplanned and attributable (or at the disposal of) to others. Since PhD time does not entail a strict separation of time, especially when at home, their time becomes much more permeable to other demands. Secondly, PhD time is rhizomatic (Gravetts, 2021), marked by multiple interconnected, overlapping intervals involving alternations, downtime, and the significant exploitation of individual and self-time. Thereby, the obligation to work from home requires PhD students to juggle multiple time demands, rendering their time much more fragmented and unstructured, therefore leading to highly complex circumstances arising regarding the organisation of their time.

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7 Final Considerations

As Manathunga (2019) argues, an increasing need is faced to devise and implement a temporal equity policy in academia, assuming that most inequalities come about not as a result of differences in “quantities” of time but mainly its fragmentation and undervaluation.

This short piece of research shows that PhD students spoke of various difficulties faced in completing their PhD, referencing institutional time structures that became more noticeable during the COVID-19 pandemic: i) class schedules; ii) deadlines; iii) supervisor and teacher timetables; iv) scientific meeting schedules, and others. They also pointed out other aspects related to individual experiences of time exacerbated by the intensification of use of their homes: i) time for family, time for paid work and time for PhD studies.

The pandemic affects everyday lives of women. This has rendered them less sure about the future, which may mean they delay delivery of their thesis in addition to levels of anxiety and dropout rates increasing. Therefore, following the assumptions made surrounding the sociology of time, especially those made by Zeruvabel and Coser, who emphasise the relevance of time structures, one may conclude as to the increasing importance of Higher Education Institutions and Doctoral Directors’ ability to quickly provide new calendars and deadlines in a move towards an institutionalisation of time politics, a move which would help people redirect students’ work, even should it mean reformulating work plans, particularly for those carrying out PhDs requiring in-depth empirical research conducted in laboratories, even if in part.

In this sense, the data discussed in this paper underlines the need to further specify the measures drawn up for the PhD student population within the scope of Gender Equality Plans, which go beyond collecting quantitative information on gender, age, or scientific area. Firstly, the GEP should consider issues of time as an essential and variable framework contributing to the progress of a doctoral thesis: time available to pursue the PhD; time constraints imposed by family or work; time structured and regulated by Higher Education Institutions, PhD programme directors, teachers and supervisors; and time as a vital resource in preparing and presenting a thesis. Simple, seemingly meaningless factors such as deadlines for projects or other outputs, calendars or meeting and class schedules can have a huge impact on time experience, with subjective and objective implications. It has therefore been rendered crucial to consider both the diversity of expectations regarding PhD studies and the disparities in PhD students' living conditions and trajectories, which are intrinsically linked to a time and gender bias still persistent in Portuguese academia, producing negative implications felt mainly by women.

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Exploring Interactional Challenges in Digital Learning

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Abstract. In our project, we explore interactional challenges experienced by students and teachers in higher education digital learning due to the COVID-19 crisis. For this purpose, we conducted qualitative interviews with Styrian university students, teachers and administrative staff. Our participants encountered five main interactional challenges in synthetic learning situations: Limited perception, reduced participation, a lack of appropriate technical equipment/infrastructure as well as necessary competencies and struggles related to different academic fields. Students, teachers and administrative staff may counteract these challenges by configuring the synthetic learning situation on three interrelated dimensions: The learning scenario, the underlying digital infrastructure and the interaction situation may be transformed by the different actors in alignment with their specific communicative needs. Therefore, programs aimed at improving techno-didactic competencies may be beneficial to both faculty and students. We conclude that negotiation processes among and between these groups will be crucial for the (future) success of interaction in digital learning.

1 Introduction

When universities around the world transitioned to learning and working remotely due to COVID-19 in March 2020, teachers, students and administrative staff had to develop new practices to maintain university operations of researching, teaching, learning and working (UNESCO 2020: 2). This proved challenging, as the transition to digital learning was accompanied by the loss of the shared physical space of the university campus, which aided the creation of a sense of community (see for e.g., Stichweh 2015; Turner et al. 2020: 85).

The experiences of these digital learning periods have sparked re-investigations of long-standing debates in microsociology. Collins (2020) examines how the restriction of face-to-face interaction due to social distancing measures affects various areas of public life and concludes that there are “micro-interactional difficulties of carrying out satisfactory social relationships remotely” (Collins 2020: 496). Similar questions arise for the particular case of university teaching. Previous studies have shown that in-class-interaction between faculty and students is crucial for students’ learning outcomes and satisfaction in digital learning (Sun et al. 2018: 77f; for an overview, see Händel et al. 2020: 2). Likewise, Adnan/Anwar (2020: 49) found that students missed opportunities for face-to-face interaction during periods of digital learning, which also led to motivation issues. In their analysis of college students’ experiences in different

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digital learning scenarios, Gillis and Krull (2020: 296) observed that while students generally value interaction, the ways in which teachers specifically encourage interaction in class may be equally decisive.

In our paper, we aim to answer the following question: How do teachers and students experience interactional challenges in digital learning? In this context, we consider all situations in which two or more individuals may refer to each other via digital technologies as digital interaction situations (see section 2). By conducting qualitative interviews with university staff and students, we describe the interactional challenges experienced by our participants. In doing so, we trace how opportunities for interaction in digital learning may be enabled by specific techno-didactic measures.

Various concepts have been suggested to understand the rapid digitalization of university teaching and learning due to COVID-19, including distance learning, digital learning, online learning, and blended learning.[1] However, we argue that neither of these terms is fully suitable to describe the variety of learning scenarios encountered by our interviewees (e.g., video conferences, streams, recordings, texts, blended learning). Therefore, we use the term ‘digital learning’ to refer to learning situations which are characterized by the incorporation of and/or mediation by digital technologies, allowing the interactants to communicate synchronously or asynchronously. Thus, our understanding of ‘digital learning’ includes all scenarios commonly associated with distance, digital, online, and blended learning.

In the following section, we summarize selected theoretical concepts helpful for understanding digitally mediated interaction before giving an overview of our methods and sample (section 3). We then present five main interactional challenges identified in our data (section 4). Subsequently, we look at opportunities for different groups of actors to configure synthetic learning situations in order to overcome these challenges (section 5). Finally, we point out limitations of our research (section 6), summarize central points of our analysis and suggest some areas for further research (section 7).

[1] Gašević et al. (2015) demonstrate that the conceptual understanding of the term ‘online learning’ has evolved and diversified since its first occurrence in the 1990s, while nevertheless remaining ambiguous. They define ‘distance learning’ as “teaching and planned learning where the teaching occurs in a different place from learning” (Gašević et al. 2015: 99) while understanding ‘online learning’ as “a form of distance education where technology mediates the learning process, teaching is delivered completely using the internet and students and instructors are not required to be available at the same time and place” (Gašević et al. 2015: 100). Finally, the term ‘blended learning’ is used to denote “practices that combine (or blend) traditional face-to-face instruction with online learning” (Gašević et al. 2015: 101).

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2 From Copresent Interaction Situations to Synthetic Learning Situations

Classical microsociological theories in the Goffmanian tradition generally assume a “face to face” or “body to body starting point” (Goffman 1983: 2) to define interaction situations. These interaction situations are characterized by the “response presence” (Goffman 1983: 2) of the interactants, allowing them “to share a joint focus of attention, perceive that they do so, and perceive this perceiving” (Goffman 1983: 3). The criterion of response presence is fulfilled in conventional on-site-teaching, as students and teachers share a physical location, enabling immediate and continuous mutual monitoring of the interaction partners. In contrast, in digital teaching and learning, opportunities for interaction are enabled by telecommunication technologies. It is via these technologies that the interactants may perceive and *refer* to each other. Thus, we may argue that *coreference* rather than *copresence* is fundamental for mutual perception and signaling meaning in interaction (Houben 2018: 14), which may be fulfilled in mediated interaction situations as well as “traditional” interaction situations.

Goffman considered technological artefacts primarily regarding their role in interaction situations, either as “interactional tools” or as “laminations of frames” (Klowait 2019: 606). Pinch (2019: 412) argues that Goffman’s theories can also be read as a “hidden sociology of technology”, describing the interactional importance of artefacts. During the material turn in STS, theorists increasingly focused on technological artefacts specifically: researchers investigated how the meaning of artefacts is generated resulting from negotiating processes between different groups of actors, which lead to an increased examination of the potential agency of artefacts and the historical contingencies enabling current interaction situations (Klowait 2019: 608). The increased occurrence of mediated communication formats encouraged endeavors to develop “framework extensions” (Klowait 2019: 608) allowing classical microsociological theories to conceptualize diverse interactional formats. Furthermore, theoretical perspectives offered by fields like actor network theory (Klowait 2019: 617) and presence studies (Hahn/Stempfhuber 2015: 8; Steuer 1992) have shown that a clear distinction between “mediated” and “non-mediated” interaction situations cannot be maintained.

Looking closer at mediated interaction situations, Knorr-Cetina’s (2009: 69) conception of “synthetic situations” proves useful. Synthetic situations are interaction situations which are augmented and extended by scopic systems. Scopic systems allow their users to collect, observe and project different kinds of information relevant to interaction situations by using telecommunication technologies. The importance of scopic systems for enabling interaction can vary in different types of synthetic

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situations, ranging from situations with singular synthetic components to “telepresence arrangement[s]” (Knorr-Cetina 2009: 69), for example in video conferencing scenarios. Thus, digital learning can occur in varyingly synthesized situations. Because of their contingent and fluid nature, synthetic situations may be continuously rearranged by the interactants according to their specific communicative needs. For example, in synthetic learning situations, students may use video conferencing software to interact with their peers and teachers, while simultaneously taking notes digitally.

In all cases, successful interaction in synthetic situations is based on well-functioning technology. In this context, the material design and features of technologies *afford* the interactants specific ways of referring to each other (Davis/Chouinard 2016; Hutchby 2001; Pinch 2019: 421). For example, some video conferencing software applications allow their users to send chat messages or share their screen with the other participants, thereby providing additional ways of interacting.

When it comes to digital learning, co-reference in synthetic learning situations may be enabled by employing different kinds of techno-didactic learning scenarios. Following Matos (2014), we understand learning scenarios as “hypothetical situation[s] of teaching-learning [...] composed of a set of elements that (i) describe the context in which learning takes place, and (ii) structures the environment in which learning happens” (transl. by Pedro et al. 2019: 269f). The focus of this paper is on synchronous digital teaching via video conferencing software, as this learning scenario was experienced most frequently by our participants and therefore provides useful material for a differentiated analysis of interactional challenges. The exploration of these challenges as well as the strategies employed by our participants to address them may allow insights into how the interaction order of (digital) learning is being negotiated and potentially adapted to the characteristics of synthetic learning situations.

3 Methods and Sample

The concepts introduced in the previous section are useful to contextualize our participants’ shared experiences during the COVID-19 pandemic. However, in this paper, we do not aim to provide a systematic theoretical framework due to the unprecedented circumstances and constantly changing pandemic conditions as well as the highly heterogeneous individual and organizational coping strategies. Rather, our research approach is data-driven, and aims to give an explorative overview over interactional challenges and possible solutions for providing opportunities for interaction in synthetic learning situations.

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3.1 Research Approach

All of the data analyzed in this paper has been gathered in the context of the ongoing research project "*Digitalisierungschancen der steirischen Universitäten*".[2] The project's goal is to monitor the COVID-19 induced digitalization practices in higher education by examining experiences of students, teachers and non-scientific university staff from four universities located in the Austrian federal state of Styria. The perceived potentials and challenges resulting from digital technologies and practices put into action due to the COVID-19 crisis may be used as a base for reflection to guide current and future digitalization processes in Styrian higher education. The project is scheduled to be completed by September 2021; therefore, all reported results must be understood as preliminary.

This project takes a qualitative approach in both data collection and analysis. Qualitative methods are well-suited to make sense of experiences, feelings, relationships, coping strategies and personal perspectives of interviewees (Strauss/Corbin 1996: 4f). Universities are places where several social groups operate and interact with each other. A qualitative approach can handle this diversity and the relations and interdependencies of these different fields and actors (Flick et al. 2017: 17). Finally, the flexibility and openness afforded by qualitative research is helpful to deal with the changing conditions for research due to the COVID-19 pandemic (Przyborski/Wohlrab-Sahr 2014: 118).

3.2 Sampling and Data Analysis

The data material for this project was collected by conducting guided, qualitative interviews with participants from four Styrian universities.[3] The project sample as of May 31st consists of 57 interviews total, including 18 interviews with students (undergraduate and graduate), 20 interviews with scientific staff/faculty (from pre-doctoral level to habilitated) and 19 interviews with non-scientific staff/key actors

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[2] The project team consists of researchers with a social science and computer science background from Graz University of Technology. Team members include Stefanie Lindstaedt, Bernhard Wieser, Viktoria Pammer-Schindler, Christian Dayé, Stefan Reichmann, Marion Rowies and Kübra Karatas, as well as Mia Bangerl and Franziska Gürtl. The current project "*Digitalisierungschancen der steirischen Universitäten*" is funded by the Styrian Department of Science and Research within the funding program "*Aus der Corona-Krise lernen!*". Part of the collected data was originally gathered for a similar predecessor project "*Reallabor - die eilige Digitalisierung*" and was included in the follow-up project with consent from the interviewees.

[3] Data collection so far has taken place in two time periods. The first period began in May 2020 and ended in September 2020, covering the final months and summer break of the first COVID-19 semester in Styrian universities. The second period stretched from January to March 2021, covering the final month of the second semester, the semester break and then the beginning of the third semester in distance mode.

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(various organizational positions). In our sampling process we prioritized diversity and aimed to include participants from different academic disciplines, personal life circumstances (e.g., childcare responsibilities), seniority levels, and pre-pandemic experiences with digital teaching and learning technologies.

The interview transcripts and protocols[4] were analyzed qualitatively following Kuckartz's (2016: 101-111) guidelines for *content structuring qualitative content analysis*. This method of analysis allows the researcher to build analytical codes and subcodes both deductively and inductively (Kuckartz 2016: 101f). By coding the material, common perspectives, experiences and themes are identified and put in relation to each other, which facilitates the development of analytical models and frameworks (Kuckartz 2016: 117-121). At the early stages of our analysis, a basic coding system was inductively crafted from selected data segments and then extended and defined in detail in a systematic coding guideline. The changing pandemic circumstances, its consequences on higher education as well as increased digital competencies of university staff and students required us to revise and extend the original coding system and guidelines several times to suit all gathered data.

4 Interactional Challenges

When talking about their interaction experiences in synthetic learning situations, many of our participants described a feeling of something being lost in digital interaction or feeling *qualitatively different* compared to face-to-face interaction. These perceived differences were the starting point for our investigation exploring interactional challenges, which we will present in this section.

> "They [the teachers] say themselves that if I talk into the screen for an hour and a half, I can never provide the same information as in being present. Unfortunately, that's also a bit of a problem." (S1[5])

S1 compares their experience in digital learning to regular on-site teaching and states that the informational quality of the interaction feels different. Another student describes that they experienced a "barrier" in video conferencing and goes on to add that the perceived loss in interactional richness is less of a problem for course types that generally include little student-teacher interaction, such as lectures (S2). Some participants tended to idealize and romanticize teacher-student-interaction in on-site teaching due to their familiar interaction opportunities. Furthermore, the participants'

[4] All quotes from the data in this paper have been translated to English from the original language, German.

[5] Numbered identifiers are used to refer to interviews in this paper: S denotes interviews with students, T denotes teachers, and A denotes key members of the university administration.

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reflection on recent digital learning experiences led to a re-evaluation of established didactic methods and formats. For example, both teachers and students explained that it is easier to deliver lectures digitally compared to seminars. This motivated some participants to comment on the "antiquated" nature of lecture-oriented classes, criticizing the "impersonal" and "outdated" didactic format due to its teacher centeredness (S2, T3, T6). In general, students as well as teachers are more likely to be satisfied with their learning/teaching experience in highly interactive classes (S13, T6, T7), consistent with the literature (Sun et al. 2018: 77f).[6]

Therefore, it is crucial to take a closer look at the "new sorts of interactional problems which interactants need to solve" (Pinch 2019: 422) in order to understand the apparent difficulties both teachers and students encountered in their digital learning experience.

As the COVID-19 pandemic affected all areas of life, students and faculty experienced additional barriers to digital learning, such as increased levels of stress and anxiety, challenges related to caring responsibilities, and income as well as housing insecurity, all of which are linked to the pandemic (see also Gillis/Krull 2020). Factors like the living situation (e.g., noise level) significantly influenced our participants' abilities to focus on and participate in digital learning. While it is essential to acknowledge these barriers, they will not be the focus of our analysis. Instead, the main barriers for interaction in digital learning settings we identify and discuss in the following section are linked to limitations in *perception*, increased struggles with *participation*, inadequate availability of both *technical equipment and infrastructure* as well as *competencies*, along with the communicative needs of specific *academic cultures and communities of practice*.

4.1 Perception

One key barrier for interaction in digital learning experienced by the interviewees is that it is difficult to grasp the interaction situation. This includes limited sensory perception of the interaction partners and their verbal and non-verbal communication signals. Consequently, it is challenging for teachers and students to assess the mood of the group:

> "When I stand in the room, I perceive, I see, I hear, maybe I even smell something, I'm not sure. But I perceive how people are doing. The first person is perhaps bored, the second is worried, the third is looking for something, and I notice that. I don't need to be active. I don't need to look at them, it's just there. It gives me a sense for the mood in the room, of the group, which is essential to enable an exchange of

[6] Various educational researchers have specifically examined interactional practices in face-to-face teaching. See for example Tyagunova's (2017) analysis of students' strategies to manage their engagement in seminars or Wenzl's (2010) study on school children's participatory practices and their socializing function.

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information. Of course, that's missing when everyone is sitting in front of their screen. This overall feeling is gone.” (T4)

Difficulties in perceiving the interaction partners may lead to feelings of uncertainty and exhaustion (“Zoom fatigue”, see also Collins 2020: 495f) which may motivate the interaction partners to withdraw from the interaction situation, for example, by turning off their cameras. Students explained that they feel tempted to keep their cameras turned off in class, even though they are aware that this may lead to them not paying attention in class (S9, S11, S13). The students’ hesitation to turn on their cameras is partly based on feelings of discomfort and shame associated with exposing private spaces. Turned-off cameras may therefore serve as “involvement shield[s]” (Goffman 1963, cited by Turner 2020: 78). In synthetic learning situations where the cameras were turned on, the interviewees reported that it was easier to get a feel for the joint interaction situation, which motivated students to engage in discussions.

For teachers, the lack of responses and reactions from students leads to an increasing feeling of ‘talking into emptiness’, which left some teachers demotivated and frustrated towards teaching in digital settings (T5, T9). This is why teachers appreciate it if students turn on their cameras, as the visual information provides additional “nonverbal, bodily feedback” (T9), allowing them to monitor if the students are continuously present in front of their screen at home and are able to comprehend the class content (T7, T9, T10). Over time, teachers devised several strategies for checking and maintaining the student's level of engagement.[7]

There are also some perceptual advantages in synthetic situations afforded by technical features of video conferencing software. Some interviewees noted that the well-organized layout of certain software facilitates identifying the current speaker, which makes it easier to assess the students’ level of participation (T1, T3).

4.2 Participation

For students, opportunities to ask questions are an essential component of learning. In general, students found it more difficult to make a verbal contribution or ask questions in synthetic learning situations compared to face-to-face teaching (S13), matching the observations of Turner et al. (2020: 81).

One reason for the students’ reluctance to speak up in digital classes was that they found it challenging to anticipate how their verbal contribution would be interpreted by the other students and judged by the class teacher. Therefore, students sometimes

[7] However, as Collins (2020: 488) notes, “[w]e cannot assume that F2F classrooms are automatically successful Interaction Rituals”. Muhle (2021) has shown that students use various strategies to stage presence and non-presence in seminar classrooms. Thus, it would be insightful to investigate how students may adapt their interactional strategies to different digital learning scenarios.

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hesitated to ask questions in class because they were afraid of exposing knowledge gaps or of asking “dumb questions”:

> “And sometimes you can’t be sure how dumb your question really is. And if it is a small group and the teacher approximately knows your names, you don’t want to ask extremely obvious questions. Maybe this completely anonymous thing. [...] I think, we don’t have any teachers who are that vindictive, but still, you don’t want to look stupid.” (S12)

This insecurity was amplified in synthetic learning situations, as some students were having difficulties to remain attentive and were thus afraid of asking questions (S9, S12). Interestingly, students reported that they feel more comfortable asking questions in a regular lecture hall where they feel more anonymous and can evaluate the reactions of their interaction partners more easily (S4). Because of this insecurity, students would appreciate opportunities to ask questions anonymously in synthetic learning situations (S4, S12).

Another reason for decreased levels of participation in digital classes is that verbal contributions must be well-coordinated regarding timing and an adequate handling of telecommunication technologies to avoid awkwardness. For instance, students and teachers tried to wait for the right moment to unmute their microphones. This is difficult because regular turn-taking-strategies such as monitoring non-verbal cues cannot be applied easily in synthetic learning situations. Alternative forms of communicating like the chat function also require specific time-sensitive considerations, as composing a question in writing usually takes more time (T9, S13).

Other factors that influence the level of participation in synthetic learning situations are individual motivation and interest in the course subject. Also, teachers as well as students explained that the students’ motivation to participate is higher in small groups or break-out-sessions. Hence, while teachers and students found ways of interacting strategically in synthetic learning situations, they experienced a lack of spontaneous interaction compared to face-to-face teaching (see also Turner 2020: 92).

4.3 Technical Equipment and Infrastructure

During the COVID-19 pandemic, the organizational or personal ownership of adequate and well-functioning technological infrastructure was a necessary requirement for any learning situation (Gillis/Krull 2020: 295f). Therefore, digital learning was often not achievable in regions located on the lower spectrum of the digital divide (Adnan/Anwar 2020: 49), in contrast to countries like Germany, where Händel et al. (2020: 5f) found that students were generally well-equipped for digital learning.

Internet bandwidth and performance substantially influenced how both university students and teachers were able to initiate and participate in interaction situations. Owning a webcam or headset of sufficient quality were also crucial to be able to

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participate in synthetic learning situations successfully. This challenge was recognized by both students and teachers as well as universities boards and departments. Despite university administration's financial efforts, a large number of teachers and students had to invest personal means to upgrade their equipment in order to teach and attend their classes.

If students encountered technological difficulties, they were not only less able, but also less willing to participate in interaction opportunities.

> "During the very first lockdown I had problems with my laptop and my audio never worked properly and then I used my phone for everything. So, I used my phone for all the online stuff. And then I always felt like, somehow, I didn't really want to say anything, because sometimes the audio wasn't working properly again, and nobody could understand me. And this is so arduous somehow." (S9)

Also, it must be mentioned that even under ideal circumstances, the digital technologies available for teaching and learning are not (yet) able to fully accommodate all communicative needs of academic learning scenarios (see section 4.5). Burgstahler et al. (2004: 244) also point out that barrier-free technology-design is crucial for ensuring accessibility and inclusivity for both students and teachers with disabilities in digital learning. While technological improvements are to be expected, at the moment, technologies are not only enriching, but also constraining, teaching and learning.

4.4 Competencies

Besides technological requirements, digital learning also requires a set of competencies to be able to enter, manipulate and interact in synthetic learning situations. However, not all teachers and students could draw on these competencies to enable a successful transition to digital learning (Zawacki-Richter 2020: 218f; Turner et al. 2020: 84).

First and foremost, this concerns skills in operating technology—both the digital learning software chosen by the university or teacher and the necessary hardware (e.g., computer, headset) for running and accessing these programs to be able to access the benefits of their communicative affordances (e.g., muting and unmuting, screen sharing, creating breakout-rooms, etc.; see also Hutchby 2001: 448).

According to employees of university IT and media departments, vast differences in these competencies became visible once the COVID-19-induced digital transformation of the universities started. Some teachers were already experienced in digital learning and encountered little to no trouble in learning to work with these mostly unfamiliar digital technologies. Others were able to convert their classes to digital formats but would have liked more support from the university. Some teachers struggled hard with teaching digitally due to their lack of technological skills. For them, teaching became

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frustrating, and some decided to stop all teaching activity and wait out the pandemic until they could teach on-site again.

Also, even though most students were able to participate in their digital classes relatively easily, the competencies necessary to interact in fully synthesized learning situations are not limited to technology, but also include the skills to concentrate and participate without the familiar on-site infrastructure (A1, see also Turner et al. 2020: 96). Moreover, teachers need competencies for planning and carrying out digital classes to be able to access the benefits and enrichments of digital technologies, rather than being constrained by the limitations.

Both teachers and students agreed that digital learning is characterized by different dynamics and demands different didactic concepts than on-site classes.

> "If I want to produce a good video on YouTube, I won't film myself standing at the blackboard [...] but I may use visualizations or videos. Yes, I don't know. But in this direction, by all means. So, you have to change the teaching, the way of lecturing. And not just record it like it was before." (S3).

In general, overcoming interactional challenges in digital learning might need further discourse and coordination among and between parties about questions of responsibility (see section 5.2). Among our interviewees, university further (digital) education offers were mainly valued and attended by teachers who had always been striving to improve their teaching (T4, T6, T10). Therefore, generating personal and professional interest in improving teaching is a crucial step towards improving digitally mediated interaction in university classes.

4.5 Academic Cultures and Communities of Practice

As some academic disciplines pose special challenges for digitally mediated interaction, we strived to interview participants from various academic disciplines in our data sample. In doing so, we identified three main interactional challenges that are related to the specific practices of different academic cultures.

Firstly, these challenges are often related to the necessity of working with specific on-site equipment. This is the case for many natural sciences as well as technical disciplines where students learn practical skills in laboratories and workshops. Other examples include rehearsing with heavy or rare instruments (e.g., church organ) or using physical infrastructure providing collective knowledge (e.g., libraries, archives).

Secondly, some challenges are connected to collaborative work. This is especially relevant for artistic disciplines such as music and performing arts because successful collaboration in these subjects depends on exact synchronicity, high audio quality and visibility. For example, even a minimal delay is highly disruptive to a chamber music ensemble rehearsing digitally. The reduced sensory perception in digitally mediated

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interaction (see section 4.1) is an equally great obstacle for acting lessons, because it disables the students from fully perceiving gestures and facial expressions (S7).

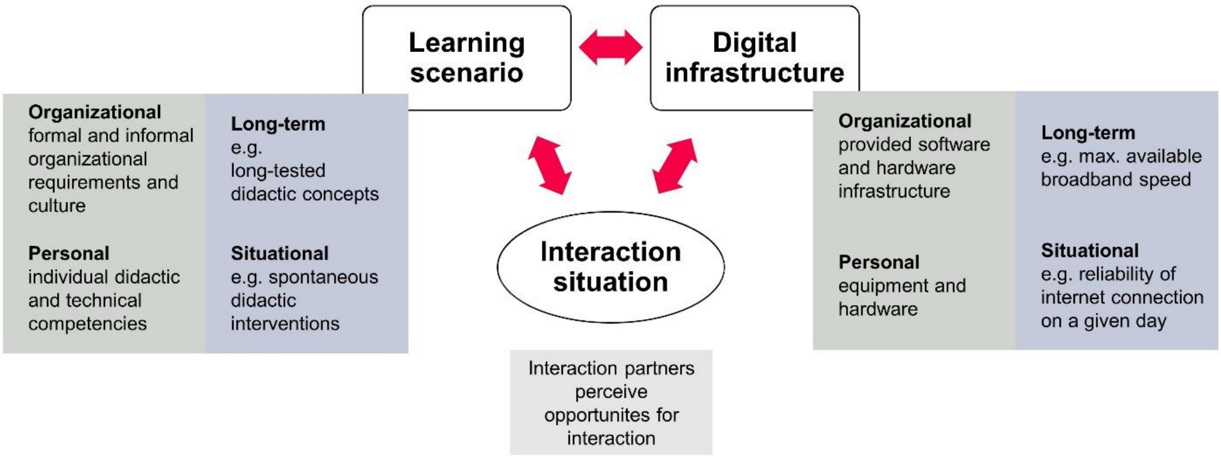
Finally, physical spaces are often tightly connected to specific social infrastructure. When lacking the familiar physical spaces, social communities can struggle to adjust and adapt their routines, practices, and rituals in digital spaces. One example for this challenge are practicums in school classrooms for students in education studies. Affected interviewees reported that digital teaching practicums were very different to their previous on-site experiences (S9, A9). Another example is the interaction between performers and their audience in music and performing arts classes.

5 Configuring Synthetic Learning Situations

5.1 Conceptual Framework: Synthetic Learning Situations

We have shown that there are various interactional challenges in synthetic learning situations that often influence and amplify each other. The interactional challenges experienced by students and teachers can be organized in three interrelated dimensions (learning scenario, digital infrastructure, interaction situation). What follows is a brief outline of how the three dimensions influence the configuration of the synthetic learning interaction situation (see figure 1). In the next section, we argue that the configuration of the three dimensions can be manipulated situationally or structurally by different actors according to their specific communicative needs.

Fig. 1. Configuration of synthetic learning situations (Source: compiled by the authors)



5.1.1 Learning scenario

Firstly, the design of a specific learning scenario is determined by organizational factors such as formal requirements and informal organizational expectations, for example concerning course and exam type. In addition, the teachers' personal didactic and technical competencies and preferences influence how learning scenarios are conceptualized by teachers. Furthermore, the teachers' didactic experiences as well as spontaneous situational interventions (e.g., encouraging students to ask questions in class) impact how students and teachers may refer to each other in class. While long-term planning helps to create effective learning scenarios, situational flexibility is crucial in digital learning during a pandemic, and the specific situational implementation of the learning scenario may be equally decisive as the overall didactic design (Gillis/Krull 2020: 296).

5.1.2 Digital infrastructure

Secondly, the digital infrastructure provided by higher education institutions has a major influence on how learning scenarios may be implemented. Many teachers have also supplemented the institutionally provided equipment with personal hardware and software. Moreover, the long-term availability and situational reliability of the infrastructure is crucial for interference-free synthetic interaction situations. In all cases, specific technical features afford and constrain specific forms of interaction in digital learning scenarios (Pinch 2019: 421; Hutchby 2001). Thus, technical affordances may enable, stimulate, obstruct and prevent interaction (Davis/Chouinard 2016).

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5.1.3 Interaction situation

Thirdly, students and teachers perceive opportunities for interaction in synthetic learning situations.[8] At this point, all the previously mentioned interactional challenges are relevant: Besides technical challenges and competencies, factors like the difficulty to monitor verbal and non-verbal cues of the interaction partners, *Zoom fatigue* (Collins 2020: 490f), the class size, the affective state of the interactants as well as personal interest and preferences all affect the interactants' inclination to contribute to the in-class-conversation. Also, feelings of invisibility due to switched off cameras may lead to disengagement (Turner 2020: 85). Moreover, in digital learning, multicommunication practices pose a special challenge, as the interactants may engage in multiple conversations simultaneously, which requires interactants to employ various strategies to "engage the attention of their audience before they can start a conversation" (Turner et al. 2020: 79).

5.2 Configuring the Synthetic Learning Situation

We have seen that there are some prerequisites for creating synthetic interaction situations and for participating and interacting successfully (see section 4). There are three main groups of actors that can affect the configuration of the interaction situation: Teachers, students and key members of the university administration (e.g., IT-administrators, administrative decision-makers, etc.). The different actors may be limited individually in their scope of action according to their organizational status.

In this section, some of the solutions developed by these groups of actors in response to the interactional challenges will be described. As we will show, some of the devised strategies are the result of negotiating processes between different groups of actors.

5.2.1 Students

Students have developed various strategies to deal with the specificities of interacting in digital learning environments. For example, they decided to ask their peers for help if there were no opportunities to interact with the class teacher (S5). While students enjoyed the flexibility of controlling their level of engagement by choosing whether to turn on their cameras in class, they were also aware of a certain ambivalence (S8, S9). Both students and teachers know that it is easier for students to withdraw from synthetic learning situations completely compared to on-site teaching, as students can always decide to turn off their microphones and cameras and not participate at all (T6).

[8] Here, an extended analysis of suitable data (e.g., ethnography) could look closer at the organizational, personal, situational, and long-term parameters of the interaction situation and thereby elaborate on the interactants' bodily and affective states.

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Because of the temptation to disengage from class, some students would like their teachers to take care of the arrangement of the synthetic learning situation, for example, by providing explicit behavioral guidelines like a camera requirement (S3, S6, S9; see also Turner 2020: 93):

“But if somehow the camera requirement is not there, then I have the feeling, you can forget it anyway. Because we all know each other. So, if we are somehow not observed during a lecture, then everyone just does something else. […] So, when I don't have my camera switched on, I always let myself be a bit distracted. But when you have the camera, you're more involved in the course. So, if I were a professor, I would introduce the camera requirement.” (S9)

However, some teachers were reluctant to enforce a camera-rule due to privacy concerns (T6). Students also appreciated it if they were encouraged to respond to teachers’ questions or obliged to ask questions themselves to stimulate discussion (S10, S11). Finally, students welcomed opportunities to ask (anonymous) questions about class content (synchronously or asynchronously, during class time or in dedicated “question hours”).

In summary, consistent with results from Turner et al. (2020), the participants expect teachers to develop learning scenarios which are tailored to the characteristics of synthetic learning situations and provide clear information on class requirements.

5.2.2 Teachers

Among our participants, teachers implemented a number of strategies to promote interaction in synthetic learning situations.

Firstly, they had to decide on specific digital infrastructures to fit their preferred digital learning scenario. This could be challenging, because optimally, teachers wanted to fit the digital technologies to their preferred learning scenario. However, the available teaching software-infrastructure was organizationally limited due to IT-support capacities and their university’s data protection policy. To promote interaction, teachers especially valued video conference formats, affording verbal communication opportunities. Naturally, these steps and decisions required teachers to test, research and learn about multiple digital teaching tools, which was time-consuming and could be challenging for some, as we explained in section 4.4.

Secondly, to ensure interaction opportunities, the teachers planned and conceptualized their teaching sessions according to their didactic strategies and principles (see also Gillis/Krull 2020: 284f). Many of those strategies were similar to on-site teaching (e.g., creating feedback opportunities for students), but played out differently in fully digital scenarios (e.g., using a digital feedback tool instead of writing on paper). Additionally, some didactic planning steps seem to be especially beneficial to digital scenarios. This includes, for example, structuring classes in designated

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components (lecture, practical tasks, revision, discussion, etc.), to be able to choose a suitable techno-didactic implementation for each component (T2, T6). Another example is the provision of a netiquette, a clear guideline for behavior and interaction in digital learning scenarios (e.g., obligation to switch on the camera).

Finally, the university teachers repeatedly pointed out that specific attitudes and behaviors can stimulate interaction with and among students. This also applies to non-digital scenarios, but even more so to digital learning scenarios, due to the limited possibilities of perceiving and assessing the situation (see section 4.1). Therefore, teachers tried to provide a comfortable learning atmosphere by gesturally, mimically and verbally encouraging students to ask questions, engage in discussions and generally use all available interaction opportunities.

This also raises questions about the self-image of teachers. When it comes to interaction in class, some teachers believe that “if someone doesn’t want to engage, I can’t force them” (T8). But others feel that it is part of their job to activate and motivate the students to participate in class. For them, teaching is not only a job, but also a mission:

> “This is our youth; this is our future. We have the chance to be with them, to develop them and accompany them with knowledge and love for research, and ignite the spark with love, with empathy, with wit and community and enthusiasm.” (T5)

5.2.3 Technical Administrators and Key Actors

As we established in section 5.2, different groups of actors can manipulate synthetic learning situations according to their respective area of activity and organizational position. However, it is important to keep in mind that technological design and organizational availability of technologies are the result of negotiating processes and choices made by various actors within universities. This is why we decided to include technical administrators, experts in digital teaching and high-ranking university officials in our data sample.

During the past COVID-19 semesters, these actors put a lot of effort into devising coping strategies for pandemic related challenges. Because most teachers and students had little to no experience in digital learning and teaching prior to the pandemic, university administrative staff were occupied with supporting and equipping those in need of immediate help.

Administrative staff agreed that digital learning and teaching offers benefits for higher education beyond pandemic digital learning periods (A1–A8). In order to maximize these benefits, university officials and key actors discussed strategies to equip university staff with suitable technological devices. Moreover, efforts were aimed at informing both staff and students about the usage and qualities of selected digital technologies and at supporting the development of technical and didactic

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competencies for digital learning and teaching. IT-services employees and digital teaching experts also strived to stay informed about current developments in digital technologies in order to select and support appropriate tools for their university's pool of technologies and services complying to data protection guidelines (A1, A3, A4, A5).

Furthermore, a need for better communication between groups of actors was recognized and a wish for designated feedback channels between the university and its faculty and students was expressed (A1, A2, A9, A10).

The interviewees also commented on the general importance of digital technologies in university teaching and learning. To them, it was crucial to make teachers and students realize that digital technologies are already present in everyday life and should therefore also be a part of higher education curricula (see also Adnan/Anwar 2020: 49). However, they did not see digital learning as a replacement, but rather as an enrichment for on-site teaching and learning. For them, the university of the future should make use of digital learning infrastructure where it is deemed beneficial:

> "It is and was always our goal to return to on-campus teaching and working. Technology should complement, not replace, or else we can turn into a distance university altogether and only do distance learning." (A8)

6. Limitations

Acknowledging some of the limitations of our research, we want to note once more that all of our results are preliminary and data collection is still ongoing. Also, our sample only contains data collected at Styrian universities. The ways in which synthetic learning situations affect interactional challenges may vary in different higher education contexts according to students' and teachers' expectations. Finally, the general setting of our research in the context of the COVID-19 pandemic affects how our participants make sense of their recent experiences in digital learning. Nevertheless, the pandemic experiences can be interpreted as a test phase for intensified digital learning which provides a useful basis for reflecting on the future of higher education. These results can help in imagining future potentials and challenges of incorporating digital technologies into higher education teaching and learning.

7. Conclusion

In this study, we set out to explore interactional challenges in digital learning. By looking at digital teaching and learning experiences from multiple perspectives, we identified several interactional problems. Interactional problems in digital learning are linked to the mutual perception of the interactants, participatory commitment, technical affordances, competencies, and specific challenges related to communicative

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demands of different academic disciplines. In addition, it has become clear that the use of digital technologies also offers potential for new forms of participation and learning.

We have seen that the configuration of synthetic learning situations may be shaped by different groups of actors (students, teachers, key actors) according to their specific communicative needs within their respective scope of action. Moreover, the configuration of the synthetic learning situation may be affected on a situational or a transsituational level. For example, students may control their level of engagement in digital classes by deliberately turning their cameras on or off in a particular class. Teachers may decide to alter their didactic concept spontaneously to respond to situational interactional needs. However, in most cases, only technical administrators can adapt existing digital teaching tools on a structural level by adding or removing features. In all cases, digital teaching tools can enhance digital learning if their affordances correspond to the communicative needs of the interactants to enable reliable coreference. Furthermore, both faculty and students can benefit from training programs aimed at improving didactic and digital competencies (see also Händel et al. 2020: 10).

In many cases, the configuration of the synthetic learning situation is shaped by negotiating processes between different groups of actors: For instance, teachers and students may agree on clear rules of conduct for digital learning to facilitate interaction in digital classes and thereby “co-creat[e]” (Turner et al. 2020: 95) interactional expectations for synthetic learning situations. Key members of the university administration may allow faculty and students to engage in participatory decision-making processes to decide on the available technological infrastructure and the development of a digitalization strategy aligned with the university’s long-term development goals.

Pinch (2019: 423) calls for future research to address “technological choices specifically, and how they are negotiated as part of the interaction order”. In our paper, we tried to hint at what an analysis of this kind might look like, as we have shown which kinds of interactional challenges may occur in digital learning that interactants need to address by appropriately configuring synthetic learning situations.

However, when thinking about the future of higher education and the long-term role of digital technologies, a critical perspective should be applied. In this context, it is essential to investigate which actors are involved in decision-making processes and which individuals and corporations may benefit from an increasing corporation of digital technologies into higher education. Particularly, questions related to digital inequality, personal data protection and security, privacy, digital discrimination and ethics, digital didactics and technological innovation offer diverse opportunities for future research.

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Digital Ethics in Practice: Implementing Ethical Principles to Guide Participatory Use of Videorecorded Instrumental and Vocal Lessons in Higher Music Education

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Abstract. In this study we reflect sustainable and responsible use of digital content in instrumental and vocal pedagogy. The aim of this contribution is to raise awareness of ethical principles toward responsible use of videography in instrumental and vocal (higher) teacher education and professional teachers' development. Finally, our aim is to provide pedagogical recommendations for teachers in the ethically justifiable use of videorecorded instrumental and vocal lessons. We take into account the perspective and feelings of all stakeholders, as well as ambiguity, complexity and diversity in data interpretation.

Keywords: digital ethics, videorecorded instrumental and vocal lessons, music education, reflective practice

1 Introduction

Technological advancements necessitate continual, in-depth, and reflexive considerations. The use of digital content with videos has increased in higher music education for in-person and virtual classes (Doerne & Lessing 2020) and continues. Although video recordings can refer to a plethora of categories, for instance teacher-recorded, student-recorded, publicly-available video content (e.g., youtube, TED talks), supplemental online course content, and so on, here we address videorecorded instrumental and vocal lessons. Video use in this case refers specifically to one-to-one instrumental lessons taught synchronously and live by graduate students to their own music students. These lesson videos were recorded themselves, then reflected upon with graduate peers as homework assignments in an instrumental pedagogy class. The students were required to choose three minutes of the lesson, cut the video and share this part with their colleagues. We challenged the students to consider the necessity of conscious distinction between observation, interpretation and evaluation (Rosenberg 2016) while collaboratively reflecting their videos.

As Selwyn (2019, p. vi) noted, "The fast-changing nature of scholarship and knowledge" normalizes digitally-networked interactions and communications. Improved equipment and increased possibilities of new technologies, like video recordings, have become increasingly popular in classroom settings. From the stages of preparation and production to analysis, teacher-researchers must consider legal and ethical implications of videography with respect for subjects' rights.

Despite these challenges, video recordings in teacher education offer the possibility to overcome long-standing theory-to-praxis problems that many teachers face:

> "there are films that show particularly sensitive people such as children and adolescents or people with health impairments, in which situations are presented that pose challenges for teachers and are therefore at the same time suitable for enabling problem-oriented learning by students. It is precisely because of this that they offer a special potential for analysis with students in courses, have so far hardly been considered in the literature." (Sonnleitner, Manthey & Prock 2020, p. 233)

Desiderata within the field of music education includes data protection laws and in-depth ethical discussions of videorecorded lessons in teacher education (Sonnleitner, Manthey & Prock 2020, p. 233). "Numerous videorecorded teaching situations run the risk of exposing or damaging filmed people through a targeted video cut of the raw data material" (Sonnleitner, Manthey & Prock 2020, p. 232).

The main aim of this contribution is to raise awareness of digital ethics with the use of videography in higher music education so that students who actively teach (e.g., graduate music education students who simultaneously teach their own music students) may sensitively observe, interpret, and assess learners. Video-recorded instrumental and vocal lessons of their teaching can be reflected on collaboratively and used as a learning tool. The research question is: how might students observe, interpret, and evaluate videorecorded instrumental and vocal lessons in exchange with colleagues?

We suggest field-specific ethical principles as important for music education, emphasizing peer feedback in order to create a collaborative and participatory culture. Wilkens and Shin (2010) stated that peer feedback promotes dialogue, encouraging students to see others' teaching and learning approaches. This can help students verbalize their own experiences and identify unconscious knowledge, to question and reflect on behaviors and attitudes in music lessons, and to critically examine alternative or innovative ways of thinking and acting. Further considerations for the implementation of ethical principles may emerge with the use of intentional processes, such as a community of practice (Lave & Wenger 1991). Communities of practice are groups that accept new members who adhere to the established normative practices of the group (Lave & Wenger 1991). A community of practice is a collaborative endeavor, upholding group norms, which ideally facilitates the presence and expression of diverse perspectives as the group works together toward a particular goal.

Ethics are an integral part of research from beginning to end, and ethical compliance is pivotal to achieve research excellence (European Commission (n.d.): "Ethics," ¶ 1

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[para.]). According to Clausen (2009), whose definition we used in developing ethical principles, responsibility is made up of a subject (who takes responsibility), an object (for what), one or several addressees (to whom) and those with decision-making power (why). With a framework of Responsible Research and Innovation (RRI), scientists attempt to think critically about an alignment of innovation and considerations of pressing societal issues. While upholding strong ethical stances, researchers consider communities as potential contributors as well as those impacted by innovations. Levikov, Quacinella and Duca (2020) noted that responsible research and innovation necessitates an in-depth consideration of contextual factors that impact research.

In this contribution, we summarize best practices for digital ethics informed by literature (viz., ethical principles of Smith 2003) and use them to discuss participatory scientific research and practices in higher music education. We seek a nuanced reflection that includes curated digital content and students' collective thoughts on its use. In addition, we discuss positionality that informs use of curated digital content. We include considerations for critical response among peers and experts (see Lermann & Borstel 2003) and note the role that holistic, or big picture thinking, can play in the consideration of ethics, including attitudes of inquiry and empathy and the capacity for ambiguity, complexity and diversity (Ford & Chen 2001; Goodenough 1976). A discussion of both ethical principles and pedagogical considerations in the field of music pedagogy then follows.

2 Background

Our topic is distilled from a wider inquiry, the Transfer of Knowledge Project *Reflective Practice in the Network IGP.* This project is a research cooperation of the Knowledge Transfer Center (WTZ) south (WTZ Süd, 2017), which is financed by the Austria Wirtschaftsservice Society (AWS) with funds from the National Foundation for Research, Technology, and Development (Austria Fund). The aim is to strengthen processes of professionalization and knowledge transfer within a professional group of instrumental and vocal teachers. The project is characterized by intensive didactic and collaborative exchange toward testing innovative principles of reflection.

Our project is also inspired by a roundtable discussion that was held in December 2020—a component of the aforementioned larger inquiry. We invited varied experts to discuss video content for teaching, as well as overarching topics of data protection and digital ethics. The discussion included use of video recordings in lessons, focusing on ethical standards, as well as data protection and digital ethics.[1] The discussion was framed by the increased use and roles of video in university education and the resulting need for both data protection and security measures, as well as ethical standards to

[1] Due to COVID-19 restrictions, the roundtable discussion occurred in a Zoom videoconference.

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guide practice. The panelists were invited by Kruse-Weber, the lead researcher on the project. The group purposefully represented a variety of perspectives and were identified as contributors by their experiences, which included expertise in digital ethics or instrumental and vocal pedagogy. Kruse-Weber moderated the group with guiding questions, for instance: In which context have you been involved with instructional videos and how can you describe your role? Following, together the group analyzed a video with guiding questions such as e.g. What do you notice? What challenges do you face? What needs to be noted? What is justifiable and useful to record, what is not? What is defensible and useful in further handling of the videos? and What are ethical concerns/reservations teachers and learners have about recording, selecting, and using instructional videos?

Panellists discussed a variety of topics that included knowledge-transfer processes (including digitization), broad societal challenges and a need for positive change aligned with RRI initiatives. This led to another tenant of RRI involving participatory science, specifically crowdsourced scientific inquiry. Panellists sought representation and participation among those with diverse roles, for instance teachers, professors, and graduate students. In addition, panellists affirmed value for the integration of communities of practice into collective processes of problem-finding and solution-identification. The panel recommended generating innovative research in participatory processes that includes a variety of collaborations among communities of practice.

The roundtable discussion provided a foundation for later analysis. It was audio recorded, and research assistants transcribed the discussion. Kruse-Weber and Bucura separately coded the transcript for themes and discussed them in identifying emergent themes. Themes related to both of the overarching topics: data protection and ethical standards. We focus primarily on ethical standards in this manuscript. Major themes related to ethical standards included the following: continual reflection, transparency, and harm avoidance. Participants raised concerns, for instance, about purposes of the video, depiction of those in the video, informed consent to participate in being recorded, and storage and protection of the video recording.

2.1 Discussion of Data Protections and Ethics

The roundtable discussion led to insights for ethical principles that may guide use of video in higher music education for videographic instrumental and vocal lessons. We refer to this roundtable discussion as it provided an initial foundation for analysis toward the ethical practices we discuss in this paper. We summarize the roundtable here in two parts: data protection (§2.1.1) and ethics (§2.1.2).

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2.1.1 Data protection

Roundtable panellists focused their discussion of data protection on legal guidance and practice. They noted that data protection provides guidance supported by legal terms, ensuring the right of personality and informational self-determination, as well as protection for private citizens from any encroachment upon it. Article 4, no. 1 of Regulation (EU) 2016/679 defined personal data as information that relates to identified or identifiable people (Council of the European Union & European Parliament 2016, p. 33). When enough individual characteristics are shown, the individual's identity can be deciphered, then use of the content without permission is then prohibited (see Aksoy, 2008).

Practical considerations for data protection included privacy, copyright, teacher- and student-preparation, and knowledge transfer processes. Panellists discussed not only whether one should display video content, but also to whom videos might be shown, how much video to show, and the need for a clear rationale for use. Further, panellists discussed the scope of knowledge transfer processes in relation to researchers and communities of practice.

2.1.2 Ethics

Dialogue involving ethics was decidedly more practical in the roundtable discussion, although less precise. Panellists posed guiding questions to ground educational researchers in ethical inquiry. While necessary and we include them, their voluntary nature contrasts the obligatory nature of data protection laws.

Panellists considered the feasibility of anonymizing video subjects and determined it could be tedious to carry out and could also disrupt critical analysis by obscuring facial expression, for instance signs of understanding or stress, which are particularly important indicators to be used as teaching tools. Panellists enthused that ethics dictate one speak transparently with those included in the film. Conversations should be open so participants can have ownership of their part, providing autonomy over their own content. Panellists felt however, that social pressure may make it difficult for students to deny consent in the presence of peers.

Panellists stressed that video platforms offer varying degrees of protection, particularly when videos are not hosted on internal servers. Thus, those who intend to use such platforms should consider carefully how to protect subjects' data. They recommended guiding principles for making such decisions and discussed the hierarchical implications of who has control of the video, for instance professors or students.

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2.2 Responsible Science, Ethics and Pedagogy Scholarship

Authors have discussed ethical considerations in general, both in terms of pedagogy and digitization and media. Blomberg et al. (2013) noted five research-based heuristics to guide video use in preservice teacher education. Specifically: when, how and why one might choose to present video content to students in discussion of affordances and limitations. Blomberg et al.'s suggestions included (1) an identification of learning goals, (2) identification and rationale for instructional approach, (3) specific video materials chosen for use, (4) acknowledgement and articulation of limitations, and (5) alignment with both instructional goals and assessment strategies.

2.2.1 Digital material

Widespread societal and technological changes have impacted higher education. For instance, digital media play increasingly important roles in higher education contexts. This is particularly true in current times, as education became largely virtual during the COVID-19 pandemic. According to Pink, Lingard and Harley (2016), novel possibilities exist for the use of digital video pedagogy, which can bring about positive and radical changes. They noted:

> "In a contemporary context where mobile media and technologies are increasingly ubiquitous in everyday life… being at work can be understood as participating in a digital material environment."

The authors use the term *digital materiality*, referencing Pink, Ardevol and Lanzeni (2016), to discuss contexts by which digital forms, materials and designs are integrated as processes of research, design and intervention. Pink, Lingard and Harley noted that not only can these technologies, platforms and content become integrated, but they may also become entangled as individuals navigate their usefulness in professional practice and in relation to one another. While we focus specifically on digital video, we recognize ways digital materials beyond video are emplaced, integrated, and entangled in preservice music teachers' lives both within and outside professional practices.

2.2.2 Open software

Technological developments have brought about new possibilities, therefore change, to both science and education. Open platforms, for instance, encourage community participation in science so that global challenges might be considered collaboratively (Pardo Martinez & Poveda 2018). *Open data* is also a term used to describe data creation that involves great public interest (Hasegawa & Asano 2016). Sikder et al. (2019) noted that the term *open* itself, has encouraged new approaches to both science and education.

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In a study of RRI implementation in higher education, Levikov, Quacinella and Duca (2020) sought best practices. They noted that academics must maintain an open and receptive mindset, being responsive to societal needs. Authors also stated that academics must foster connections with stakeholders outside universities. Levikov, Quacinella and Duca recommended contextualizing a nuanced understanding of RRI, which in our case highlight diverse voices (for instance university students' own music students) represented in a pedagogical course for instrumental and vocal music teaching.

Additionally, five approaches can be applied to the use of open science (Sikder et al., 2019, p. 412, fig. 80, drawing from Fecher & Friesike, 2014): *democratic*, using so-called "free knowledge"; *pragmatic*, where diverse people like researchers, teachers and students intensively collaborate in order to create; *infrastructure*, using open tools and platforms (video); *public*, a citizen science approach used for identifying participants as well as others; and *measurement*, acknowledging value for possible alternative impacts (e.g., different types of participants, diverse voices).

2.2.3 Participatory culture

Current students live in a participatory and often virtually-mediated environment. Jenkins (2006, p. 5) described participatory cultures as low-barrier opportunities to create and contribute while experiencing informal mentorship or support. Jenkins noted that participants should feel socially connected to one another. Particularly due to COVID-19 restrictions, a reliance has developed for digital mediation that can become crowdsourced. The concept of crowdsourcing research builds on communities of practice, highlighting their role in problem-finding and collaboratively brainstorming solutions for a societal benefit.

Music education scholars Hewitt (2009, p. 3) and Shevy (2008) discussed the importance of communities of practice. Hewitt described communities of practice as having distinctive practices and behaviors that define their group identity (e.g., through music creation, performance and consumption). Shevy emphasized extramusical norms exercised by groups that define communities. According to Hewitt (2009, p. 4), three are particularly important in higher music education: pedagogical practices, performance practices, and transmission practices.

In education, learning involves interconnections of experience (prior and current), inquiry, collaboration, information, and so on. These interconnections necessitate group norms that define community practices. Communities of practice may institute norms such as respectful dialogue, mutuality, negotiation and a sense of welcome. In parallel, scientists seek participatory spaces, involving collaboration and a negotiation of varied perspectives. The resulting ambiguity, complexity and diversity of practices is reminiscent of teaching/learning communities of practice.

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Pink, Lingard and Harley (2016, p. 5), drawing on Fors, Bäckström and Pink (2013) and Howes (2005), advocated the concept of *emplacement*, suggesting the sensory experience of environment, including virtual environments, is integral to the learning process. Learning, therefore, can be understood as embodied, and furthermore, embedded, enacted, and extended (Schiavio & van der Schyff, 2018), "not as embodied but also as emplaced" (Fors, Bäckström and Pink 2013, p. 182) in an integrated relationship of mind, body and environment. According to Pink, Lingard and Harley (2016, p. 5), approaches in the cognitive and psychological sciences must reconsider digital learning environments to emphasize embodied experiences of technology use. These experiences are impacted by learning environments, whether they are in-person, virtual or hybrid.

Questions persist about the nature of learning and interacting in scientific inquiry. Increasing virtual interactions (e.g., online and hybrid classes) and digital content influence teaching and learning. Historic preservation of digital content is challenging in that it can be ambiguous and open-ended. For example, it can be difficult to maintain a historical record that retains the dynamic nature of commenting, re-tweeting, texting, sharing and so on, that may be decontextualized or lost entirely in records. This is often true, too in educational environments, where differences exist in the preservation of historical records, although conversely so. For instance, person-to-person conversations may be lost in a live class, yet digital mediation may preserve conversations (e.g., digital discussion board or video-recorded breakout room discussion), necessitating continued ethical considerations.

3 Discussion

We now discuss digital ethics specifically to music education research and practice. We reflect on research findings against the background of policy- and theory-driven debates about the role of science and universities in society, particularly how digital ethics can be imagined in pedagogical and research use. In this section, we discuss three topics: ethical principles (§3.1), pedagogical considerations (§3.2), and holistic thinking (§3.3).

3.1 Ethical Principles

An examination of the ethical implications of increased digitization for research practice and research organization is important. This involves a discourse on digital ethics, which are the ethical aspects of research and design specific to digitization practices and approaches. Such problems may reference the design of digital technologies and products but also reference digital methodology. We focus on the latter. Based on the roundtable discussion, we summarize ethical principles for pedagogical practice.

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Digital tools for pedagogical practice can include, for instance, recordings of online lectures; videos made by teachers and students for tutorials and assignments; YouTube videos used for analysis, evaluation, and modelling; and so on. Videos are particularly valuable for self-reflection. Roundtable panellists noted that students who produced a video tended to practice more, leading to self-reflection, self-organization and self-competence. They noted that recorded videos eliminated problems of poor sound quality, delays and poor internet connections, which can be particularly problematic with digitally mediated and synchronous virtual music instruction.

Ethical principles outlined here involve transparency and explicit voluntary consent. Detailed questions are noted in order to guide practical decisions. Teachers can ask, for example, the purpose of a video, underlining rationale for its use, including whether different people have different purposes, and whose interests the video might serve (and how). These questions can provide varying levels of analysis. The university professor must pose such questions (to themselves and to university students), yet the university students who also teach their own music students should then also consider these questions for their own teaching. Those on the video (possibly young music students and their parents) should similarly be consulted in terms of their role on the video, who might view the video and for what purposes, which provides necessary information prior to their consent (and assent) to use the video. Teachers must weigh potential benefits against harms that might result from a video's use, which can be complex and intersecting. They must also consider what will happen with the video afterward. For example, will it stay within a small circle, become published, or deleted? If published, one may lose control of distribution. What is the context of the video? How does it depict people and the situation? This can be particularly important when subjects perceive they are presented negatively. Imperfect teaching examples, however, are important for student evaluation and analysis, as no human interactions, including teaching, can be deemed perfect. Furthermore, it is important to foster a learning culture with a growth mindset (Dweck 2006), in other words focusing on learning rather than existing ability.

Considerations should also involve informed consent, which is ubiquitous in research. However, in practical teaching and learning, it may be less obvious how to ask for and continually ensure consent. Individuals' rights to be informed are important indicators for whether a video should be made or used; who will record it; and how it will be recorded, stored and shared. Additionally, are there multiple views? If so, what rationale supports the need for them?

3.2 Pedagogical Considerations

Here we discuss the importance of reflecting and fostering a reflective disposition, significant goals for teacher educators and students alike. One's reflective skills also

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serve a research-minded approach. We focus on the critical response process (Kruse-Weber & Hadji 2020; Lermann & Borstel 2003), which we have used to foster such dispositions. We outline specific principles here to guide practice.

3.2.1 Participatory practices

In a community of practice, participants should gain perspectives by learning from and with one another. Diverse perspectives are therefore welcome and necessary. Digital spaces and digital content can serve to build up or perhaps subvert holistic thinking however, possibly skewing broad perspectives. Cheng and Zhang (2017) drew upon the work of Ford and Chan (2001) and Goodenough (1976) to describe holistic thinking as a style of cognition that begins with the big picture. In the first step of the crtical response process learners express overall statements of meanings (Lerman & Borstel, 2003). Holistic thinking therefore involves the whole first (cf. Clarke 1993), providing a foundation on which details can be considered contextually. According to Sandars and Murray (2009), while reflection is known as a tool for lifelong learning and professional practice, undergraduate students must nevertheless learn these skills.

3.2.2 Fostering critical thinking

Critical response is one process used to connect to ethics and practice, considering the possibilities of ambiguity, empathy and diversity toward building and furthering a participatory culture.

In music pedagogy we have drawn from critical response process (Lermann & Borstel 2003) to engage student-centered opportunities for gaining skills in reflection, feedback and growth. The pillars of critical response can support a collective and meaningful dialogue. For example, ethical dilemmas (hypothetical or experienced) can be considered collaboratively using video reflection. Such dialogue can engage all members, creating open spaces for diverse perspectives and meanings about teaching and learning, along with the tensions and negotiations inherent that might lead to best practices and personal growth. With critical response processes, participants (e.g., artist musicians, teacher/facilitators, students) progress through five guided stages that first include initial and personal impressions, followed second by neutral and open questions that lead toward an understanding of the learning process or ethical situation. Third, participants formulate feedback through neutral questions that mirror what they noticed or what occurred. Importantly, these questions must be devoid of judgement. A fourth stage follows, in which they express personal opinions, interpretations, and possible solutions. The fifth stage then engages participants in summarizing the discussion and identifying next steps (Lermann & Borstel 2003).

Through such critical thinking, students verbalize their experiences and uncover unconscious prior knowledge. Students engage in a critical examination of alternative

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and innovative ways of thinking and communicating. By not allowing participants to make judgements in CRP, the students are confronted with the challenge of reformulating and revisiting their opinions. Aligned with the work of Dweck (2006), as aforementioned, critical response focuses toward what one is becoming, rather than a deficiency-mindset of what one is not.

3.2.3 Ethical principles and processes

Using Smith's (2003) ethical principles for educational research, based on the American Psychological Association (APA, 2021) guidelines, and with inclusion of Blomberg et al. (2013), we summarize ethical principles for research and pedagogical practices (Fig. 1). In addition, we discuss not only the recommendations of ethical practices as principles, but we also consider an implementation of them specific to our inquiry in higher education music pedagogy. Figure 1 therefore also includes both pre- and post- planning and reflection, as well as ways holistic thinking and crucial response can be implemented within a community of practice.

First, we consider that a community of practice is necessary for collaborative and individual reflection. While Lave and Wenger's (1991) notion of a community of practice may appear exclusionary due to the establishment of group norms, normative practices can provide structure by which diverse representation can be upheld. Norms of respect, openness and an atmosphere of welcome, carried out through Hewitt's (2009) extramusical categories of pedagogical practices, performance practices and transmission, support such inclusivity.

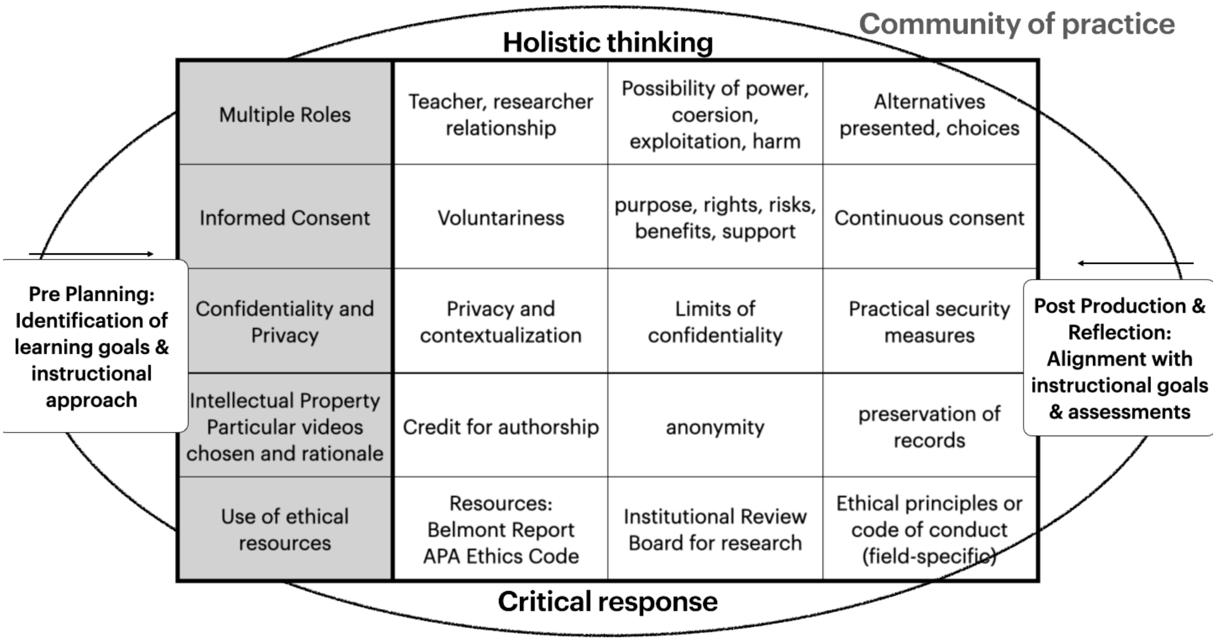

Fig. 1. Ethical principles and process. (Adapted from Blomberg et al. 2013; Smith 2003.)

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Holistic thinking (watching, observing) and critical response can inform a practical implementation of ethical principles. Holistic thinking is a whole–part–whole approach to learning: viewing the big picture, delving into contextualized details, and applying it back to the whole. This can be an individual style of cognition, established as a norm in a community of practice, and encouraged through one's facilitation of students' experiences. Initial, open-ended questions can prompt students into big-picture thinking. Critical response process however, necessitates group interactions within the community of practice. Here, students similarly progress through stages that begin with general impressions of the big picture, yet they do so collaboratively in order to gain skills in reflection and a negotiation of perspectives. As learning is both individual and collaborative, holistic thinking and critical response are equally important for student growth.

Also, we consider the significance of planning and reflection for the implementation of ethical principles. An important precursor to ethical video use involves discussing the aims of video use, the content identified for use, and the extent to which students are informed. Practical elements of videography must be considered, for instance camera placement, subjects and framing, context, and so on. Video postproduction demands further consideration: the length of time videos will be stored, selected content to present, and editing practices. These choices can also serve a pedagogical purpose, revealing much about the student who makes these decisions. For instance, editing can highlight confidence or imperfections, which may be instructive, or feign perfection to avoid demonstrating vulnerabilities. Similarly, it can be revealing for instructors to see whether a student shares content from a deficit-model (e.g., mistakes, struggles, frustrations) or a positive orientation (e.g., successes, enthusiasm). These choices may implicate the student's feelings of psychological safety (or lack of) among peers and teachers/researchers.

Smith (2003) noted five categories for ethical practices in educational research, which we discuss in detail below: (1) intellectual property, (2) multiple roles, (3) informed consent, (4) confidentiality and privacy, and (5) use of ethical resources. Blomberg et al. (2013) also noted ethical considerations for the pedagogical use of video content. They highlighted the need to first identify learning goals and to provide a thoughtful rationale for instructional approaches and for video selection. Blomberg et al. also noted the importance of acknowledging and articulating limitations, strategies and reflection in alignment with instructional goals and assessment. Additionally, we include insights from the Code of Ethics of the *Deutsche Gesellschaft für Erziehungswissenschaft* (DGfE; German Educational Research Association; DGfE Council 2016), which provides additional guidelines for pedagogy.

Intellectual property provides explicit credit for authorship, considering author roles and the relationship of their contributions to the whole. Authors should ideally discuss

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intended contributions in advance of the work, documenting them carefully. Intellectual property includes topics of confidentiality and anonymity. These are intended to protect contributors' identities and identifying information. Intellectual property also involves authenticity and a careful preservation of records, like safe storage and establishment of trust. These principles coincide with Article 2 of DGfE's Code of Ethics: Publications (DGfE Council 2016, p. 2). Research results should be made available to the public and all project contributors, including predecessors, partners and competitors, who are given explicit credit for their roles.

Multiple roles, including intersecting or overlapping roles, are common in educational research. A teacher-researcher must carefully navigate their possibly conflicting roles. Possibilities exist for undue coercion that results from an unavoidable teaching power dynamic. In the lessons, exploitation and harm are possible, even when unintended. Similarly, the graduate students in this discussion are both teachers and students. In a university class they take on the role of student among colleagues, while music teacher to their students. They must navigate their roles carefully to avoid harming their own students. Allowing students (both university students and their pupils) to make alternative choices (for instance not appearing on a video recording but participating in a live peer teaching episode instead) may mitigate potential harm as they navigate these roles and participate in a community of practice. The DGfE Council (2016, p. 3) noted the importance of dealing respectfully and ethically with colleagues and others in the context of research. In Article 5, they stated that rules of good practice are a necessary and worthwhile component of teaching and academic career preparation. Principles of objectivity and justice must be upheld so as not to disadvantage or discriminate others.

Informed consent speaks to people's rights (e.g., students, participants) to willingly consent to participate. Specifically, participants must not be coerced, but instead must voluntarily and explicitly consent to participate with an understanding of the purposes and limitations of the study or learning scenario. Consent, however, is continuous, meaning it can be revoked at any time. With digital video content, participants can request that videos of themselves be deleted or de-identified (e.g., blurred face, names cut from the title/label, audio and/or video). Participants must understand their rights as well as the possible risks or benefits of their participation. The DGfE Council's (2016, pp. 1–3) use of informed consent involves respect for a person's identity and integrity, their explicit consent, and confidentiality of data.

Confidentiality and privacy overlaps somewhat with informed consent, yet necessitates distinct consideration. Privacy must be contextualized to the specific population and individual. For example, privacy concerns among one group may not be problematic to another. While one individual may express comfort with personal data included on video content for continuous use, another may stipulate concerns

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(e.g., that their name not be used or that their video data must be encrypted for storage and only accessed by certain individuals). Others may not offer their consent. These choices must be made individually, with no explanation needed. Prior to asking for consent, researchers must make these options clear so that individuals do not feel pressured or coerced. Confidentiality, even with the highest standards, has limitations. Encrypted data, for instance, can be breached, and de-identified videos could still be recognizable. Participants must understand the limits of confidentiality measures in order to be fully informed when making decisions. Practical security measures, however, can provide layers of protection.

Finally, we discuss *ethical resources*. *The Belmont Report*, for instance, reminds researchers of the need for oversight and the possibility of research harm (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979). All ethical decisions should be grounded in a commitment to do no harm to those involved. Institutional review boards and ethics commissions provide helpful oversight and guidance. Researchers should therefore consult them with questions that arise during any stage of the process. Additionally, field-specific ethical principles (e.g., ethical principles of music pedagogy) should be developed, consulted, and revised over time. The DGfE Council (2016) noted that experts can weigh in with opinions and reviews, within or apart from ethical bodies such as university ethics commissions.

3.2.4 Didactic sequencing

For all stages of ethical decision making, we propose the following pedagogical sequence (see Fig. 2). Teacher-researchers must weigh each of the five categories sensitively and thoroughly as they move through the considerations outlined above using holistic thinking and critical response approaches with the class. They can utilize the same analytic skills they use for teaching to process through ethical practices and research. Preservice teachers can use this sequence to build reflective habits.

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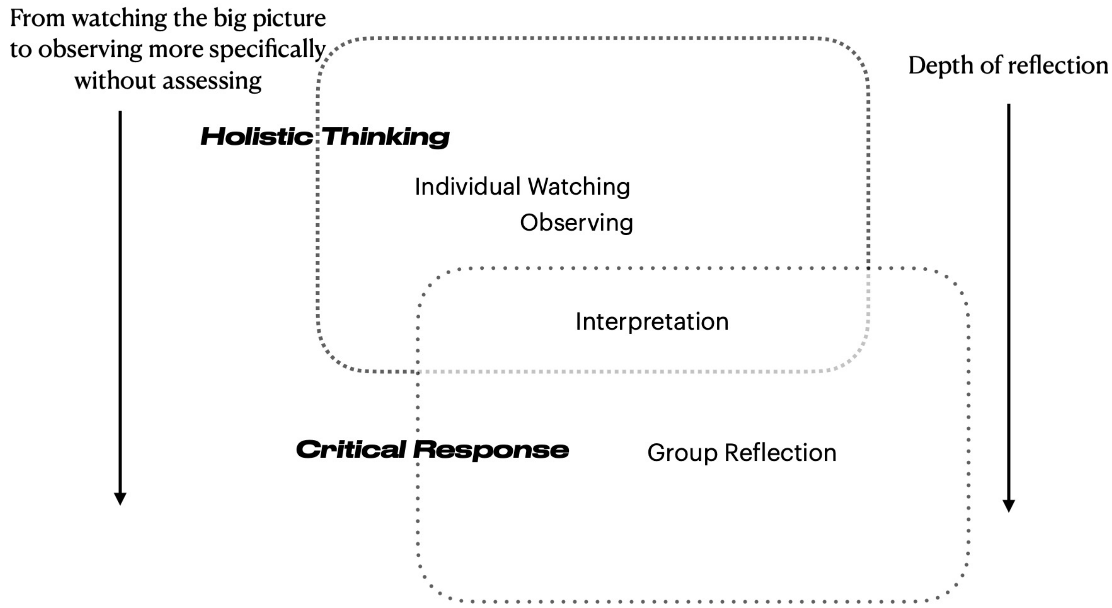

Fig. 2. Didactic sequence for ethical video use.

While the video students bring to class will be fixed, they will continue to record lessons, therefore reflect in planning new goals for their teaching behavior for subsequent recordings. Once a video is made, it will be determined through reflective practice to what extent it will be shown in the teaching environment. The sequence begins with students watching the video to determine the overall scope of the video's pedagogical use and its holistic value through statements of meanings. It is particularly important to be guided toward holistic thinking, as one may otherwise prematurely focus on opinion/judgement, or minutiae, such as poorly-worded instructions or a student's off-task behavior. In the context of instrumental and vocal lessons instructor and peer feedback should emphasize autonomous learning, giving learners the ability to evaluate their own work. Accordingly, we first concentrate in the overall meaning of the work, embracing a diversity of perspectives. The question stands, how did we experience this work? In research, ethical decisions demand the same: an initial viewing to ascertain the value and purpose of content (e.g., a video). The holistic thinking stage is primarily an individual act; it involves watching and thinking in the moment, that is, while teaching one's student, and considering oneself afterward in a reflective state while viewing (and reviewing) the recording.

The middle phase, interpretation, exists between—and is a blend of—holistic thinking as an individual, and the critical response process of a community of practice. This is a social activity, requiring psychological safety as a participatory community of practice, and necessitates guidelines of mutual respect, openness to different ideas and voice for all participants. Interpretation begins with one's own thinking and gradually moves from the macro to micro. It includes the form or arc of the lesson,

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interactions, pacing and sequence of instruction between teacher and student, the conditions of the learning environment, clues about participants' feelings, and so on. These components are an important stage in an interpretation of video content.

Interpretation organically transitions into social dialogue, enabling preservice music teachers to engage in the critical response process. This creates a structure of safety for meaningful dialogue. We believe that the critical response process fosters preservice music teacher-researchers to think deeply, creatively, and subtly about their roles as teachers, researchers, and students, while weighing unclear ethical and teaching dilemmas that will become a cornerstone of their pedagogical practices.

4 Conclusion

In this paper we reflect a sustainable and responsible use of digital content in the context of instrumental and vocal pedagogy. Our aim is to raise awareness of ethical principles toward responsible use of videography in instrumental and vocal lessons and teacher education in alignment with RRI principles. These pedagogical recommendations should be used to build community, foster empathy and trust, and build perspective and growth among music teachers as reflective practitioners who can sensitively consider the ethics of their teaching related to digital content.

Music presents a challenge to digitally mediated spaces, particularly when addressing problems of sound feedback, delay, and poor audio quality. The use of digital content like video recorded instrumental lessons can alleviate some of these problems, as it can preserve the sound quality and timing, approximating the original live sounds. Referencing Hewitt's (2009, p. 4), three norms of pedagogical practices, performance practices, and transmission practices in higher music education, music is a domain well-situated within values of participatory culture and community of practice. Music should be social, interactive, and improvisatory as a historically human endeavor spanning all cultures. Music therefore must be in time and with quality audio in order to facilitate students' growing artistry. Among less experienced music students this issue becomes even more pressing. As Fors, Bäckström and Pink (2013) noted, learning is emplaced in an integrated relationship of mind, body and environment. Music too, encompasses these interactions of the intellectual, the physical, and the collective, particularly important when digitally mediated.

Videography in this project is focused primarily on student-created video recordings of their own teaching of instrumental or vocal synchronous and live lessons. It can also reference a wide array of other possibilities, including public content, instructor-created class content, digital supporting materials, and so on. Each type of digital content may require in-depth ethical considerations, perhaps expanding or broadening beyond the principles we have outlined here. As digital content continues to take on new forms and roles in higher education, these considerations will become continually pressing not only for university students' learning experiences, but for the role modelling such considerations provide them when then enacting their teaching roles. As well, classes that are held virtually may necessitate different considerations for fostering a community of practice than those held hybrid or in-person.

Naturally, aspects of the aforementioned ethical considerations for video use are also relevant to other fields in higher education that make use of video recordings as a didactic resource. Most notably, this applies in general teacher education, as pedagogical considerations take center stage, but may be liberated from the concerns associated with top sound quality and artistic interactions.

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Simulating the Healthy Body: How Exoskeletal Devices Invent New Forms of Capability in Rehabilitative Environment

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Abstract. Exoskeletons are recent robotic developments in rehabilitation that draw attention to new ways of perceiving impairments. While simulating human walking or movements of the arms, exoskeletons redefine basic experiential parameters such as “motor intentionality” (Merleau-Ponty, [1945] 2012, p. 112-113; Pacherie, 2018), but also various forms of experiencing one’s body as being abled. Hence, exoskeletons are markers of a partial transition from “I cannot” to “I can”, which they perform through the simulation of healthy bodies. Although these changes take place mostly in the confined space of a clinic or lab, they are of major importance, and open the possibility to interrogate how the contextual use of exoskeletons in clinical environments changes the status of their users to “temporarily abled.” In these new rehabilitative techniques, users are engaged in specific forms of “body work” (Gimlin, 2002; Gimlin, 2007). After first describing the current state of exoskeletal devices, I will analyze how healthy bodies are used as materials to provide models for impaired ones and discuss procedures of simulation based on a logic of “essentialization.” In the next section, I will explore the specificity of “body work” with exoskeletons for rehabilitation purposes and how further conceptions of intercorporeality emerge due to the development of these novel technologies. I will support my arguments with excerpts from qualitative empirical material from sociological research conducted between 2014 and 2021 and correlate them to the phenomenology of the body.

1. Introduction

Recent robotic developments in rehabilitation such as exoskeletons draw attention to new ways of perceiving impairments and join the wider family of technological innovations in the medical field (Schlich, 2007). The main functions exoskeletons fulfill in medical environments are to assist and rehabilitate neurological conditions. In order to develop these possibilities, exoskeletons simulate motor patterns that characterize healthy human bodies, which identifies these gadgets as “translating” technologies for which simulation plays a crucial role. In this vein, exoskeletons simultaneously mediate and “intermediate” forms of motor capability, their aim being to capture motor patterns of healthy bodies in order to adjust or support impaired ones.

The first time when I had the chance to see an exoskeleton for rehabilitation in a clinic was in 2017 during a preliminary fieldwork visit. This device was intended to help people having experienced stroke and was conceived for arm training. What surprised me at first sight was the heaviness of the robot; yet shortly after discussing with one of

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the PhD students working in the lab and who explained me how the robot works and what the patients usually do in a training session, one understands that the device was hiding a world of corporeal possibilities hardly conceivable until recently. Stroke is just one of the examples of neurological affections that exoskeletal devices aim to respond to. Another one which exoskeletons aim to assist with is spinal cord injury. Regarding this type of injury, the devices I saw or tried myself were mainly developed for walking practice.

Exoskeletons for walking are either static, meaning that the device is immobile and functions like a fitness gadget, the impaired person being harnessed inside the device and having her or his legs moved by it, or they may be mobile. The first category of models is usually available in clinics and labs. The second type of models is intended both for training in clinics as well as for home use, in case users are autonomous enough. These exoskeletons usually function with crutches[1]. Whereas some exoskeleton models, especially the static ones are already on the market and have received certification, others that aim to provide more freedom and mobility for their users are often work in progress. Walking exoskeletons that have crutches are more restrictive; as a consequence, their users need to have a relatively good physical condition to manipulate the device. Nevertheless, one of the technical components in both types of devices that is crucial for the concrete practice is represented by sensors, which need to be very sensitive in order to capture remaining functions in the users' arms or legs and communicate this information to the robot so that the user may receive the needed support.

Because they simulate human walking or movements of the arms, exoskeletons impact basic experiential parameters such as "motor intentionality" (Merleau-Ponty, [1945] 2012, p. 112-113; Pacherie, 2018), but also various forms of "feeling" one's body as being able. This is a reason why they may be understood as technologies contributing to reformulate and reorganize specific phenomenological potentials on a more global level. Motor patterns may be described in very general terms; yet every user of exoskeletons has particular remaining motor resources, and often these differences that exoskeletons are designed to respond to may be challenging for a proper use of the device.

Simulation processes and procedures therefore relate to a very specific meaning with respect to my analyzed case. Unlike classical views in STS that conceive of simulation in relation to predictive practices (Heymann et al., 2017; Sundberg, 2010; Turkle, 1995; 2009), simulation mechanisms used in rehabilitative robotics enter other conceptions, the main goal of these projects being related to medical interests.

[1] The company Wandercraft from France developed an exoskeleton functioning without crutches for paraplegics, Atalante: https://www.wandercraft.eu/ (accessed 18/08/2021). However, this model is currently used only in clinics and hospitals.

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Different from such examples as goals in marketing or weather forecasting (Boumans, 2005; Daipha, 2015; Fine, 2007; Friedman, 2014), simulation characterizing the functioning of exoskeletal devices in rehabilitation gravitates around human bodies and their remaining possibilities to perform specific motor patterns. In this line of thought, exoskeletons are markers of a transition from forms of “I cannot”[2] to temporary forms of “I can” (Leder, 1990; Butnaru, 2018). The models used to train the impaired persons in clinics or labs are elaborated starting from healthy bodies which brings exoskeletons to simulate healthy movements while dis-simulating the specific impaired movements of their users. Due to the possibility of such a transformation, the interrogation of how the contextual use of exoskeletons in clinical environment changes the status of impaired persons into “temporarily abled” ones emerges, a phenomenon correlatively connected to the understanding of the clinical space (although for a short time) as one of corporeal normality.

The aim of this paper is to discuss the production of current forms of body cultures in rehabilitative environments where exoskeletons attempt to find their ways. My intention is to capture the dynamics of processes of simulation in this context while showing how new forms of motor capability are produced due to the use of this type of technology in the medical field. The simulation of a healthy body is crucial first for developing the technological device and second for the aimed achievements with impaired users.

After briefly describing the current state of exoskeletal devices, I will discuss what corporeal simulation means in the rehabilitative context. I rely on qualitative empirical material sourced from a sociological project started in 2014 and finished since recently.[3] The material comprises participations in scientific presentations and trade shows, narrative and expert interviews, as well as multi-sited ethnography in centers and labs where exoskeletal devices were developed, tested and used.[4] The

[2] Drew Leder discusses in his well-known study, *The Body Absent* (1990) the category of “I cannot” in relation to people’s capacity to intentionally decide anatomical processes. He notes: “Though I can lift my arm without any problem, I cannot in the same way choose to secrete a little more bile or accelerate my digestion” (Leder, 1990, p. 48). In case a person becomes a paraplegic following a spinal cord injury or has a half of the body paralyzed after a stroke, her or his body enters the realm of “I cannot”. It is due to the temporary and sequential modification of damaged walking or arm movement that exoskeletons act like translators towards forms of “I can”.

[3] The project’s aim was to inquire into the development and application of exoskeletal devices for both impaired and able bodies (industry and armed forces). In this paper, I only discuss one aspect related to the design of exoskeletons for rehabilitation purposes.

[4] For anonymization of the expert interviews, I used the following codes: Eng (engineer), a numeral showing the order of the interview in the series with that type of interview and an abbreviation of the country where the engineer was professionally employed at the time of the interview. For example, Eng1CH refers to the first interview I conducted in Switzerland. For narrative interviews I used the code: Reha (for rehabilitation), M if it is a male user and F if it is a female user, and then the country where

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impairment examples evoked later on for my analysis are spinal cord injury (SCI) and cerebrovascular accidents (CVA), more commonly known as stroke. I show what simulation aspects ground the conception and use of exoskeletal devices in rehabilitation, in which healthy motility patterns play a crucial role and how these further contribute to forms of body work and conceptions of intercorporeality, while correlating the empirical findings to the phenomenology of the body (Merleau-Ponty, [1945] 2012; Gallagher, 2012; Zahavi, 2019).

2. Wonder Objects

Because of their presence in science fiction movies, exoskeletons are often associated with enhancement, which is a first feature rendering these objects unusual or wondrous. However, the current reality of these devices is far from any pop culture figures of heroes using them. Currently, exoskeletons are developed for three fields: rehabilitation, industry, and armed forces. Their role is either to assist strenuous human motility patterns, which is why they are used by able people or rehabilitate but also assist people whose motor patterns are damaged and thus impaired. A peculiarity regarding exoskeletons' potential use in rehabilitation refers to two distinct cases: when impaired people have residual functions, which may improve due to practice with the device, one speaks of rehabilitation; in case that deficiencies are severe and the functions cannot be recovered, one speaks of assistance. I could experience concretely in my fieldwork why and how these devices bring the human bodies to practice what they could - walking but also moving one's arm after stroke - although this happened for a short interval.

Different from the fields of industry and military operations, exoskeletons in rehabilitation contribute to spectacular transformations. This is precisely because sometimes they enter worlds of heavy impairment, thought incurable until recently. Spinal cord injury and stroke are types of neurological affections that may have hard consequences for the people experiencing them. It is because of their exceptional and sequential impact on the motor deficiency of these category of persons that I categorize exoskeletons as "wonder objects." My use distances itself from any science fiction connotation and considers the impact that these technologies have on human bodies often living in pain. Besides the very phenomenological impact that exoskeletons induce, these devices are spectacular for a second reason: their changes in damaged bodies are unprecedented in the history of medical innovations and medical

the user comes from the number after the code of the interviewee refers to the paragraph. I analyzed the interviews with the software Maxqda.

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technologies. Such peculiarities reinforce the perception of exoskeletons as being "wondrous".

Both spinal cord injury and stroke have long represented strong challenges for both the people who experienced them as well as for medical personnel involved in their care. Exoskeletons reorient the focus on how these impairments can be medically transformed, and on another level, on the understanding of what human bodies can or cannot (anymore). In this sense, the bodies of people with (sometimes severe) impairments are transformed by these gadgets for short intervals of time into capable bodies, where capability means that they are partially able to perform sequences of movement. Take, for example, the experience of being verticalized after many years of sitting in a wheelchair or seeing one's image in a mirror while walking with an exoskeleton. These may seem to be unimportant details at first sight, especially for those who are healthy; and yet, for the people with spinal cord injury or stroke, walking or standing represents an alteration in their everyday lives with deep consequences, one that renders the experience of using an exoskeleton as an exceptional encounter. Although training with these devices may have a regularity in that the persons with spinal cord injury or stroke have consistently scheduled training sessions, these moments are marked by a temporary experience of what impaired bodies used to be able to perform in terms of motor repertoire. Due to this temporary character, exoskeletons retain their quality of being wondrous.

As one of the users recounted to me his first experience of using a walking exoskeleton after many years spent in a wheelchair, "the first steps, I would say, this was grandiose. When I sit in a wheelchair, I am the impaired person; when I stand up with an exoskeleton and I walk, then I belong back in society. Then, I am not impaired anymore" (RehaM3GE: 211; 213) (my transl. from German). In this line of thought, exoskeletons operate a clear mutation between ability and impairment, which actually starts at an invisible level. The wonder exoskeletons elicit happens both outside but especially inside the body of their users[5]. One of the interviewed engineers recounted to me about the impact of the initial use of a static exoskeleton for one of the observed patients, an impaired woman who re-experienced standing up again after many years

[5] In a recent broadcast of the magazine 28 Minutes on the TV channel Arte, Dorine Bourneton who is a paraplegic aerobatic pilot explicitly drew attention to what exoskeletons change. Her comments on her experience with the exoskeleton Atalante from the company Wandercraft, resonate with reactions of users I met during my research. She said: "First time that I got inside the exoskeleton, I told myself that this is how it should be. This is real life. This is how one should live. It is standing up. (La première fois que je me suis mise dans l'exosquelette, je me suis dit : c'est comme ça ; c'est la vraie vie. C'est comme ça qu'il faut vivre. C'est être debout.) (my transl. D.B.) And later on she evokes the quality of exoskeletons of "repairing the inside" (se sentir réparé de l'intérieur). See: https://www.arte.tv/fr/videos/103696-032-A/28-minutes/ (access 19.08.2021).

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of sitting in a wheelchair with whom the engineer worked during a study on this type of device. The engineer said:

> "Many patients report good psychological effects. Because they are always sitting in the wheelchair. And now, that they see that they are standing and walking, even if it is the machine that walks them, just the fact of seeing themselves upright is super beneficial for their well-being. Actually, some years ago, when I did a study here with [name of exoskeleton], I had a patient with spinal cord injury who didn't walk for like thirteen years. And when I put her in the [name of exoskeleton] she cried out of joy, and she told me to take a video for the children. So, it was really touching. And she is not the first. Many people actually, even if they know they cannot walk anymore, they require [name of exoskeleton] training just for the well-being. Because psychologically, it's good for them just to have this hour when they can stand up" (Eng13CH: 165).

The described surprise indeed transforms these gadgets into "wonder objects." Though the "wonder" may be very real, to achieve concrete success, complex procedures nevertheless must be elaborated and many hours of preliminary tests are required, which inscribes exoskeletons in specific forms of career of becoming one's "own body" after impairments occur. Among these, simulation, which in my analyzed case refers to the implementation of models of walking or moving one's arm in healthy bodies into the algorithm of the robot, plays a central role. Simulation already characterizes some practices related to the medical field as for example the education of specialists in surgery (Prentice, 2005; Prentice 2013). Yet besides educating experts of human bodies, current forms of digitally mediated simulation redefine and reinvent boundaries between models of bodily ability and models of bodily impairment and this is where exoskeletons intervene. They act, therefore, as an interface between healthy bodies and impaired ones. Interestingly, they engage their users into specific forms of experiencing their bodies in that if in general the human body is our primary site in the world because it situates us, when a person with neurological impairments uses an exoskeleton, her or his body becomes re-situated.

On another level, what these devices do is to challenge and reconfigure the landscape of contemporary "cultures of prediction" (Heymann, Gramelsberger and Mahony, 2017) that, different from technological cultures where exoskeletons are developed, have a much longer existence. Unlike other "cultures of prediction," which as Heymann et al. define as "cultures of power and, hence, transformative forces, which are all the more effective as they are often black-boxed, hidden, and invisible" (2017, p. 7), in my observed examples the main aim of simulation processes and procedures is to contribute to the development of medical epistemologies and practices. In my discussed example, although simulation obviously belongs to "cultures of prediction", its explicit purpose is to overcome corporeal damaged capacities. As I

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will detail in the following sections, simulation of healthy bodies relies on two central processes, which are interrelated – body essentialization and body work, both of which allow to further theorize phenomenological concepts.

3. Extending Cultures of Simulation: How Exoskeletons Intervene in Rehabilitation

3.1. Healthy Bodies and Their Simulation(s): Essentialization and Safety Procedures

Different from other simulation techniques involving quantification and contributing to the legitimization of various political, economic, or scientific decisions—weather forecasting is one of these examples (Fine, 2007)—exoskeletons integrate simulation to respond to other needs. If the former techniques may be associated with the development of "technologies of distance" (Porter, 1995: IX), exoskeletons may be understood as contributing to forge the field of "technologies of proximity" (Butnaru, 2021). The quantification procedures leading to their design, although impersonal at first sight, aim at finding solutions for a variety of human bodies and their motor impairments. Accordingly, exoskeletons contribute to the emergence of unprecedented forms of "idioculture"[6] inside the realm of medical robotics. Besides these, they also transform conceptions of impairment and bodily capacities, having a clear impact on the very subjective experiences of their users. These reasons grant exoskeletons a deep phenomenological potential. Alone, their influence of the "motor intentionality" (Merleau-Ponty, [1945] 2012, p. 112-113; Pacherie, 2018) of their users, associated with one's "sense of agency" (Gallagher, 2017), represent important aspects of transforming bodies thought irremediably damaged into bodies that sequentially regain motor functions. Clearly, associating quantification and simulation in engineering cultures with the fine grained details of each and every human body for which these devices are designed not only seems a complicate and intricate enterprise, but it also is de facto. And yet, interestingly, it is due to processes of simulation, that new phenomenological experiences are invented and, if enough practice with the device is possible, sometimes durably maintained.

[6] According to Gary Alan Fine, the category of "idioculture" refers to "a system of knowledge, beliefs, behaviors, and customs shared by members of an interacting group to which members can refer that serves as the basis of further interaction. Members recognize that they share experiences, and these experiences can be referred to with the expectation that they will be understood by other members" (Fine, 2007, p. 69).

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Among the mechanisms contributing to the simulation process in the conception of exoskeletal devices, besides the classical procedures of counting, measuring, compiling and not less importantly datafying and quantifying, one specific procedure I observed in my fieldwork was that of “essentializing” bodies. Generally, simulation mechanisms characterize a variety of forms of “cultures of prediction,” to stay with the above-mentioned concept. However, different from other areas for which charting capacities of human able bodies serves the purpose of predicting and controlling, what I observed in my fieldwork was that engineers engage in processes of data accumulation, which essentialize human capacities according to the intended correction of damaged motor capacities. Simulating healthy bodies representationally results in a very reduced “silhouette” that engineers name the “stick figure.” The stick figure may be understood as a computational translation of living bodies, which further construes the process of the simulation of healthy bodies for exoskeleton design in terms of what I identify as “body essentialization.”

“Body essentialization” first covers a very material aspect: able test subjects are invited to visit labs and centers and allow experts to gather information about their physiological and anatomical characteristics. Because very often it is easier to work with doctoral students or master students who are themselves involved in the team designing exoskeletons, it is these able people whose body values are collected. One of the advantage in using healthy subjects who are experts in engineering science is that they may quickly identify whether there are problems with the device. A second aspect of “body essentialization” involves the datafication of specific values characterizing the bodies of the test subjects. This epistemic procedure of capturing focused characteristics helps in concentrating the constitution of an algorithm for a particular aspect, as for example the metabolic cost. Interestingly in this process of essentialization the focus is on building a model which although composed of very specific values of people’s healthy bodies aims at a general application. The final aim is that the “collected capacities” composing the algorithm may be further transposed onto the impaired subjects by means of the device. In my observed examples of spinal cord injury and stroke, this refers to motor patterns of arms or legs and their correlated intentions.

In a study discussing how virtual reality simulators contribute to professionalize surgeons in their developing skills to perform minimal invasive interventions, Rachel Prentice proposes the concept of “body objects.” In her view, these objects refer to “representation of human bodies as they have been engineered to inhabit computers” (2005, p. 847). As she further details:

> “Body objects also are narrow: because the computer requires specific mathematical descriptions to calculate a line or determine a trajectory, body objects cannot be loosely described in ways humans understand intuitively. Body objects are

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representations of bodies articulated graphically and haptically, so humans can understand them, and mathematically, so computers can understand them" (ibid.).

Recording motor values and characteristics of healthy bodies for exoskeletons design is highly focused on very specific properties, which further partitions and simplifies the reality of human bodies. However, what the peculiarity of my example shows is that, if one stays with the previously evoked vocabulary of representations, the end product one perceives after a laboratory test is carried out to the end is very far from typical representations in anatomy and physiology. Actually is quite the contrary. Stick figures are minimal representations of human bodies that serve different purposes in the process of shaping skills. And yet, despite seeking such forms of necessary reduction and simplification, stick figures are essential stages in body simulations. Apart from forging understanding of how healthy subjects move, stick figures contribute to shape specific "epistemic cultures" (Knorr Cetina, 1999), the engineering ones. Simplification itself is a necessary procedural step in engineering sciences, the aims of which are functional and oriented toward solving problems. This is a feature that obviously differs from medical sciences, mostly confronted with complexity. As one of the engineers recounted to me when I asked him about the logic behind conceiving exoskeletons for rehabilitation:

"The problem was that the people with disabilities after spinal cord injury could not move. And there is a technology to stimulate muscles. You can electrically, artificially stimulate muscles and this way they can move their limbs. But the control is not by the brain but by a machine which has to be programmed. And the challenge was to stimulate the muscles in that way that the people can move and that the people can move in a functional way. So, part of the hardship to stimulate is to know how to stimulate the muscles in order to get a meaning for movement. It has to stimulate the body in a dedicated right way to get a functional movement. I had to think about how movement works, how the muscle contracts, how we can model the human mathematically, because this can help to simplify the strategy. That was a given goal. And then, as an engineer you always try to formulate the problem, and then, to find solutions for the problem. You formulate subproblems and you try to find subsolutions. And again and again. You get new questions on the way to the goal which has to be solved. That is the task of the engineer: to look ahead and solve single technical problems. It's always a technical problem, a small technical problem. It's not so much the overall problem of the disability. Of course in the very beginning, you see the day and the people. But then, soon, you go to the subproblem in order to solve it. It's becoming technical and less social […]" (Eng1CH: 24).

That bodies engineered to inhabit computers in the form of stick figures and contributing further to processes of rehabilitation and assistance of people with motor impairments are elaborated from healthy people is a logic that may surprise at first

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sight. Yet, as the above interviewed engineer explained to me, the role of healthy people whose body values contribute to shape the algorithm for the robot, besides providing the very fleshy material and motor patterns, is to help detect anomalies or malfunctions of the devices. The simulation of healthy bodies for the rehabilitation of impaired ones reaches therefore a more involved level. What the simulation procedure does, besides "shaping" impaired bodies and training them to re-appropriate lost or damaged "body techniques," is play a safety role. Because impaired users, who usually have paralyzed limbs as well as sensation and perception deficits, cannot assess if the exoskeleton is working properly and thus aiding their bodies, healthy subjects instead provide this information to engineers. They may thus help in preventing malfunctions and injuries that impaired persons would otherwise ignore. As such, healthy test subjects have a critical role in guaranteeing the safety of use of these novel devices because they have the ability to warn when the devices function incorrectly. As I was explained by one of the users himself an engineer participating in a program for exoskeleton development at the time of the interview:

> "If a normal person can get in the exoskeleton, then it'll just move their legs. But if the exoskeleton does something wrong, then, the normal person could also move their legs to prevent it. Or, they could also feel that the machine is doing something weird that it shouldn't be doing. And able persons are more readily available. There are very few spinal cord injured people around. We have to set up appointments with the physical therapist and then get them to sign consent forms. So it's just easier to try it on people who are available" (RehaM2USA: 177).

Following this description, exoskeletons may be understood as "healthy bodies collectors", while essentializing them and transforming these very bodies into sentinels. As technological objects, not only do exoskeletons have the function to literally objectify healthy motor patterns; in addition, they conjoin a multiplicity of bodily experiences, scientific visions, and conceptions about health and impairment, and thus advance a further perspective of simulation practices that demarcate contemporary cultures of rehabilitation and medical ones. In this attempt, exoskeletons highlight how simulation in rehabilitative robotics relies on multiple levels of collaborative work to repair bodies and, as I will show in the following section, contribute to advance new understandings of how material corporealities are actually made (Gimlin, 2007; Shilling, 2005) in contemporary worlds of rehabilitation.

The body experiences of the healthy test subjects, the expertise of medical professionals, and those of the users as insiders of their impairments in the final stages of design, makes simulation a plural architecture. Its multilayered articulation further forges the limits of knowledge claims about human bodies in these very contexts, where the final aim is the long-lasting care and maintenance of achieved motor patterns, though this remains an open and unfinished project. Attaining the category of what Sherry Turkle names “fluent users of simulation” (Turkle, 2009, p. 10) is for the time being a difficult enterprise, as not all impaired users may benefit of training with exoskeletons. One reason is that neurological injuries concretely lead to a strong variety of profiles. Another reason is that fluency of use relies on many hours but also conceptions of “body work” and forms of intercorporeality, aspects that I will discuss in the next section.

3.2. Body work with exoskeletons and novel forms of intercorporeality

The main aim of designing and applying exoskeletal devices in rehabilitation is to transform forms of “I cannot” in human damaged bodies into forms of what I name temporary “I can”. The category of “I can” is a classical one in the phenomenological tradition (Husserl, 1989; Merleau-Ponty, [2012] 1945; Leder, 1990). If the “I can” in preliminary Husserlian definitions referred mainly to the possibilities entailed by the egological consciousness (Husserl, [1928] 1973), in later elaborations of this concept they were related in particular to the field of phenomenology of the body. The “I can” extended to embed our dispositions to act and interact (Gallagher, 2017). Our embodiment is the precondition of our active engagement in a variety of experiences, performing actions, or interactions with other people. As Shaun Gallagher notes in a recent study while discussing mainly perceptual experience with respect to the phenomenological potential of “I can,”

> “what it’s like to experience the color red or green is not just an abstract state of phenomenal consciousness – it is affected by, and it affects our postural readiness to act, which may be experienced as a feeling of discomfort or awkwardness, or alternatively, a feeling of extreme readiness pertaining to engaging in a particular action. Whatever we call such phenomena – qualia, hyletic experiences, somaesthetic factors – they delimit our perception and action possibilities, as well as our cognitive possibilities” (Gallagher, 2012, p. 97).

Exoskeletons in rehabilitative environments do not explicitly aim to transform perceptual skills, but motor ones, and more specifically motor-impaired ones. However, their impact on one’s own bodily capacities to act and interact are obvious, one of the first experiential layers exoskeletons modify being one’s “sense of agency.” According to Shaun Gallagher, the “sense of agency” refers to “the pre-reflective experience that I am the one who is causing or generating a movement or action or thought process” (Gallagher, 2012, p. 132).

One’s being paralyzed delimits a specific sphere of “what it is like,” “knowing how,” or being able or unable to. Obviously, what prevails in this situation is the “I cannot” or “I no longer can” (Leder, 1990, p. 83), the main role of exoskeletons being to achieve a durable impact on these aspects. Such transformations mostly take place in the confined space of a clinic or a lab at present, since users mostly have the possibility of working with an exoskeleton in these type of environments. Consequently, the capability produced by means of using exoskeletal devices is delimited both in time and space and usually carried under the supervision of such professionals as physiotherapists, although circumstantially engineers may assist to training sessions for the purpose of assessing the device's performance and its improvement. These limitations lead to conceive of exoskeletons as sequential bodily producers. Within the algorithmic forms conditioning these very productions, the simulation of healthy bodies, is central and at the source of specific forms of "body work." The process of building up temporary abled bodies in the confined spaces of specialized institutions involves precisely many hours of "body work," a type of "work" far surpassing the phenomenological sphere of one's own body. According to Debra Gimlin, who discussed this category in a classical study in which she analyzed cosmetic surgery (Gimlin, 2002), "body work" is crucial because it is related to work on the self. As she mentions,

> "the self that is enacted through the body is both a social construction and, at least at the level of cultural understanding, a distinctively individual possession. […] The body is fundamental to the self because it serves to indicate who an individual is internally, what habits the person has, and even what social value the individual merits" (2002, p. 3).

Clearly, the fact that exoskeletons are for the time being not widespread technologies impacts the generalization of self transformations. Yet as the findings in my fieldwork show, for some people with impairments, training with an exoskeleton even for only a thirty to forty-five minute session in a clinic strongly impacts the value of their bodies (Butnaru, 2021), and if one follows Gimlin's strong correlation between bodies and selves, also of their selves.[7] In the line of understanding selves as a collection of capabilities, skills, and a variety of forms of expertise, exoskeletons indeed rearrange them and enact them anew, despite limitations of accessibility, further limitations defined in terms of time and space, and their being obvious marks of dependency. Under these circumstances, the rehabilitation time and its sites become a synonym for reinventing one's own body and some of its phenomenological dispositions. What the fieldwork experiences show is precisely that during the training time experiences of former capability are actualized in bodies heavily impaired. Interestingly, this is a process deeply anchored in experiences of simulating other human bodies, and more specifically in entering, traversing, and copying the patterns of these very bodies, categorized as healthy, which are solicited to build up the

[7] The category of "self" is a very complex and debated one in phenomenology, as well as in social sciences. I will not enter the debates that oppose these two fields. My position is that selves are embodied, which is what has been defended in recent studies in phenomenology (Gallagher and Zahavi, 2008; Gallagher, 2011; Gallagher, 2017; Zahavi, 2005).

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algorithm. It is this feature that makes exoskeletons and their contained simulations specific intercorporeal instances.

The articulation of simulation in rehabilitative worlds with exoskeletons and its correlated body work (or forms of body work, since there is not one or only one form of body work) is based on the conjunction of experiential patterns of human motility that need appropriate codification and translation for the conception of the algorithm inside the robot. Translation is a necessary step in processes of simulation (Prentice, 2005, p. 854). As Konrad and Cepera note, “with computer simulation in general and agent-based modelling and simulation (ABMS) in particular, the complex reality of a system can be reduced to formalised and simplified rules” (2019: 242). One of the difficulties raised by “body work” with exoskeletons is this precise contradiction between the perspective behind simulation procedures that aim at generality, which characterize usually the third person perspective of experts and the specificity of the human bodies the exoskeleton needs to accompany, briefly put their very phenomenologies.

Within these fluctuations between material and immaterial patterns where simulation actually attempts to find its justification, the aim is not mere copying or reintegrating former “techniques of the body” (Mauss, [1934] 1973) that were damaged. Rather, what is sought refers to the elaboration of areas of subjectively articulated body knowledge that need to be invested anew, and where simulated motor patterns of healthy bodies are expected to overlap. This logic justifies the active existence of “body work” in rehabilitation centers and clinics provided with exoskeletal devices. Whereas “body work” may embrace a variety of forms (Gimlin, 2007; Shilling, 2005), among which are those discussed in Gimlin’s work (2002; 2010) whose empirical example concerns interventions in cosmetic surgery, that concretely and “fleshly” mark the limit between a “before” and an “after” of the human body, the “body work” with exoskeletons follows another type of logic. First, the “body work” with exoskeletons in clinics and labs is based on a consistent number of hours of practice that the bodies of the users need to withstand. Second, different from surgical interventions that usually happen once, the “body work” in rehabilitation is conceived of as happening for longer periods of time, the aim being the maintenance of skills or motor patterns, or the amelioration of anatomical functions. And third, besides the temporal and iterative aspects that underline that what exoskeletons do to the bodies they accompany is never completely achieved, the “body work” in this case is conditioned by undamaged possibilities that the bodies of the users may retain. This third aspect actually highlights the huge gap between the expected achievements and what the technological objects

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may currently offer[8]. As one of the interviewed engineers commented on this discrepancy regarding facts and expectations,

> "there has been a lot of hype around exoskeletons, you know. Because it is quite impressive to see people that cannot move their legs to be able to stand up. But […] there is a mismatch between what they hope to achieve and what is the reality right now. You know, ideally, in a few years, then things will get a lot better" (Eng14CH: 320).

Contrary to the use of other technologies for motor impairments such as wheelchairs (Winance, 2006; 2010), which are much more common and more immediately associated with the assistance of motor deficiencies, the use of exoskeletons and their correlated "body work" follows specific licenses. Interestingly, because of the generality of simulated motor patterns of healthy bodies, the aim is to cover the widest possible range of corporeal profiles. And still, simulation of healthy bodies may act as a selective factor. By this I mean that not all the people having spinal cord injury or stroke may have enough corporeal resources to enter the algorithmic copies of healthy bodies that the robot actualizes during the training sessions in the clinic or lab. Thus, simulating healthy bodies is a process related to forms of dis-simulation (Shin, 2021), by which I mean that despite the explicit goal of adjusting and improving injured functions of the human body, the current state of these technologies offers only partial answers for the needs of their projected users, not to say that literally exoskeletons are not "usable" by each and every body. One of the interviewees with a spinal cord injury concretely mentioned this detail in one of the interviews. He said:

> "Ideally, the target for exoskeletons is a young population, people who are not in the wheelchair for a long time, and who didn't develop bad habits. Because after a few years in a wheelchair, one develops bad habits. For instance, bones which are stiff, no possibility to move, lie down completely. So, for some people verticalization is not possible anymore and thus there is an incompatibility with the machine" (RehaM9FR: 211) (transl. from French).

Besides the very type of body, another limitation is, for example, the severity of injury of the users. If people with spinal cord injury or stroke cannot sustain the effort that the

[8] In a recent study *Robo sapiens japanicus* (2018), Jennifer Robertson briefly discusses her experience of one of the Japanese exoskeletons for rehabilitation from the company Cyberdine, namely Hybrid Assistive Limb (HAL) (Robertson 2018: 163-167), and notes that for the time being the use of this type of exoskeleton is relatively "challenging" (Robertson 2018: 167). Obviously Robertson's perspective comes from a person who is able and who has healthy motor functions and she pertinently notes the difficulties caused by the lack of fluidity between the movements of the robot and those specific to human bodies. Despite these difficulties there are some users who manage to regularly use some exoskeleton models, yet after many hours of training. It is in this context that I elaborated the category of "body work", a type of work which is highly specific and hence phenomenological, because each and every human body and each and every experienced injury are different and are different to compare.

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device imposes on them during a training session, this becomes as the engineers name it, a “contraindication,” which results in either the limitation of “body work” or its complete interdiction. Capability forms may indeed be recuperated and sustained with exoskeletal devices in cases of spinal cord injury and stroke, provided that they exist as residual functions, a condition which is usually assessed by medical doctors. As one of the interviewed engineers explained to me, when I asked her about the limitations in “body work” that exoskeletons may impose, she said:

> “We have some contraindications both for upper and lower extremity devices. One of the main contraindications is osteoporosis. If the patients have problems because the [name of exoskeleton] is an exoskeleton which really moves the legs of the patient and, so, the legs might be weak, then the legs may get fractures. So, this is really important because if the therapist trains a patient with severe osteoporosis it might happen that, I don't know, there is a problem. And the patient maybe stumbles with the foot on the treadmill and the tibia breaks. […] So, the therapists always have to take care that if the osteoporosis is too severe, maybe a [name of exoskeleton] is not the best treatment” (Eng10CH: 114).

The production of temporary forms of capability takes place therefore in a circuit where the exoskeleton acts as a corporeal translator at the core of which both simulation and dis-simulation procedures of healthy bodies mangle. This observation makes exoskeletons new adherents to what Andrew Pickering defined as the “mangle of practice,” a “dialectic of resistance and accommodation” (Pickering, 1995, p. xi) with a specificity: exoskeletons collect human bodies in the form of models[9], which further on are used as corporeal instruments for rehabilitation of neurological impairments. In this procedure of both scientific and subjective experiential translation that sequentially reforms the very possibility of how impaired bodies may materially experience themselves, novel forms of intercorporeality (Merleau-Ponty, [1945] 2012) emerge. Here the materiality of human bodies enters algorithmic procedures, which speak for their immateriality for the purpose of re-creating healthy motor patterns around rather than inside damaged ones. The simulation happens around the body of the user because unlike other medical technologies that are literally situated inside human bodies in order to help, adjust, or correct anatomical or physiological functions, exoskeletons are currently “exo,” not “endo”, although what they aim to impact is the “endo” aspect. They entail an algorithmic intercorporeality that is later at disposal for rehabilitation, facilitating some of forms of “body work” I previously evoked and with them the manufacture of temporary motor ability in rehabilitative environments. These processes identify current cultures of simulation and essentially rely on forms of

[9] For a discussion on models and their function as mediating instruments, see *Models as Mediators* (1999) Mary S. Morgan and Margaret Morrison (eds.). Cambridge: Cambridge University Press.

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distributed ownership and agency, despite their aiming at yielding subjective "sense(s) of agency" (and partially ownership) (Gallagher, 2005; 2012; 2017).

That intercorporeality is a general characteristic of how human beings act and interact with one another is an assumption with a long conceptual history to which the phenomenological paradigm I previously evoked made an extensive contribution (Zahavi, 2005, p. 147-163). However, the logic of collecting motor patterns from healthy bodies for the purpose of helping impaired ones elucidates that intercorporeality needs to be newly defined. One of the dimensions where intercorporeality may currently gain more prominence is provided by the current cultures of simulation and "multiple ownership(s)" (Leach, 2005) to which exoskeletons doubtlessly belong.

4. Conclusion

In keeping with this narrative, exoskeletons appear to promise the re-anchorage of deficient manners of acting and performing tasks, but also the transformation of corporeal characteristics thought to be permanently unrecoverable into actual possibilities. That is why I named them "wonder objects." While surfing the possible and the feasible, exoskeletons permanently switch between forms of "I can" and "I cannot" or forms of "I no longer can," to retain the terminology of Drew Leder (Leder, 1990). In these fluctuations, what these devices ultimately do is redraw forms and possibilities of how living with severe forms of impairments has transformed in the past decade and attribute further meanings to procedures of simulation.

Whereas the role of simulating practical scenarios may be reversible in some situations—take, for example, learning to fly a plane, or the formerly evoked example of the education of surgeons—the role of simulation in rehabilitation with exoskeletons reinvests this strategy and consequent conceptions of what it is like to experience back temporarily lost capacities. As Theodore M. Porter noted in a well-known study, *Trust in Numbers*, "any domain of quantified knowledge, like any domain of experimental knowledge, is in a sense artificial. But reality is constructed from artifice" (1995, p. 5). The corporeal productions that exoskeletons aim at bring this perspective to a further level. In their settings of action, explicitly delimited by time and space, rehabilitation exoskeletons re-articulate human bodies with impairments through human healthy bodies in an algorithmically sanctioned intercorporeal play. In doing so, they contribute to renegotiate corporeal boundaries beyond the experiential potential of human bodies.

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Improving Equality in Scientific Careers: The Care Factor Proposal

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Abstract. In academia, as well as in other spheres work, there exist some disparities. They are associated with discriminations based on ethnicity, gender, discipline and so on. A relevant issue concerns the hidden (male) cultural model and related tacit assumptions underlying the (academic) evaluation of the scientific productivity. In addition, concerning the latter, several research studies on care-giving highlighted the inversely proportional relation between care activities and scientific production, i.e. a slowdown on scholarly productivity. The latter could prove to be detrimental when the candidate takes part in recruiting or promotion processes, as the number of publications is often used as an important criterion in evaluation. Reconciliation policies and promoting family-friendly cultures, environments and workplaces are certainly useful tools to help dilute this effect. However, they require social and cultural changes that are (unfortunately) not immediate. Hence, practical proposals in the short and medium term to reduce inequalities in scientific careers are urgently needed. For this purpose, “affirmative actions” can help. One of these actions could be the use of the *Care Factor*, an index to weigh the scientific productivity of a candidate who is involved in child-rearing. It could be a transitional instrument, certainly not permanent, but useful to balance the gap between those who are involved in care activities and those who are not. However, the *Care Factor* should not be conceived of as a proposal to reward, but not to penalize those who care for children.

1 Introduction

In academia, as in other spheres work, there are some disparities. They are associated with discriminations based on discipline (e.g., some research topics are considered more mainstream than others are; some research methods more relevant than others etc.), on ethnicity, gender etc. On some of them, there is a significant reflection and a copious literature; on other attention, it has so far been less.

An issue not yet sufficiently explored concerns the relation between care activities and scientific production. Especially as the first could have an impact on the second. More specifically, how to grow the activity of care we can have a slowdown in scientific production. More-over, since the latter is one of the main criteria for hiring or upgrading a candidate, it becomes important to enlighten this relationship.

This correlation does not, in the first instance, pertain the theme of the genre, but who (man or woman) is engaged in care (so that both motherhood and fatherhood). Moreover, in the new generations care activities are (albeit slowly) further harmonizing,

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with a greater response of men to the responsibilities and demands from the domestic sphere.

However, since they are still women to be more engaged in the care, this correlation is particularly unfavorable to them. So practical proposals in order to reduce inequalities in scientific careers are urgently needed.

2 How the Scientific Product of an Individual is (Currently) Evaluated

Being publications (examined in their quality and quantity) an increasingly important criterion for evaluating a candidate who wishes to a job or an upgrade, it is important to carefully analyze the inner mechanisms of the evaluation process. This provides insight into how these evaluative mechanisms tend (often unconsciously) to discriminate the very people who are most involved in an activity of care, which (we assume) is the main cause of the slowdown in scientific production. Let us analyze this evaluation process.

2.1 Measurement?

Usually we hear about “measurement” of individual scientific production. However, the measurement is an operation allowed only

a) with variables that have *continuous* properties (e.g., time, weight, height, income, age etc.) and
b) where there is a *measurement* unit (then a predetermined amount of size, which has been conventionally accepted).

Only these two requirements, which must be present together, allow the measurement (see Marradi 1981, 1990 for a discussion).

Instead, more soberly, the evaluation of scientific production rests on other procedures or modes: counting, classification and reading (the content of a publication), which are not therefore measurements (see Table 1).

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Table 1: The three procedures in the evaluation of scientific products

Counts	Classifications (not countable)	Reading (the content of the scientific product)
• **h-index** (based on the number of quotations) • **number of publications** (above or below the median) • ***Impact Factor*** of journals, where the article has been published • **number** of readers and downloads for a publication, • **number** of tags, bookmarks, comments, tweets or blogging to assess the impact of authors or publications	• the **language** (preferably English) in which s/he published • if it is **books** or **articles** or **chapters** (of books) • whether with or without **referees** (in the case of publications on journals) • **taxonomy** of the journals (top, average, bottom journals, with preference of the top ones…) • **taxonomy** of publishers (with preference of prestigious ones…) • etc.	• Thorough reading • Fast reading • skim

The contemporary tragedy is that the counts and classifications are rapidly replacing reading, which should be the leading procedure. In other words, how do I evaluate an article if I have not previously read? How do I assess the scientific output of an individual if I have not read his work? In theory, it could not, but the bibliometric and classificatory *nouvelle vague* has invented shortcuts: just a few to count and classification, and you are done. In this way, two (useful but surely) peripheral modes compared to the content of a publication, now become the main procedures, losing the possibility to evaluate the **merit** of a publication.[1]

[1] This is precisely the criticism contained in the Declaration on Research Assessment (DORA), drawn up by a group of editors and publishers of scientific journals, gathered in San Francisco, December 16, 2012, at the annual meeting of the American Society for Cell Biology (ASCB). Since this declaration has been signed by hundreds of organizations (scientific journals and associations) and thousands of scholars. Joining DORA commits to supporting the adoption of scientifically correct

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So, evaluators and recruiters are flooded with an avalanche of publications to be *evaluated in a short time* (an oxymoron!), in the midst of so many other things that a scientist has to do. The result is that the scientific products of the candidates are not read seriously (except a few cases); but only skim, searching for the sound of scholarship. A humiliating practice for the authors of the publications.

3. Monitoring or Evaluating?

This reflection, on the (current) assessment practices of the scientific production of a candidate, makes us realize that perhaps (beyond the more or less intellectually honest intent) what evaluators and recruiters are doing is not a genuine evaluation. In fact evaluation it should be “a cognitive activity aims to provide a judgement of an action (or set of coordinated actions) performed intentionally/or being undertaken, designed to produce external effects, using the tools of the social sciences, according to strict and codified procedures” (Palumbo 2001: 59). If we accept this definition, in use in the evaluators’ scientific community, counts and classifications (the first two procedures) should not fully included in the evaluation because their result is not a outcome or a (subjective) judgment, but simply an output that could provide by any person (including an administrator!) who has been provided with instructions and a related grid (a sheet showing the top, average and low quality journals; another sheet with the ranking of the publishers, and so on). Unlike the expert (the scientist in the discipline or research area) is indispensable in the third procedure, one in which it is necessary to judge, discern, identify, understand, in a word 'evaluate', having read and examined the publication.

Unlike in the first two procedures there is little evaluation and much **monitoring**. The latter, like basic research, applied research (Palumbo 2001: 64), audit (Bezzi 2001: 65, 67), benchmarking, certification, social budgeting, is **not** evaluation. Indeed Bezzi (2001: 66) puts monitoring at the opposite of the evaluation. The evaluation includes the tasks of monitoring and audit, but is not limited to them; it goes further because it adds a critical judgment. Counts and classifications can therefore be only a pre-condition of the evaluation, an initial screening; not an assessment in itself.

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research practices evaluation. DORA contains 18 recommendations addressed to the different actors of the research world: funding agencies, institutions, publishers, organizations producing bibliometric data and individual researchers. One of them insists in eliminating the use of metrics related to journals - like Impact Factor- for funding, recruitment and promotions (or) as a surrogate measure of the quality, or to evaluate the contribution of the individual scientist, or decisions relating to recruitment, promotion and funding.

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4. Against Abstractive Evaluation: Desperately Seeking the Society

The two procedures, become queens in the evaluation of scientific products, fall into an abstractive evaluation pattern, divorced from the social dynamics, epistemologically naive, politically inexperienced and not reflexive. This pattern, apparently rational and transparent, does not take into account of how indicators are (socially) constructed, and which representations, mental models and tacit knowledge are embedded in them.

4.1 What Makes a Person a Good Researcher: a Problem of Conceptualization

All methodological textbooks teach that to conduct research is first necessary to conceptualize the phenomenon. In other words, to define the so-called ‘object of research’. I cannot start a research study on family or poverty, if I do not previously define what is a family (and we know how definitions are controversial and change over time) or who is a poor. In other words, what criteria I adopt to include that particular relationship between people in the category ‘family’ or what requirements must have a person to be defined as a poor.

The same applies to the evaluation of a researcher. **Before** evaluating a researcher, you must conceptualization who (or what) is a good researcher. **Before** choosing the performance indicators, we should discuss what the attributes (according to constructivism) or properties/characteristics (following realism) of the concept of ‘good researcher’ (the so-called 'intension') are. Instead, the common practice is moving in reverse: choosing indicators (in a confused, abstractive and naïve way, without reflecting about what is behind these cognitive tools, what is their cultural background) and then ex-post building the concept good researcher.

4.2. An Evaluation Without… Society

Existing tools for assessment of scientific production assess people as if they were impersonal data-bases, not as social actors. They assess them forgetting that they are... people (with biographies, social trajectories etc.). As if the authors and their products belong to two separate and unconnected worlds.

Instead, the assessment is primarily a social and political practice, that is guided by certain “theory-driven”, cultural (tacit and/or explicit), assumptions, by particular mental models (on who is a good researcher). Not a simple observation based on neutral formats and criteria. So, as Chen and Rossi (1981, 1989), Chen (1990), Weiss (1995, 1997), Pawson and Tilley (1997) and many others have long pointed out, the assessment is only secondarily a technical issue. One example is the conclusion of research conducted by the think tank New Economics Foundation (Nef), a group of 50 economists, famous for bringing in the agenda of the G7 and G8 issues such as

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international debt, whose motto is (significantly): Economics as if people and the planet mattered.

Starting from the assumption (therefore theory!) that there should be a direct correspondence between what we paid and the value that our work generates for society, Eilis Lawlor, Helen Kersley and Susan Steed (the authors of the Nef report) calculated the economic value of six different jobs, three paid very well and three very bad. As the authors explain in the introduction,

> "we take a new approach to looking at the value of work. We go beyond how much different professions are paid to look at what they contribute to society. We use some of the principles and valuation techniques of Social Return on Investment analysis to quantify the social, environmental and economic value that these roles produce – or in some cases undermine" (p. 4).

Following the criterion of linking salaries to the contribution of well-being that a job brings to the community, bankers (concludes Nef) ditch the society and cause damage to the global economy. Similarly comparing a garbage collector, a tax affairs lawyer, the former contributes with his work to the health of the environment through recycling of garbage, the second harms society because he intrigues how to pay less taxes to taxpayers. So, looking at the social contribution of their job, it turns out that the work paid less are the most useful to society.

5. The Tacit Assumptions of the Academic Evaluation: The Hidden (Male) Cultural Model

Given that the evaluation is primarily a theoretical activity, it is worth to try to explore the main cultural assumptions (tacit and/or explicit), the particular mental model of who is a good researcher. In the academic common sense, an ideal good researcher is one who:

- teaches a lot (and with a good quality of teaching),
- publishes many products (better if high scholarly ones, in the form of prestigious or, at least, peer-reviewed journal articles and books in innovative areas of research)
- conducts good research,
- wins national and international grants,
- participates at national and international conferences,
- accepts institutional duty,
- participates at the department intellectual life (seminars, conferences, etc.),
- etc.

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Any academic would subscribe (at least ideally) this list (Keith and Moore 1995; Pescosolido and Aminzade 1999; Golde and Walker 2006; Sweitzer 2009).

5.1. The Society Enters Evaluation: Assessment as if People Mattered

Ask ourselves now who could perform (equal intelligence) on all of these areas. Think that all can do it is utopian and takes us back to an abstractive model of evaluation. Unlike a sociologically plausible ranking would be:

1. single
2. person with partner, without children
3. person with partner, with 1 child (or a sick or disabled adult)
4. person with partner, with 2 children
5. person with partner, with 3 children
6. etc.

Leaving aside other possible combinations (like the partner away for work, the support of parents, wealthy economic conditions that allow babysitter ad lib etc.), because otherwise it becomes difficult to manage the complexity and treat it with standardized instruments.

Obviously, we are talking about people, not of men or women in particular. The variable gender (for the moment) does not come into play yet. And, when it will, it will make even more “social” the evaluation.

If this ranking is sociologically plausible (and we will soon see how it is) other questions arise:

- what is the cultural model underlying these evaluation criteria?
- what tacit assumptions are embedded in it?
- what is the underlying profile?
- maybe that Nobel Prize Rita Levi Montalcini (single) or the famous astrophysics Margherita Hack (with partner, no children)?
- is it reasonable to assume that those who have children, with the same intellectual capacity, has had a slowdown in scientific production (with a reduced capacity to do research and guarantee an institutional presence)?

5.2. Women Nobel Prize

An interesting case to document this hypothesis is the award of the Nobel Prize. How premise is interesting to note that only few women have been awarded the Nobel Prize (see Cole 1987, Wade 2002). In fact, the Nobel Prize and Prize in Economic Sciences have been awarded to women 47 times between 1901 and 2014 (only one woman, Marie Curie, has been honored twice). This means that 46 women in total have been awarded the Nobel Prize between 1901 and 2014, while men were … 814. Women’s creativity is underrepresented in science.

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But even more interesting for our hypothesis is to note that many of these women did not have children (Stemwedel 2009). Comparing (by the variables birth order, marital status, children, awards ─ as Fulbright, Rhodes, and number of honorary awards received ─ highest education level and Nobel mentor) the 11 female Nobel laureates in physics, chemistry and physiology/medicine between 1901 and 2006 with 37 males who received the Nobel Prize in the same area one year prior and one year after them, it was found “that female Nobel laureates were significantly less likely to marry and have children. When female laureates had children, they had significantly fewer children than male laureates. Female laureates also had fewer publications than their male counterparts” (Charyton, Elliott, Rahman, Woodard and Dedios 2011: 203). The authors conclude that eminent women scientists tend to choose the pursuit of scientific discovery over starting families more often than eminent male scientists.

One of the reasons is long well-known: the double burden. In fact, in the 1970s started the first reflections on the “double presence” (Balbo 1978) or “double burden” “double day”, “double duty”, “second shift” (Hochschild and Machung 1990). These expressions are to indicate the dual role of women: public and private, reproductive in the family and productive in the society. The concept tricot the idea of a squeeze of woman between dual responsibilities: to the family and that to his independence, represented by the work, which results in her own penalty. This phenomenon is found in all (of course with different intensities) companies and continents. In fact, men’s contribution, in order to alleviate double burden, is understood as an option for most couples, even those who share family responsibilities equally…male role in the allocation of family work is limited to a minimum necessary assistance (Jana 2011: 176-7).

If this phenomenon is still existing in the vast majority of women working in the academy, would be reasonable to ask for a correction, a weight, an adjustment (in the current assessment procedures) that takes into account the double burden, the number of children and their care-giving?

6. Social Policies to Reduce Gender Inequalities

Since the late 1970s, worldwide, they were launched public policies in favor of gender equality. There are different (some potentially complementary; other ideologically incompatible with each other) because of the different cultural and theoretical perspectives that guide them:

- affirmative actions (Shalev 2008; Marra 2014);
- social protection (services provided by the institutions of the welfare state, monetary transfers as maternity or illness allowances, retirement etc. – see Marra 2014);

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- public policies known as gender mainstreaming (Rubery 2002; Verloo 2005; Gornick and Meyers 2008; Knijn and Smit 2009);
- proposals by a more purely feminist approaches (Pillow 2002; Sielbeck-Bowen et al. 2002; Marra 2014), which consider differences between and within genders as irreducible and an asset to society, a resource to respect and promote balancing the pressures to homologation embodied in the social organization of the most advanced economies.

These four approaches are often difficult to reconcile. So much so that it has been suggested to go beyond the Feminist and Gender-based approaches (Marra 2014).

6.1 We Can Think of Something Faster*?*

Several studies (Barclay and Lupton 1999; Harrington, Van Deusen, Humberd 2011; Miller 2011; Jana 2011; Hook and Wolfe 2013; Kaufman and Bernhardt 2014; Rehel 2014, Pizzorno, Benozzo, Fina, Sabato and Scopesi 2014) show that the traditional type of division of roles in child rearing is changing. It is emerging a new model, in which there is greater equality in dealing with couples double careers: more and more fathers participate at the family life and are involved in caring activities (Marotte, Reynolds and Savarese 2011). In addition, social and conciliation policies (Marra 2012), which help the rebalancing of care activities between gender roles, are increasingly spreading: flexible regulation of work hours both for men and women; increase and improvement of health services; better reconciliation practices for women and men; in the State, in the businesses, in trade unions and in the civil society (see Gasauka 2011). Though the recent pandemic caused a lot of re-traditionalization regarding childcare between fathers and mothers.

However, these changes are slow and the effects of these policies manifest themselves only over decades. Waiting for these effects, could we instead introduce, immediately, some corrective to reduce (at least partially) the existing inequality, particularly by the scientific production of the mothers, which (as we have seen) is often the first criterion used to evaluate a person?

7. Towards a Care-sensitive (and Mother-sensitive) Assessment

If the care-giving involves a slowdown in scientific production, then it needs an evaluation that takes it into account, which is care-sensitive.

However, because men and women (for the moment) do not participate equally to the child-rearing and family responsibilities, it becomes necessary that the assessment should be more mother-sensitive. If men and women are different (and often unequal)

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in society, we cannot assume that the effects of this diversity (and inequality) are suspended when we turn to scientific production. The same applies to the mothers. However currently there is little attention toward a differentiated assessment of the scientific production, so pretending that in this respect men and women are equal.

7.1. Unfortunately, For Mothers ... Few Data

Researchers who compared the scientific production between men and women (to see if there is a real difference) rarely report the data about the fact that these women have or not children. There are few academic data which include this information and have the related variable that would be very useful for a more accurate assessment.

In fact, on the side of the scientific production, it does not seem reasonable to hypothesize differences between men and women if both childless. Instead, the discussion would become more interesting if we could “discover” if children (in addition to diseases, care of parents, lack of livelihood etc. which here we do not consider) are a possible and important cause of the slowdown in production scientific (and the difficulty of doing research, participate in the institutional life of the department, conferences etc. which, again, here we do not consider). Just now that many investigations in different Countries show that child-rearing is still strongly attributed to the mothers.

Unfortunately, current research and comparisons rarely outsource this data and therefore do not help us to understand whether there is an impact of children on women's scientific production. For example, Tower, Plummer and Ridgewell (2007) conducted a study on top (according to them) six journals in the world, as rated 2006 Thompson 'ISI index. They chose two for each category: 2 in science (Science and Cancer Journal for Clinicians), 2 in business (Academy of Management Review and Quarterly Journal of Economics) and 2 social sciences (Archive of General Psychiatry and Harvard Law Review). Leaving aside the questionability of this selection (for example I am not sure how many social scientists know the existence of the last two journals...), they find no difference (in 2005) in productivity when the percentage of the women participating in the academic work force is factored in: 30–35% of participation rates in academy university position and represented almost 30% of the authors in the top tiered journals. In addition, they did not find any significantly statistical difference in journal Impact Factor ratings between women and men. This is an example of abstractive statistical analyses, totally decontextualized. Except that their analysis covers six top journals only (so the generalizability of these results should be at least cautious), the authors do not check if those women have (or not) children. They take into consideration only the (abstract) variable ‘gender’ without any contextual analysis to understand the biography of these women and men (age, marital status, children,

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etc.). The same 'bugs' is in Rothausen-Vange, Marler and Wright (2005) and Dasaratha, Raghunandam, Logan and Barkman (1997).

So there remains only look comparative research between men and women, and then weigh these results via a virtual or "thought experiment" (*Gedankenexperiment*), with the use of 'counterfactual' conditionals (Van Dijk 1977: 79-81), a type of research used in economics, physics, cognitive sciences, history, etc. (see Gobo 2008: 151-152).

7.2. Women's Scholarly Productivity

Much of the literature on work/family issues in academia suggest that women with children have a harder time maintaining an ideal career because of the difficulty of combining work and family activities, both of which are regarded as "greedy institutions" (Hochschild 1975). Women "are expected to (and often do) take on more childrearing and housework responsibilities. If separated or divorced, women are more likely to be the custodial parent. There is considerable literature that women academics are hampered in their efforts to have an ideal career" (Spalter-Roth and Van Vooren 2012). According to a report from the Committee on the Status of Women in Sociology (2004): "Women may face serious disadvantages. Careers often are built …around a model of a worker who has no competing responsibilities to work and is able to devote full attention to (usually his) professional life. Persons who do not conform to this pattern of the unencumbered worker will be disadvantaged in achieving success within the profession".

In a study of doctoral students at the University of California, over 70 percent reported that they considered academic careers in universities unfriendly to family life (Mason 2012). Women with children "may be unable to regularly stay late to muse over intellectual questions with colleagues at the office or a local pub, but instead may have to pick up children from school or day care or return home to prepare dinner" (Spalter-Roth and Van Vooren 2012). In addition, women may sometimes need to bring the baby to class with them (Kennelly and Spalter-Roth 2006).

Research suggests that parenting within the academy is a gendered phenomenon. Mason and Goulden's (2002) widely-cited study of a nationally representative sample of PhD recipients between 1973 and 1999 finds that raising children, especially early in one's academic career, has a negative effect on women's but not men's careers: women who have children are more likely than men with children to have marginal or alternative careers.

However the research on women's the scientific productivity offers other controversial results, and not always easy to interpret. If on one hand women begin to be more productive when the children are older, more independent and less in need of care Kyvik (1990), on the other hand the same Kyvik, and amazingly the same

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article, states that both men and women, married and divorced people are more productive than singles.

A datum not credible, in the light of the above statements. As it is the next result: women with children are more productive than women without children (Kyvik 1990). These are statistics out of context, without an account of social dynamics. In other words, it would be important to know: who are those women with children? How many do they have? 1, 2 or 3? Have they domestic help? To which social class they belong? Without this information, any interpretation appears shaky.

Instead, to Long, Allison and McGinnis (1993) result that although men and women start out as assistant professors with similar productivity, after 6 years men have significantly more publications. Kyvik and Teigen (1996) notice that in the span 1989-1991 (of their database), men had on average 6.9 articles, while women 5.6 (20% less); in the same period (1989-1991), male faculty member under age 40 published twice as many article equivalents than their female counterparts, whereas for faculty over age 40 the difference is small (10-15%) (Kyvik and Teigen 1996).

From this research, although not always consistently, it begins to emerge with some clarity the differences between men and women.

Ward and Wolf-Wendel (2012) did a longitudinal study, interviewing over one hundred women who are both professors and mothers, and examining how they navigated their professional lives at different career stages: how women faculty on the tenure track managed work and family in their early careers (pre-tenure), when their children were young (under the age of five), and then again in mid-career (post-tenure) when their children were older. The findings suggest that family plays a role in how people develop in their academic careers, just as careers play a role in how people evolve in their family.

7.3. Women and Bibliometric: What Happened in Italy?

In 2012, in Italy, the National Agency for the Evaluation of the University System and Research (ANVUR) settled (by ministerial decree) the minimum requirements to become a full professor. Shortly after Corsi and Zacchia (2013) did a simulation by applying the ANVUR's bibliometric "recipe" to the scientific production of the women economists, to see how many of them (already faculty and potential candidates for promotion to full professor) satisfy the criteria established by the ANVUR. The result was surprising.

If we look at the median of journal articles and book chapters, out of a total of 301 female economists (including 110 associate professors) only 22% of lectures and associate professors satisfy the first requirement, which had a median equal to or greater than 8. Unlike for men the percentage of success is 35%. If we look at the median of the books, only 3.6% of female lectures and associate professors had published at least one monograph over the past decade. In addition, in this case the percentage male was higher and equal to 9%.

Finally, if we monitor the median of publications on top journals, the criterion of excellence of the economic disciplines SECS-P01/P06 ranges from 0 (in science of finance, economic history, history of economic thought) to 6 publications (Econometrics) in ten years. Although this was a poor coverage of the top journals in the Econlit data base, only 26% of female economists had at least one publication in the past decade included in the list of the requirements of “excellence”: specifically, 25% of associate professors and 27 % of lecturers. In this case, the gender gap was more pronounced; because about 90% of men had at least one record in the last ten years published a top journal.

7.4. Causes of Gender Disparities in Academic Publishing

In literature, the underproduction of academic women in research outcomes have been pointed out in:

- Women and men tend to collaborate with co-authors of the same sex; because there a relatively few women in faculties, women have more difficult to find co-authors (Ashcroft, Bigger and Coates 1996; Suitor, Mecom and Feld 2001; Bentley 2003).
- Females are more likely to work in non-tenure track, part-time and temporary positions, to work in teaching colleges… less time for research and publishing (Dasaratha, Raghunandam, Logan and Barkman 1997; Mathews and Andersen 2001; Robinson 2006), more involved in service activities at the expense of research (Dasaratha, Raghunandam, Logan and Barkman 1997; Maske, Durden and Gaynor 2003; Corley and Gaughan 2005; Robinson 2006) disadvantaged by family responsibilities (men spent more time in university and less at home, even among married faculty), especially during child-rearing years (Mathews and Andersen 2001; Bentley 2003; Suitor, Mecom and Feld 2001).

These causes are slowly removing. However, they take a long time, and social and cultural changes are not easily predictable. Therefore, it would be necessary to do something now.

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8. Contextualizing Indicators (and Consequently Factors and Indices)

To accelerate the achievement of equality in scientific careers, it is necessary to adopt different criteria for the evaluation of CVs, and in particular for the scientific production. If, as the literature has documented, men and women are different (and diversity management is now a reality), it is not clear why they should be treated as equal.

To this end, the proposals can be many and diversified. If a candidate is strongly committed to child-rearing, it could (for example) normalize her/his scientific production by the number of children[2]. That the weighting can be reasonable is testified by the practice (now widely accepted and published) of normalizing the scientific production for the age of the candidate. So, we can assume different remedies (even standardized as weights, corrective coefficients, adjustments, normalization etc.), that take account of social dynamics and inequalities in behalf of those engaged in activities of care, in order to better assess the scientific production. For example:

1. To normalize, to attribute a score, an additive weighting etc. to those who have children or
2. To give priority to the quality of publications, rather than quantity: candidates could indicate three publications (which they consider the best, the most innovative, etc.) and the assessment will be on those only. So at least the referees will read them ... what they do not do when they receive 20 publications
3. To give space in the cv for quality management (practical skills, multi-tasking, negotiation skills, ability to reconcile different commitments etc.) that come from playing a role of mother/father strongly present in the family (see 11)
4. To make a multidimensional assessment of research (see Ferrini and Tucci 2011).

8.1. The Multidimensional Assessment of Research: the R Factor

The economists Ferrini and Tucci 2011, in proposing a multidimensional evaluation of research, start from two very “social”: assumptions (2011: 27-28):

[2] Obviously taking into consideration that the number of children owns cardinal properties apparently only: in fact three children are not 3 times 1 son. Again social dynamics should be taken into account, because the burden of caring three children depends on many factors: whether there are some twins, or they have few or many years apart from each other ,etc. That is why when the society will enter also in mathematics will be (welcome, but) always too late.

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1. The publication of articles is only one aspect, albeit important, of a researcher's scientific activity;
2. There are a number of activities, not always visible (and not always transformed into articles and citations), which nonetheless contribute to scientific progress.

To take better account of these two assumptions, they have construct what they called index R-factor.

It consists, in turn, by the following sub-indices:

- Articles published in journals index
- Monographs and essays index
- Grey literature index
- Coordination activities (conferences, research groups, coordination, doctoral classes, theses supervision) index
- Dissemination activities (seminars, conferences etc.) index
- Type activities publishing (journal editor, board member etc.) index
- Administrative activities (dean, chair, coordinator, director of research centres) index.

But we could put (albeit not required by the authors) also:

- The amount of teaching hours
- Annual number of exams
- Number of theses and dissertation tutored
- etc.

As we can see, the term "evaluation" (attributed to this proposal) is very stretched, being nothing less (and no more) of a complex monitoring. However, the proposal looks very interesting and fruitful. In it would look a Care-factor index, built on:

- Number of children
- Children age
- Health status of children.

While taking into consideration other indices (such as parental capital, economic capital, etc.), even if significant, it could be complicated.

9. The C Weighting and its "Enemies": Men and Women

Although there is a broad consensus on the need to balance the parental roles, then when we move to operationalize this need (through technical proposals) various opposite claims arise.

The main "enemies" of the C weighting are primarily men (especially in the Latin Countries, basically more reluctant to split care practices with their partner) because it is reductively seen as an advantage (exclusive) for women. In fact, it is difficult to make

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understandable to men that it could be applied also to a father who decides to spend more time with children and family. It is no coincidence that, al-though in many Countries there are rules allowing fathers to take advantage of parental leaves (for child-rearing), requests for such leaves are scarce: many men are ashamed to express this desire and prefer to give the benefit up rather than be exposed to jokes and macho criticisms by males (and also by some female colleague).

A second aspect concerns the competition between universities: if the goal of an university is to maximize its results, it will tend to recruit candidates who publish more, do more research, more education, are more institutionally present etc.; why should hire or promote career advancement for those who (like women), probably, is less productive? However this type of reasoning (tacitly quite spread) is based on a very limited rationality, unable to think globally, because ultimately the universities stand on (both economically and educationally) on students. Moreover, today children could be the students of tomorrow. If for someone the reproduction of the species cannot be a positive value for the community (therefore as such not be positively evaluated) the fact remains that someone has to take responsibility for this task. Of course, we can decide to discourage reproductive activity to scientists and delegate it to unemployed, poor, migrant people etc. But at least that this (aberrant) plan needs to be made explicit and not only tacitly active in recruiting practices.

It may seem paradoxical, but also quite a few women waves in front of the C factor (as they still are, or have been for years, for the affirmative actions). One such feature is the “wonder women” (by the 1941 famous comic): mothers who spent their lives doing somersaults in balancing work and family and that, in the face of enormous personal sacrifices, “they make it”, that is became professors. They do not believe in the correlation that to more children follows less scientific productivity. Indeed they think that if they made it, then other women can do, thus entering into a macho loop that damages the younger generations of women (who, not random, have raised the age of motherhood or chose not to procreate). Therefore, they believe that mothers do not need affirmative actions to “tear up” the men’s competition.

10. Conclusion

Several researchers on care-giving highlight how it has an impact on the scientific productivity of a scientist, causing a related slowdown. The latter could prove to be diriment when the candidate takes part in the selection (often based on the criterion of their publications) for recruiting or promotion.

Reconciliation policies are certainly a useful tool to dilute this effect. Also promoting family-friendly cultures, environments and workplaces are important, and institutions of higher education are increasingly recognizing that being “family friendly” is an asset

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in terms of recruiting and retaining top faculty members (Evans and Grant 2008; Ward and Wolf-Wendel 2012; Mason, Wolfinger and Goulden 2013). However, they require social and cultural changes that are (unfortunately) not immediate. So practical proposals, short and medium term, in order to reduce inequalities in scientific careers are urgently needed. Affirmative actions such as those active, for ex-ample, in the company law where the boards of directors of listed companies and publicly owned corporations are required to have at least 1/3 of women. They are affirmative actions of short or medium term (e.g., valid for 10 years) within which it is hoped to achieve the goal of removing the obstacles that have so far limited the access of women to leadership roles, encouraging a process of cultural renewal in support for greater meritocracy and growth opportunities. Through these actions thousands of women had (and still have) the opportunity to take on leadership roles (although it would not hurt also extend this rule to academic staffs such as the Senate and the boards of directors of the university).

One of these affirmative actions, in the academy, could be the use of the Care factor, a tool to weigh the scientific productivity of a candidate who bears the child-rearing. A transitional instrument, certainly not permanent, but useful to balance the gap between those who are involved in activities of care and who is not.

However, the Care factor should not be conceived as a proposal that rewards those who care for children; unlike, it is not meant to reward, but not to penalize those engaged in care. Not only. The care activity should be enhanced even further and become one of the different recruitment and promotion criteria. In fact, the child-rearing is not to be conceived exclusively as a burden, a subtractive activity not related at all within academic activities. Unfortunately, as Ward and Wolf-Wendel (2012) write, much of the existing literature on balancing work and family presents a pessimistic view and offers cautionary tales of what to avoid and how to avoid it. In contrast, child-rearing is bearing skills that the academy, like every other working sphere, badly needs. As Balbo (1978) theorized, the “double presence” is a way to “pass through many worlds” and thus be more innovative in both areas (work and family). Competences and practical skills learned from juggling in many areas, from negotiating and reconciling different needs to mediating between different instances come in handy especially in collective dimensions of the research work, as well as in the management of the university.

That the idea of a Care factor is not so implausible is witnessed by Acumen, an EU Seventh Framework Program funded European project, which aimed to find assessment parameters, not so much of the research as the work of researchers. For example, in its *Guidelines for Good Evaluation Practices* (April 2014), the calculation of the academic age is based on a conventional value which takes account of the number of children raised (p. 10), of special allowances and other ‘penalizing’ factors (like diseases, part-time jobs etc.).

The dream is that become popular experiences such as that experienced by Carol V. Robinson: she went to work at age 16, then graduated and take a bachelor's, a master's degree and a Ph.D. in chemistry. Then she left the university for eight years to raise three children. On her return, by her research she gained a professorship at Oxford (the first of a woman in chemistry) and countless awards, including the *Dame Commander of the Order of the British Empire*.

She succeeded without the Care factor. However, it is also an isolated case. Can we do something to make it more widespread? The *Care* factor goes in this direction.

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Normative Objects in Educational Infrastructures[1]

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Abstract. This paper describes open learning and teaching materials, so-called open educational resources (OER), as visualizing, economic and normative objects, and classifies these into a plenum with interwoven practices and arrangements of material (Schatzki). The plenum determines how the actors, their socio-material practices, and the associated political and technical frameworks each generate different interpretations of OER for the actors. The discussion is based on a case study of a video platform providing academic content. The empirical example, studied via document analysis and content analysis, of the TIB AV portal as an educational infrastructure offering videos of scientific conferences and teaching as an online service shows how the normative requirements to open educational resources are produced by the infrastructure. The paper focuses on the argument that the normative dimension of OER be part of material arrangements. The normative OER model is implemented in the infrastructure, while the social norms of openness are provided by the service. OER in terms of normative objects embodying the norm of openness are produced performatively through repositories.

1 Introduction

This paper shows how learning and teaching materials can be framed as different objects of knowledge: as visualizing objects, as economic objects and as normative objects. Open learning and teaching materials were first labelled “open educational resources” (OER) in 2002 by UNESCO and a global movement (community) has since developed around this concept. An early initiative in 2001 is MIT OpenCourseWare.[2] An online open publishing platform for educational materials from MIT (Massachusetts Institute of Technology) courses. For 20 years the non-governmental organization Creative Commons (CC) has designed license models to enable the practice of sharing knowledge.[3] In 2007 the Cape Town Open Education Declaration issued a principle, strategy and commitment to spark dialogue, inspire action and help the open education movement grow.[4] The normative aspect is thus acknowledged. Nevertheless, OER is a minor phenomenon in higher education. Research in the activist field of the *open movement* has a mostly technical focus on implementing infrastructure. This

[1] I want to express my sincere thanks to all reviewers of the paper for elaborated and helpful feedback, and the conference organizers and participants for fruitful comments within the session.
[2] https://ocw.mit.edu/
[3] https://creativecommons.org/
[4] https://www.capetowndeclaration.org/

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contribution wants to move the focus to the socio-material arrangements of infrastructure. Seeing OER as normative objects: does the digitalisation of learning and teaching materials based on OER principles influence the concerns of teaching and learning in terms of content, location or method? This question creates a discursive framework for deciphering the digital nature of the mediality and performativity of digital educational infrastructures provided by these learning and teaching materials and asks what they achieve in their digital materiality, and how they pre-configure the interaction order of the participants and their practices. The normative model that is inscribed in this form of digital learning objects is explicated in the definition of open educational resources.[5] The example of the AV portal of the German National Library of Science and Technology (TIB) shows how this model is reproduced performatively in digital educational infrastructures. The TIB AV portal is an online service providing academic videos with a focus on technology, mathematics and natural science, including lecture and conference recordings as well as (open) audio-visual learning and teaching materials.

Below, the open educational resources will be followed as actors, in line with Bruno Latour's "follow the actors" (2005, p. 12). First, OERs will be described using the UNESCO definition and framed as normative objects. This will be framed by drawing on Theodore Schatzki's practice ontology of the plenum of practices and material arrangements (2016). A crucial contribution of ontologies to empirical analysis is their provision of concepts and ways of thinking that help conceptualize topics and objects and formulate descriptions, explanations, and interpretations (Schatzki, 2016, p. 40). Therefore, socio-material, praxeological investigations to take the plenum of practices and material arrangements seriously and develop concepts that can grasp its nature and processes (Schatzki, 2016, p. 40). The concept of practice also enables questions concerning the reproduction and transformation of cultural orders which offer actors a meaningful scope for action (Schäfer, 2016, p. 10). Based on the materiality of practice, the interactional orders in the production of OER can be shown in the use of objects and symbols.

2 Open Educational Resources as a Concept and an Object

Open educational resources can refer to texts, images, graphics, course plans, slide sets, audio and/or video recordings, scripts, textbooks, etc. The term "open" implies that this educational material should be freely accessible. Since OER are primarily a

[5]As can be seen in Downes (2001), the term "learning objects" focuses on the technical conveyance of learning and teaching materials. In its technology-conveyed capacity as "resources for distance education worldwide", it precedes the term open educational resources in a certain way.

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digital phenomenon, this means that the material should be: (1) available online without such barriers as paywalls or membership; (2) in file formats that do not require the use of software fenced off with paywalls or membership; and (3) available under an open or free licence (such as the Creative Commons licensing models) where the author universally releases extensive usage rights, for example the right to reproduce, redistribute and/or edit the material. So, they have the practice as their goal and law as their means. In their materiality and mediality, open educational resources are everyday learning and teaching materials available in various media (speech and image representations) and materialities (sounds reproduced through speakers, light shed through projections, paper and ink, blackboard and chalk).

In the open educational resources movement[6] (Knox, 2013) which is shaping the OER discourse, the UNESCO definition is usually (2019)[7] used to describe OER: "open educational resources are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions." This definition incorporates two specific sets of standards: First, social norms of open and public access, i.e., the first and second implications of the term "open" described above. Second, legal norms: copyright applies to all educational materials as works for the protection of intellectual property, but the free licences contained in OER represent a universal usage contract in terms of copyright law. The use of free licences requires identifying the materials as OER via a symbol, which nevertheless does not constitute an OER label per se.

In addition to these sets of norms inscribed in the definition and the term itself, the OER model contains two normative promises that UNESCO formulates on its website (2019): "UNESCO believes that universal access to information through high quality education contributes to peace, sustainable social and economic development, and intercultural dialogue. OER provide a strategic opportunity to improve the quality of learning and knowledge sharing as well as improve policy dialogue, knowledge-sharing and capacity-building globally." The normative promises contained in OER as learning and teaching materials framed in terms of educational policy are: First, the promise of equal opportunities and fairness in education. Open educational resources are intended to open up education to everyone. Second, to increase the quality of education; education should convey current and true knowledge. Open educational resources make a promise to "decentralize, democratise and emancipate" education with "digital technology utopianism" (Dickel and Schrape, 2015). These inscriptions

[6]The field of the open educational resources movement is interwoven with other movements such as open source, open access, open data, open content and open science.

[7]In the field of the open educational resources movement, OERs are defined at various points by different activist institutions and people, which in essence do not differ or differ only slightly in wording.

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and promises express the politically framed model of OER, to which I will return in the application of the plenum of practices and material arrangement of open educational resources.

OER as visualizing objects: I use the term “visualizing objects”, to grasp the basic function of learning and teaching materials. Visualizing objects enable knowledge to be conveyed by showing them with the help of their material and medial properties. Rheinberger (2010) shows how different modes of visualization convey scientific knowledge (“epistemic imaging strategies”). This can take different forms: (1) the interweaving of instrumental technologies, scientific objects and corresponding forms of visualization, (2) their presentation in exhibitions and lectures, or (3) descriptions in academic texts. Visualizing objects can medially represent epistemic objects (Knorr Cetina, 2001) and didactic objects (Kalthoff et al., 2020).[8]

OER as economic objects: if one considers copyright and the property rights associated with it, OER should be considered with regard to their value as intellectual property and, if applicable, any devaluing. In the open educational resources movement, it is assumed that OERs are created by teachers (and learners) in the course of their everyday teaching/learning practice.[9] According to Marx (2013, pp. 49–61), the teachers’ everyday work products become commodities for which socially necessary working hours were expended. By publishing OER under a free licence, teachers (and learners) as content deliverers exercise the property rights in unusual ways by granting everyone far-reaching non-exclusive usage rights free of charge, to the resources and thus to their work product. In line with the OER concept, this waiver is free of charge. In this way, OERs, as Marx might put it, lose their exchange value as a commodity, which no longer corresponds to their real value relationship.[10] This economic perspective is interwoven with the normative perspective.

OER as normative objects: teaching and learning materials become promising through the normative promises of OER. Turner (2010, p. 16) notes that normative objects contain tacit rules hiding behind other rules. Nonetheless, these rules are necessary. But in contrast to Turner’s understanding of normative objects where their tacit rules make them necessary and able to do things that explicit objects cannot do,

[8]All epistemic objects and didactic objects can also be visualising objects. However, not all visualising objects are epistemic objects and didactic objects.

[9]It is inherent in the idea of OER that these new resources are in turn created from existing OER. The users should, to a certain extent, find themselves in a role of prosumers, as producers and consumers in one. The lecturers, as content deliverers, have to deal with the infrastructure and thus in the second level with the models implemented by technicians and engineers.

[10]A common argument for this is that the positions of people who teach at universities and who produce the material are already publicly funded. Hess and Ostrom (2007)) plead for “understanding knowledge as a commons.” For example, the Cape Town Declaration ((2008)) demands: “Making publicly funded educational resources open to the public by default is not only a just and fair practice, it also unlocks benefits for society.”

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the normative rules of OER are not hidden, but are a prerequisite for their creation and labelling. However, they take a back seat to the primary functions of OER as visualising objects. At the same time, visualising objects only become open educational resources through normative framing and labelling through open licences. On the other hand, the normative framework of OER directly influences their meaning and value as economic objects.

3 Plenum of Open Educational Resources

Schatzki (2016, pp. 28–29) identifies three lexical commonalities in practice theory: (1) “the term 'practices' is central to their theories and analyses of social phenomena”, (2) “practices [understood] as social in character, at least in the sense of being something carried out by indefinitely many people”, and (3) “social phenomena such as organizations, power, science, education, and transportation are understood as constellations of, aspects of, or rooted in practices.” Practices are collections of actions and sets of rules and resources (Giddens, 1979; Schatzki, 2016, p. 29). In “institutional sectors such as economy, polity, law, and discourse are distinguished by which of the three structural types of rules and resources (signification, domination, legitimation) a given sector organizes” (Schatzki, 2016, p. 29).

Bearing that in mind Schatzki (2016, p. 31) defines practice ontologies as flat ontologies, “because (1) they treat practices as the central element in the constitution of social phenomena; and (2) practices are laid out on one level.” Schatzki rejects ontologies that distinguish between two separate levels of the social, i.e., a “micro” as the locus of social interactions and “macro” as the locus of social structures. Practices are to be understood as open, “spatially-temporally dispersed sets of doings and sayings organized by common understandings, teleo-affectivities (ends, tasks, emotions), and rules” (Schatzki, 1996, 2016, p. 32). Material arrangements are “linked bodies, organisms, artifacts, and things of nature” (Schatzki, 2016, p. 32). “Practices and arrangements form bundles in that (1) practices affect, alter, use, and are directed toward or are inseparable from arrangements; while (2) arrangements channel, prefigure, and facilitate practices” (Schatzki, 2016, p. 32). The “site of the social” lies in these bundles (Schatzki, 2002). There are six types of relations between practices and arrangements: causation, use, constitution, intentionality, constraint and prefiguration (Schatzki, 2016, p. 32).

According to Schatzki (2016, pp. 32–33), “The objective spatial-temporal spread of the plenum of practices and arrangements defines the boundaries of the possible objective spatial-temporal extensions and shapes of social phenomena”, which means that no priority can be given to the local situation. This is in contrast to Erving Goffman (1983) ethnomethodological and phenomenological approaches, which always

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emphasize local situations. As Schatzki writes, “The activities, entities, rules, understandings, and teleologies that are at work in any interaction or local situation are elements of phenomena - practices, arrangements, and bundles thereof - that stretch over time and space beyond such situations. Indeed, these items often come to be at work in interactions and local situations because they are components of practice-arrangement bundles” (Schatzki, 2016, pp. 32–33). Therefore the social does not exist separately above this plenum and macro and micro are not definable levels of the social (Schatzki, 2016, pp. 32–33). Schatzki rejects the perspective of Geels and Schot (2007, p. 406), who view the macro level as stabilised, material infrastructures which, as “gradients of force”, make it easier or more difficult for people to perform certain actions within them. Schatzki (2016, p. 38) says it would be “a mistake to shear off the material dimension of society and to reify it as a relatively hard form that shapes social life”. The social consists of bundles of practices and material arrangements, the material dimension of which is considerably malleable. Arrangements continually evolve with and as part of changes in bundles. The material dimension also affects activities in a variety of ways. Only nature can be treated as relatively immobile.

Schatzki (2010) describes the bundles of practices and material arrangements in an essay relating to horse breeding in the bluegrass region of Kentucky. It shows how the material participates in the social. The interweaving of practices and arrangements in horse training is connected and intertwined with those of horse breeding, horse trade, stud farms, and equestrian sport itself. The interrelationship between the material and natural entities is described as follows: “The pond makes it easy to let thirsty horses get a drink, hard to lead horses directly to the barn from the paddocks (i.e., through the pond’s middle), and invigorating to gallop one’s mount through its shallow end” (Schatzki, 2010, p. 140). Based on the history of the region, he develops the transformations of these webs (Schatzki, 2010, pp. 141–144) from the arrival of European settlers and their farming practices to the acquisition of food, the spatial-temporal cultivation of plants and the landscape, the equipment used, and the work practices used. Up to the region’s transformation into a tourism region known for its horse breeding and the associated material facilities of horse farms and riding and sightseeing practices.

Theodore Schatzki (2016) suggests a plenum of practices and material arrangement as a practice ontology. Ontology is the science of being, it centers on the categorization of the being and the fundamental structures of reality. It intends to create a classification system of basic types of entities (concrete and abstract objects, properties, issues, events, processes) and their structural relations. Thus, practice theory is always ontology. However, what are the entities and structural relations of the social? Figure 1 shows the plenum of practices and material arrangements grouped around the phenomenon of open educational resources. Hilmar Schäfer (2016, pp. 10–

11) describes, following Andreas Reckwitz (2006), how practice theory, as the integration of interpretative and structuralist cultural theories, leaves two questions unanswered: (1) What options do participants within cultural orders have? (2) How do cultural orders, their reproduction and transformation develop? This gives rise to three analytical dimensions of socio-material practices that I would like to add to the plenum of practices and material arrangements: action capabilities, transformation and reproduction.

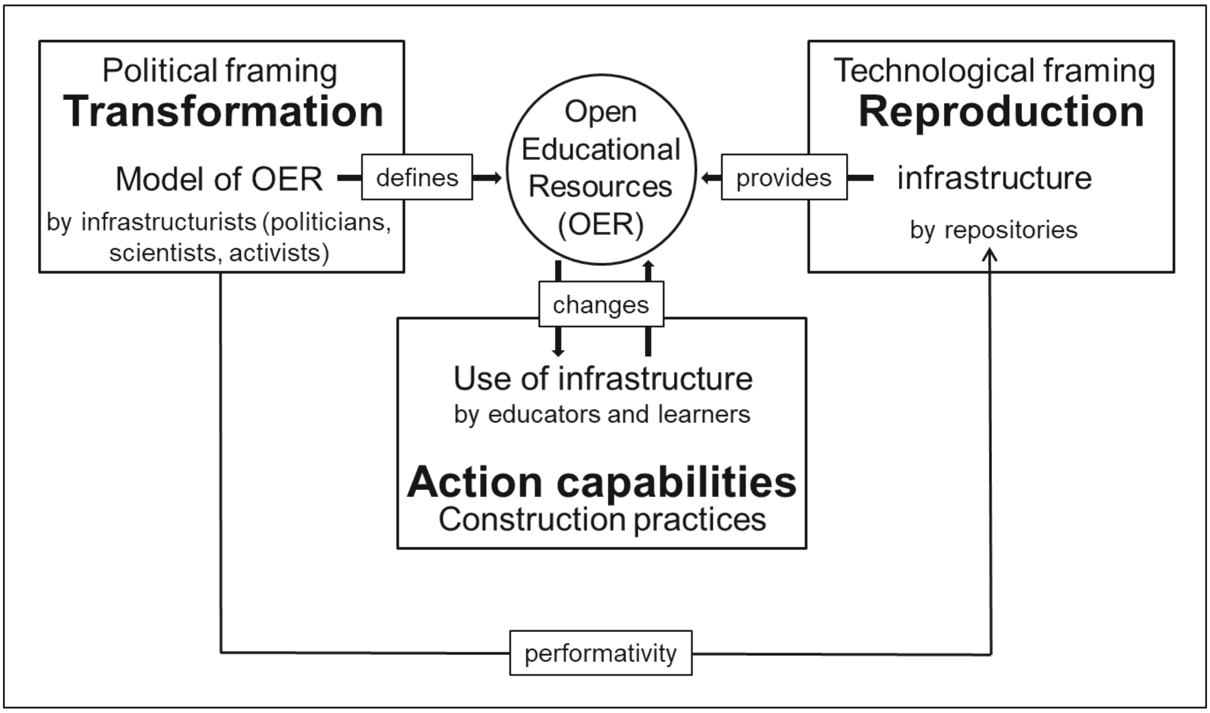

Fig. 1. Plenum of open educational resources

In order to turn learning and teaching materials into OER, various production practices are necessary. The individual practices, the creation of texts and graphics, the production of image and sound material, the search, combination, licensing, keywording, labelling and provision of educational resources, but also information about the practices and the OER model should be understood relationally and cannot be viewed in isolation; they have to be explicated in relation to the practices that preceded them, their social context and their material endowment (see also Schäfer, 2016, p. 11). Most of these practices are associated with computers and the respective input and output devices: screens, touchscreens, keyboards, mice. But there are also practices that are not (directly) connected with computers. In addition to digital pixels, ink and paper can also be used in the creation of texts and graphics, for example, for initial drafts and brainstorming. Image and sound materials are mostly recorded with digital cameras and audio recorders, but the practice of speaking (for example in a lecture) and the captured images (either as part of the lecture or to visualize epistemic

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or didactic objects) remain mostly outside the digital. Material can be searched in library holdings via an individual desk or an office computer, via online catalogues, and using internet browsers. But it can also take place in the library itself, in interaction with the library staff at the counter, but also not least by strolling through the aisles and browsing the holdings. Not least, conversations and discussions among colleagues about their current work over a cup of coffee or lunch are also important. All these practices and their material arrangements are inscribed in the teaching material. Ultimately, however, these socio-material practices are translated into the practices that produce digital learning objects. It should be noted that any consideration of open educational resources usually starts with the requisite end product. This fact must be considered in that, in their production practices, educational resources can only be labelled “open” at a later point in time through open licences. The decision to publish material does not necessarily have to be made at the beginning of the interwoven practices. The creation and use of learning and teaching material does not mean that it is also publicly available as an OER (Beaven, 2018).

The normative context of open educational resources is evident in the technical framework for making media available and the policy framework that sets the definition of OER. The relevant infrastructures will require their users to apply a certain method that will suggest the creation of resources in line with the OER model. Online educational infrastructures are, by definition, available on the internet; they can take the form of learning management systems integrated into the everyday media practices of courses (the open-source platforms Moodle or ILIAS are examples) or separate repositories outside of the everyday media practices of course modules. Repositories are document servers that secure digital learning objects and their metadata, describe the objects in a structured manner, and make them accessible. In the case of OER repositories, they are a form of virtual library providing more than just digitised books. They treat OER as normative objects in line with the OER model. They create an ordered openness for digital learning objects. The services sometimes contain the material for entire course modules or structured individual material and are aimed at teachers and/or learners; the material can either be downloaded or accessed within the service environment. In the TIB AV portal, for example, the videos can be accessed and viewed directly in a browser. In addition, the portal provides automatic video analyses for the videos in real time, for example, allowing written language (e.g. text on transparencies) to be searched through text recognition and spoken language to be displayed in the video as a transcript and made searchable through voice recognition. The repository can thus become a virtual reading room or lecture hall. Repositories allow different actions by users, while also preventing other actions by simply not including them in their setup, e.g., direct editing resources in text, picture, audio or video. These medially conveyed options for action are the mediators between

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the normative objects and the infrastructure. At the same time, the learning objects are decontextualized, as they are removed from the original context of the lesson. A separation of knowledge and context is not appropriate, since knowledge only emerges in this very context. Furthermore, lessons themselves must be seen as an educational resource. In this sense of de-/recontextualisation there are no differences between OER and traditional textbooks, if they stand alone.

The policy framework defines OERs as normative objects. An OER model is created and is then used to define what constitutes OER. Educational policymakers, activists in the open educational resources movement, and academics in media didactics, educational science, computer science, and library and information science continue to work on this model by providing recommendations, definitions and policies. To borrow a term from Eva Barlösius (2019, p. 21), these actors can be referred to as “infrastructurists”. The OER model is transforming the concept of education and learning/teaching materials. In various countries, OER policies are being developed that concentrate on the production and provision of OER and whose educational policy goals correspond to the normative model of OER. At the same time, however, it should be noted that these policies do not automatically mean that this model is adopted in the teachers’ and learners’ practices (Bossu and Stagg, 2018; Mulder, 2013; Stacey, 2013). Michael Kerres and Richard Heinen (2015, p. 34) propose a focus on infrastructural framework conditions in order to promote the spread of OER (see also Heck et al., 2020). Infrastructurists are trying to implement the theoretical assumptions of open education in the repositories as well as structure and promote OER usage. With this in mind, search systems and metadata schemes are being developed that should make it easier to find the learning objects described in the metadata.

The use of infrastructures should assist university instructors in the creation of OER. By searching for or finding and creating materials, their options for action become free. Searching for external material is part of any teacher’s practice (Beaven, 2018), but this takes place less specifically in OER repositories than in general online (Baas et al., 2019). Open solutions activists generally assume that educational materials can be produced by university lecturers and students in the course of their teaching and learning activities and (voluntarily) made available to the academic public. By using digital learning platforms such as Moodle or ILIAS, teaching practices can be changed and restructured in such a way that they favour the creation of OER. The OER community refers to teaching practices as “open educational practices”. Yet OER remain a niche phenomenon. Beaven (2018) emphasizes that the use and sharing of teaching and learning material within a community, between students and teachers and among colleagues is common, but invisible and done in private, in what she calls a “dark reuse” (see also Baas et al., 2019). The public sharing of self-created materials

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as OER occurs only to a very limited extent, but, when it is done, it takes place in public repositories (Cardoso et al., 2019).

The OER community describes the practice of use as follows: OER is used to integrate and supplement learning and teaching materials in one's own course modules. OER can be used to validate, review and/or improve one's own learning and teaching materials (Rodés et al., 2019). Content can be changed to make adjustments for individual contexts (Cardoso et al., 2019). Formal changes, such as tweaks to the wording, predominate (Beaven, 2018). While pictures, videos and online textbooks come mainly from the internet, presentations, exam materials, portfolios and course modules are either created by the user or “borrowed” from colleagues (Baas et al., 2019). Learning and teaching materials can also be adopted without changes. OER can be made available to students as additional learning and teaching materials, e.g. as self-learning units.

This comes close to the OER model for open educational resources and infrastructures. Terms such as ‘change’ and ‘adaptation’ are in the foreground. The use and acceptance of open educational resources is also the subject of research in order to develop further top-down approaches to help transform OER from a niche existence into a mass phenomenon. Open educational resources must therefore also be understood as boundary objects (Bowker and Star, 2000; Star and Griesemer, 1989), since they obviously mean different things for teachers, learners and infrastructurists. These different meanings are currently a blind spot in research, which ought to be included in the calls for further research on the transformation of higher education (Király and Géring, 2019, 2020) and OER (Zawacki-Richter et al., 2020). Now that OER has been shown both in its status as an object and in its constitution in the plenum of practices and material arrangements, a sample educational infrastructure is introduced to show its performativity.

4 Functions of Repositories

Following a qualitative content analysis (Mayring, 2014) of documents (Flick, 2018; Rapley and Rees, 2017, pp. 375–389; Wein, 2020) held by 29 German-speaking higher education repositories which make learning and teaching material openly available, the TIB AV portal was selected as the example for this paper. TIB AV-Portal went online in spring 2014. The portal is continuously developed and operated by a team of TIB (German National Library of Science and Technology). It is a web-based provider of academic videos with a focus on technology, mathematics and natural science, including lecture and conference recordings as well as (open) audio-visual learning and teaching materials. Services offered by the portal are hosting and long-term archiving of videos; automatic metadata enrichment; permanent citation with

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Digital Object Identifier (DOI); linking between video, scientific papers, research data, NameIDs; semantic search; and legally compliant publishing practices. The portal is not an exclusive OER provider. Within its collection on the basis of free licensing (via CC), many videos are not only accessible online and can also be re-used. So, the portal is for academic use. The portal can be used by scientists as well as lecturers and students.

Digital Open Educational Resources are relationally and ecologically intertwined with infrastructures (Star, 1999, p. 377) and their users in several ways. The OER sorts the participants, namely through their different technical and media performance with the (un)availability of resources in archives, how they process them at work stations, and use them in (virtual) classrooms. If the transformation of the term teaching material is taken seriously, one must ask how the intended services of an OER are provided in infrastructures. How is the OER model mapped and represented in the infrastructures? OER infrastructures usually offer four core functions on their user interface, which can be understood as a service: (1) Search, (2) Organise, (3) Help (Manual) and (4) Delivery.

Search: Searching and, hopefully, finding take place in the interaction between search services and users as searchers. Information in a complex field of knowledge is subject to search queries, especially if the complexity of the knowledge base is increased by different storage locations and the abundance of documents. The service of searching can be differentiated into two levels of search practices: the first level helps users learn how to perform a search within that service, while the second level enables acquisition of the actual piece of knowledge. Users must be readily able to make competent use of the service and so must be (self) trained in its use. By opting to use the service, it can be assumed that users will be able to use it through their (search) practices in order to fulfil their customer wishes and information needs. A second assumption is that users are already quite aware of what they are seeking, but the material must be made findable by tagging it with metadata. In addition, a certain user competence in dealing with search systems is required.

Organise: This service is mostly represented in the organisation of lists. Found documents can be saved in collections and thus made available as a list. Materials can then be added to or removed from the collections. The collections can then be shared publicly or privately. Collections can be created collaboratively. This creates a form of ordered and shared openness, not only through the list itself, but also through the relationships between the objects in the list and the people who create the list. To a certain extent, the possibilities of these collections as lists can be equated with syllabi and reading lists.

Help (Manual): The use of documents and data also includes answering questions about copyright as part of the services needed to turn users into competent

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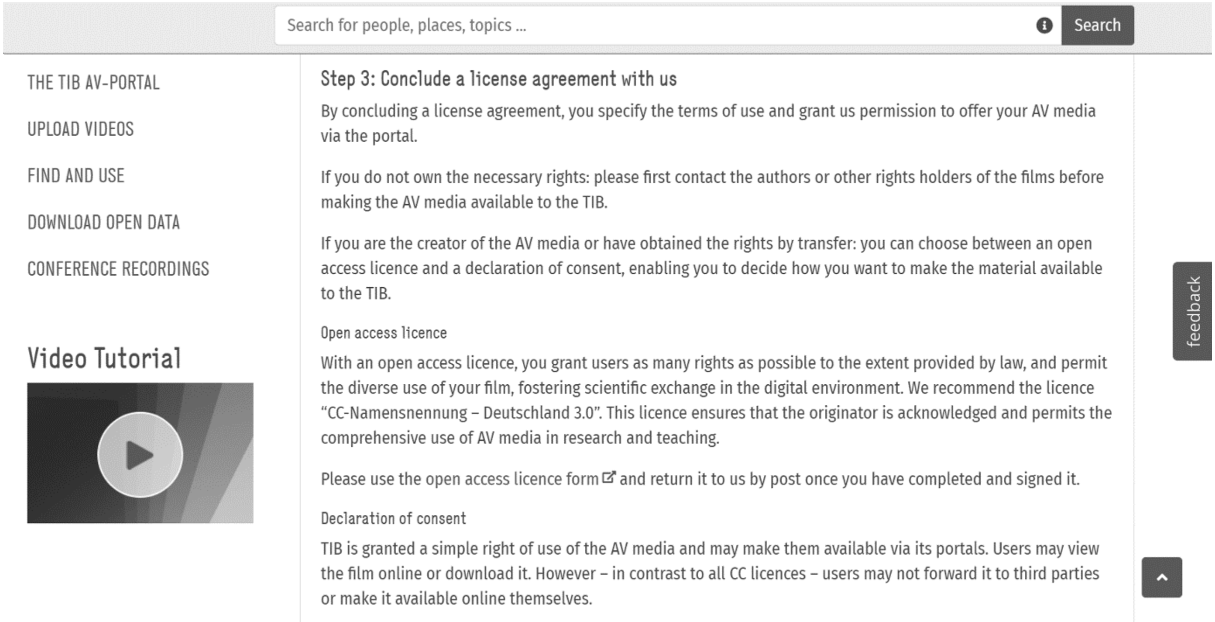

Fig. 2. License agreement

(independent) users. Infrastructures thus address users through help pages or manuals for self-socialisation. The rights and obligations of the service and users as contractual partners are presented in the service's terms of use, which not only describe the functions offered by the service, but also how these functions may and can be used. Figure 2 shows the help for license agreements, needed in the upload function to select and grant an open licence for the material.

Delivery: The learning objects are delivered from the contributor (author) to the online platform. Delivery describes the technical practice in repositories fulfilled by direct upload or sending the learning object to an editorial board. Delivery does not describe the social and collaborative aspect of contributions and the accretion of knowledge. The upload area needs to be designed in such a way that persistent identifiers (e.g., digital object identifiers (DOIs)) are assigned to the documents (automatically). Users as deliverers provide information on the title, a description of the material, its authors, etc. The users should provide as much metadata as possible to describe their material. In addition, they need to select and grant an open licence for the material. Figure 3 shows the drop-down menu for licencing.

The OER model is explained in both the help and upload functions of the infrastructure. The OER model and the restrictions on production are replicated in the infrastructure. The social norms of open and public access are provided by the service. The content can be accessed without payment or membership restrictions. Because the material can be accessed directly in an internet browser, there is no need to use software, which in turn is only available behind paywalls or membership barriers. The legal norms are stated by the explanations within the help function as well as in the pre-configuration of the upload function, which in the case of the AV portal strongly

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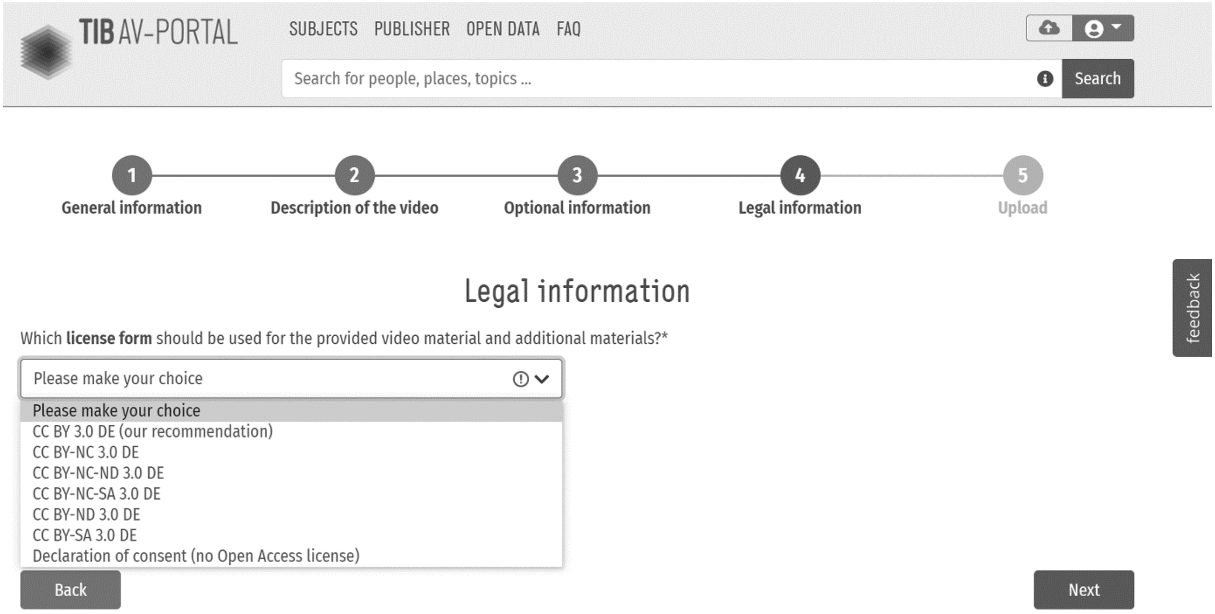

Fig. 3. Legal information

recommends users grant free licences. It should be noted that the AV portal also allows objects to be published without free licences. This means that the material licensed in this way is publicly available (open access), but may not be edited without obtaining further permission. Other services only allow free licences to be issued. In their technical framework, digital infrastructures make open educational resources medially available. Due to the technical framing, OERs are made available for reproduction in infrastructures, i.e., the repositories. The OER model is performatively inscribed into the infrastructures. However, this does not yet say whether they do justice to the interaction order of making learning and teaching material available and thus help actors in the education system.

5 Conclusion

The idea of open education has a long history (Peter and Deimann, 2013), which to this day is linked to “opening up education” (European Commission, 2013) and is linked to social issues such as: “Educational equity, fairness and inclusion, caring for the diversity of learners, open curricula and social responsibility” (Kerres and Heinen, 2015, p. 34). OER in terms of normative objects are performatively produced through repositories. The social norm of public availability and the legal norm of open processing through the granting of open licences are conveyed by the way the repositories are set up. However, this does not say whether the repositories actually implement the normative model of OER for the sake of an increase in educational equality and quality. At least, this has not yet been implemented in the repository

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technology; it lies in the resources themselves. The policy discourse around OER is not only dominated by political decision-makers, educational scientists and technicians and the perspective of university lecturers seems to be insufficiently included, so one can also speak of policy by design. It remains to be seen whether the implementation of digitalisation strategies will entail more than just transferring traditional practices, information and knowledge into a new medium (mere digitisation). In response to the question of how OER influences the interests of teaching and learning in relation to their content, this paper has shown that OER as visualising objects are to be understood as everyday educational resources and thus, in their current form, more than the mere digitisation of traditional solutions.

When understood as normative objects, OER can be seen as trying to help revolutionise education as expressed in various national policies. Through policy making, political decision-makers use OER to increase pressure towards social, economic and technological change in the education system in order to achieve the normative educational goals of increasing educational equality and quality. Within the open educational resources movement, the availability of professional, open teaching and learning materials and the associated opportunities for digital learning are perceived as a means to reach these goals. Judging the contribution OER can make to increased equal opportunities will only be possible when the OER movement is expressed in pedagogy. Either way, the established practices of teachers are put at stake. And many tend to act conservatively and maintain their academic norms and traditions. OER will put university lecturers into a new public sphere, removing them from the familiarity of seminar rooms and lecture halls into the public sphere of the World Wide Web. This not only has consequences on the visibility of their teaching work, but also has consequences for the legal status of the materials used in teaching. In this form, the digitization of learning and teaching materials through OER can transform teaching and learning issues into place and method in the long term if distance learning continues to gain importance. In this sense, digital educational infrastructures and learning objects will also gain in importance. For future research, the following questions about their constitutive role in practice must be asked for educational infrastructures as digital objects: (1) How do infrastructures change the knowledge base of their users? (2) What do learning objects mean for participants? The fact that the educational goals of increasing educational equality and the quality of education go hand-in-hand with a promise of economisation through time savings and cost efficiency raises the question of the extent to which the education system will not follow its own inherent logic, but instead subordinate itself to the logic of the economic system and confuse the goals of education with those of capitalism.

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Gender Equality and Social Justice in Funding 'European Excellence': The Case of the European Research Council

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Abstract. The starting point of this small study is the assumption of a 'structural ambivalence' (Merton 1976) between scientific excellence and gender equality and social justice as cultural goals of the European Research Area which occasionally are seen as conflicting values instead of appreciating them as fundamental preconditions of achieving ground-breaking research. Taking the case of the European Research Council (ERC) as an example, and combining qualitative and quantitative methods of social research, the paper empirically scrutinizes norms and strategies of the ERC's gender policy and its structural effects in improving gender equality and social justice in funding of top researchers. Findings show how the ERC, despite its normative commitment to equality, latently perpetuates the idea of excellence and equality as competing values. Nevertheless, the ERC's most recent awareness-raising strategies at least partly contribute to eliminating some gender inequalities inherent in its institutional processes and public science systems at large. Moreover, the paper provides a useful conceptual framework and an appropriate methodology for analysing the role of gender and social justice in funding for excellence initiatives in European, and global, science.

Keywords: gender equality, social justice, scientific excellence, research funding, European Research Council

1 The Problem: Structural Ambivalence in Gendering 'Excellence' in the European Research Area[1]

The European Union enjoys a long tradition of promoting policies and strategies for realizing gender equality in the labour market and in political representation. In the area of science and research, based on meritocratic principles, more recent funding for 'excellence' initiatives began to systematically combat stereotypes and biased evaluation procedures among the scientific community. Nevertheless, scientific excellence as cultural goal of science is still often perceived as contradicting those of

[1] A draft version was presented at the virtual STS Conference Graz 2021 Session 'Let's talk about money, sister! Governance strategies for structural change in science and research', held in May 2021 and organized by Graz University of Technology. I thank the session audience for comments and critique.

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gender equality and social justice instead of considering them fundamental preconditions for achieving innovative research.

The notion of ‘structural ambivalence’, as defined in the structural tradition of the sociology of science (Merton 1976), designates conflict or dissent between proposed cultural values, norms and goals of a given society. When applied to the scientific community, we can refer to conflicting values of the ethos of meritocratic public science versus an increasing marketization of science in contemporary academic capitalism (Nowotny 2011). This paper starts from the assumption of structural ambivalence between scientific excellence, on the one hand, and gender equality and social justice, on the other, as fundamental norms of public science systems in Europe. More particularly, it scrutinizes its complex entanglements from a conceptual, methodological and empirical perspective, taking the European Research Council (ERC), the European Research Area’s (ERA) most important supranational funding institution, as an exemplary case. In order to assess structural change in the ERA, the paper investigates how and to what extent the ERC realizes its own goals of gender equality, as articulated in its gender equality plans.

The ERC is innovative in its supranational institutional structure for research funding, reshuffling relations between the European Commission and the scientific community and enacting a strong normative impact on the national research funding landscape. It is the ERC’s cultural, or normative, influence upon public science at large, which is emphasized here, and what also creates the need for developing a conceptual framework and an appropriate methodology for scrutinizing and critically reflecting its wider impact upon the science system. European research funding is particular insofar it provides new opportunities to influence a funding landscape’s institutions and objectives, criteria and procedures, hitherto predominantly organized at national level. Apart from the question of who proves successful in the international competition for funding, new cultural norms of scientific excellence are established that are consequential for *all* members of the scientific community.

Equal opportunities in access to research funding are both an important precondition for and an integral part of the cultural legitimacy of public science. Researchers’ structural conditions and opportunities for realizing ambitious goals of scientific excellence, however, are less likely to be considered in public discourse. Taking public funding of basic research as an example, the paper examines the relationship of equal opportunities and excellence. The ERC, representing an excellence initiative at European level, is analysed with regard to how it constructs gender equality goals in relation to the notion of scientific excellence.

Conceptually, the paper outlines a structural explanatory model for analysing the role of gender in European research funding that is anchored in the structural sociology of science (Merton 1968, 1973). It can fruitfully be applied to understanding the culturally

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normative 'gendered substructure' of the ERA's multilevel system and for assessing structural change initiated by establishing gender equality plans. The model reconceptualizes the interdependence of different structural levels in the scientific system at large. The potential conflict between the ERA's cultural structure of proposed norms and their actual realization in the social structure of science is regarded as crucial measure for assessing the nature and extent of structural change.

Methodologically, the study proposes to compare the ERC's gender equality plans with empirical data on its actual realization. A combination of qualitative and quantitative research methods is applied for analysing the ERC's equality plans in researchers' structural representation, scientific careers, cognitive problem choice, and its intersection with notions of social justice as well. More particularly, a documentary analysis of the ERC's first decade's gender equality plans is contrasted with quantitative ERC statistics on funded projects and with own findings of curriculum vitae analyses based on a sample of n=601 top researchers in their roles of ERC panellists and/or grantees.

Empirically, comparative data on the ERC's gender equality plans and its actual institutional processes are useful in assessing how and to what extent any structural change with regard to gender equality were effectively initiated by these in the last years. They also set legal and institutional boundaries for research performing organisations such as European universities.

The paper starts with defining gender equality and social justice in the current ERA and the ERC and the status of research on it from an explicit gender perspective (part 2). Chapter 3 develops a conceptual framework based on the structural tradition of the sociology of science for systematically analysing the cultural, social and cognitive structure of the ERA with respect to gender equality and social justice. The applied research design for assessing structural change is specified in Chapter 4, results are presented and discussed in Chapter 5 and followed by provisional conclusions.

2 Gender Equality and Social Justice in European Research Funding: State of Research

The history of European science policy was always accompanied by conflict or ambivalence between different interests of members of the European Community. While North-Western countries have emphasized the competitive excellence idea from the 1980s onwards, the notions of transnational collaboration and cohesion found more resonance within the Mediterranean countries that were also successful in addressing the social sciences and humanities as part of the new Research Framework

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programmes (Guzzetti 2009; Hoenig 2017). That underlying structural ambivalence of European funding policies was enforced when in 2000 the ERA was called into life both for strengthening transnational collaboration and for increasing Europe's competitiveness in a global international division of labour.

2.1 The Case of the European Research Council

The ERC has been established in 2004 as an institutional instrument in order to strengthen the ERA's economic competitiveness and to realize its political objectives articulated in the Lisbon Strategy. The ERC installs a new governance level of research funding 'above' nationally defined public science systems, in order to promote ground-breaking research of individual researchers in all scientific fields. Exceptional quality or scientific excellence is regarded as sole criterion for evaluating proposals by panels of international experts. From the new programme period in 2014 onwards, the ERC's focus on 'excellence through competition' (Winnacker 2008) has had a strong impact on all initiatives of European research funding. ERA's more recent re-interpretations (EC 2020b, 2020c) explicitly underscore that the 'principle of excellence, which entails that the best researchers with the best ideas can obtain funding, remains the cornerstone for all investments' under the ERA. This is important insofar the approach represents a normative shift from strengthening social cohesion, cooperation and coordination among the ERA's members towards an increasing differentiation and stratification of individual researchers as well as their institutions. Since public research funded by nationally defined household subsidies increasingly gets under pressure, researchers and their institutions cherish great expectations towards European funding.[2]

2.2 Gender and the ERC: State of Research

While science and research always entail a strong orientation towards scientific competition and the creation of new knowledge, critics often claim a too narrow interpretation of what constitutes scientific excellence. Moreover, normative claims gender equality and social justice, as precondition of realizing scientific excellence, often strongly diverge from its actual implementation at organizational level (e.g. van den Brink & Benschop 2012; Husu & de Chevigné 2010; Dahmen & Thaler 2017).
What does an enforced excellence-principle mean for science policies and strategies of gender equality, diversity and social justice? How does the ERC, claiming to

[2] Moreover, in the last two decades funding for excellence initiatives emerged at national level as well, while simultaneously reflecting historically grown and distinct path-dependent public science systems with varying ideas on gender equality as well. The relationship of national and European research funding and the relation of excellence and equal opportunities both have found rather little attention in the research community so far (but see Hoenig 2020).

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represent European excellence, define the cultural goal, norm and values of scientific excellence vis-à-vis the goals of gender equality and equal opportunities? How does the ERC publicly justify its funding system with regard to these norms? Is there any empirical evidence for the success of its gender policies? How can its potential impact upon public science system be explained in analytic and methodological terms?

Equal opportunity policies usually make a distinction between three levels of analysis as represented in the ERA's research programmes: a) the structural participation of gendered groups in the vertical hierarchy and horizontal segregation of scientific disciplines; b) scientific careers and models for promoting women in research performing organizations, and c) cognitive content of gender studies and its institutional integration in research funding initiatives. More recently, with regard to the ERA, the new gender equality strategy of the European Union (EC 2020a) has emphasized d) the intersection of gender equality with social justice and the need for analysing the interdependence of various forms of social inequalities and discrimination.

Though funding for excellence initiatives is very well researched, and this is true for the ERC in particular, the relationship of gender equality objectives to excellence goals is less frequently analysed.[3] With reference to research on the ERC's gender dimensions, *the structural representation* of genders in the ERC affects its gender distribution among applicants, grantees, panellists, decision-making boards and internal structures (Bautista-Puig et al. 2019; Hoenig 2016). Following the EU's early goal on strengthening structural representation of women in decision-making bodies, the ERC predominantly focused on the first dimension of gender quality (EC 2004; 2009; 2012; 2017; 2017, 2020; ERC 2010, 2014a, 2014b, 2018, 2021). Since the ERC defines competitive funding exclusively through the excellence criterion, and also because of its knowledge claim towards scientific autonomy, it simultaneously distances itself from institutional strategies and measures of quota or positive action towards women (see Vernos 2013, ERC Scientific Council, undated).

Studies on *scientific careers* of researchers measure institutional procedures for receiving tenure or being promoted towards professorship and grant effects upon scientific careers (Pina et al. 2019; Vinkenburg et al. 2020). Very few studies so far

[3] Experts on the ERC and those on gender often do not take notice of each other's research. Moreover, the majority of evaluative studies on the ERC are commissioned by the institution to be evaluated, which structurally does not support discourses on 'controversial' questions or 'inconvenient' results (e.g. Wenneras & Wold 1997). Methodologically, this affects conditions of investigating the ERC for *all* researchers, because the ERC restricts access to data for independent researchers not involved in evaluation projects, e.g. to interviews with panellists, applicants' data, contents of panellists' discussions or remote reviews. Both the cultural legitimacy of public research funding and the trust in its funding institution would be strengthened by more opportunities for independent information and research available.

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focus on the *cognitive content*, such as the integration of problem choice with reference to gender studies in its panel descriptors, the (missing) gender expertise of panellists and the content of funded projects (Hoenig 2021). Research on *social justice* as part of the ERC's gender equality plan does not exist so far; the more recent focus on intersectionality in the EU's Gender Strategy (EC 2020a) might initiate structural change in that regard as well.

3 Conceptual Framework: A General Model for Analysing Structural Change

How can a multilevel system such as the ERA be analysed with regard to the role of gender equality? In which way can gender equality plans serve as normative guidelines for initiating structural change? What about the impact of the ERC on equal opportunity as goal of national research funding, and how can we explain it in conceptual terms?

This small study of gender equality in excellence initiatives is oriented towards a structural tradition of the sociology of knowledge (Merton 1968, 1973), applying Robert K. Merton's explanatory model of social action to the case of research funding (Hoenig 2014, 2017, 2018).[4] Merton makes a distinction between the *cultural structure* of culturally legitimized norms, values, and goals of a given society, for instance material success, and the *social structure* of institutionalized means available to social actors to realize these cultural goals. The notion of *opportunity structures* reflects social actors' *different rates of social choice* for realizing their goals by taking social action in a given *social situation* which is often institutionally pre-structured by available sets of particular social roles and social statuses. The very social action taken has *social consequences*, intended as well as unintended ones, at individual and collective level. Consequences or effects of social action also *feed back* to reproduce, maintain or transform the initial cultural and social structure while the possibility of 'no effects' is available as well (for a detailed account, Crothers 2021). *Social mechanisms*, a term coined by Merton, are fruitful for explaining how different levels of macro-, meso- and micro-social action are dependent upon each other; the concept refers both to the social phenomenon and building blocks of the explanatory model (Mayntz 2004; Hedström and Swedberg 1998).

[4] Merton's general social theory has not fully been worked out by himself, but is a rather latent or implicit conceptual framework present in much of his writing at large (Stinchcombe 1975; Crothers 2021) and had an enormous influence on theoretical debates often initiated by some of his students.

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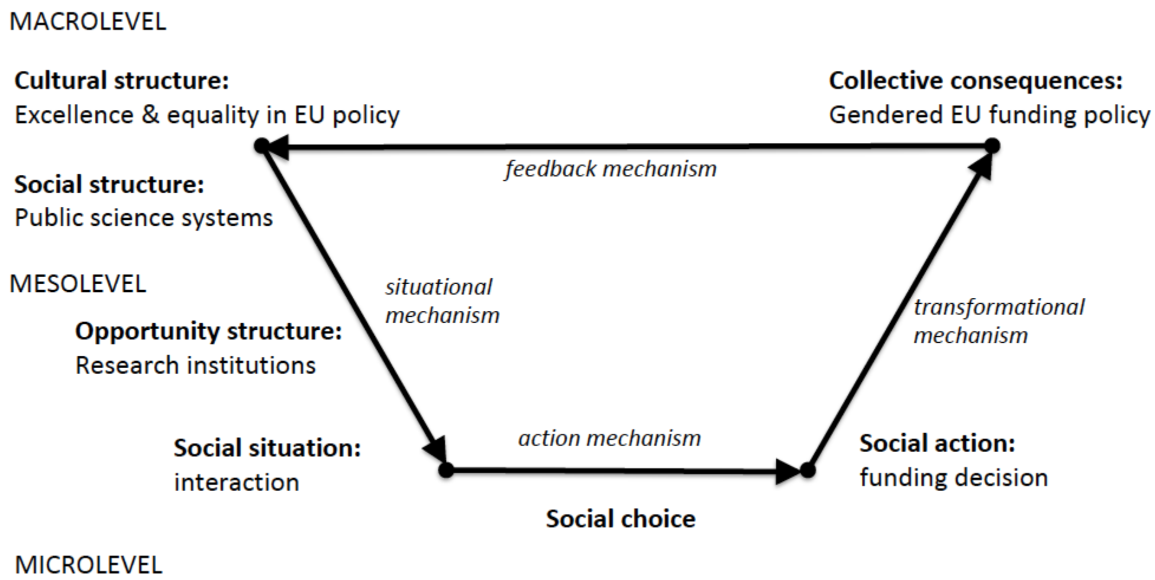

Fig. 1. Structural model for analysing gender in European research policy. Based on Merton (1968), Stinchcombe (1975), Crothers (2021), adapted from Hoenig (2017: 49).

The general explanatory model can be fruitfully applied not only for analysing structural change in a given society at large, but also in the area of European research funding and its interplay with a given social structure of public science systems (Hoenig 2014, 2017). With regard to research funding, different levels are involved: the *European* level of funding programmes; the *national* level of public science systems; the *organisational* level of research performing and funding institutions and the underlying opportunity structure for social action it provides for its agents; and the level of *social interaction* and *social choice* in particular situations, for specific social groups and actors, such as ERC panellists in situations of assessing proposals.

Analytic strengths of that conceptual framework consist in explaining the reproduction of scientific elites based on mechanisms of structural closure and symbolic reputation as self-reinforcing dynamics of the science system at large. In addition, the structural tradition of the sociology of science is able to show how and to what extent these dynamics of social inequality contradict the meritocratic ethos of science. Empirically, it scrutinizes scientific careers of Nobel laureates (Zuckerman 1977), peer review in research funding (Cole 1992), and gender specific inequalities as resulting from cumulative discrimination in low status positions (Epstein 1991; Zuckerman et al. 1991). Although these analyses predominantly refer to the United States, they are also appropriate for stimulating cross-nationally comparative research across Europe (Hoenig 2017).

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The framework can also be extended towards a structural interpretation of supranational norms of gender equality in order to empirically analyse its consequences for European and nation-state funding structures. Here I focus on gender equality plans as part of the cultural structure proposed by the ERA's funding programmes in order to analyse the function they can play for promoting structural change towards realizing gender equality. In this framework, the *cultural structure* refers to the culturally proposed norms for achieving gender equality by equality plans particular for a research funding programme (or, in the absence of an explicitly stated strategy, the prevalence of implicitly gendered cultural norms concerning gendered divisions of labour). The *social structure* refers to how gender equality plans are implemented in the structure of public science systems, concerning gendered structural representations in the distribution of scientific fields and the vertical academic hierarchy. The *opportunity structure of scientific institutions* with regard to gender evokes the differential range of social choice for women at the labour market, e.g. between more teaching or more research centred academic institutions, more or less realized equal payment in academic positions, or universities' institutional strategies towards equal opportunities. *Social action* mechanisms in funding decisions refer to how and to what extent potential gender bias or equality policies are taken into account at level of interaction in social groups such as evaluation panels. Their choices do have particular *consequences* at collective level, resulting in more or less gendered distributions of researchers' funds, positions, careers, and problem choice. Effects also *feed back* at institutional level, producing more or less pronounced structural change in a research system, such as the ERA, towards gender equality and social justice.

The proposed structural model thus provides a useful methodology for scrutinizing how cultural goals of equality are really set into practice, assessing the extent of discrepancies or variance between culturally proposed goals and their actional realizations in the social structure and also the extent of structural change in a given public science system at large. The multilevel structural model can also be usefully applied in analysing the supranational influence of the ERC's interpretation of gender equality and social justice upon the national level of funding initiatives.[5]

[5] See Hoenig 2020 for a comparative documentary analyses of the ERC's gender equality plans with three excellence initiatives at national level, implemented by the Swedish *Vetenskapsradet*, the Dutch *Nederlands Organisatie voor Wetenschappelijk Onderzoek* (*NWO)* and the Spanish *Consejo Superior de Investigaciones Científicas* (*CSIC*) as Research Councils.

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4 Assessing Structural Change: Research Design[6]

In this study, a *documentary analysis* of the ERC's gender equality plans from 2007 to 2017 is applied in order to scrutinize its cultural goals with regard to the relation of scientific excellence and gender equality it imagines and defines. The documentary analysis is complemented and contrasted with empirical evidence based on a *secondary statistical analysis* of data, provided by the ERC itself and also based on own data, in order to assess whether the ERC was successful in meeting its own normative goals or not. Findings obtained can serve as a proxy indicator of assessing, evaluating and explaining structural change (or non-change) in the ERC with regard to proposed gender equality and social justice.

The documentary analysis of gender equality policies has been contrasted by examining both ERC's gender statistics on funded projects and a sample of curriculum vitae data (Hoenig 2017) of both ERC grantees and panellists, in order to study which factors do influence top researchers' scientific careers. CV data for 601 researchers were generated via the publicly accessible internet and analysed against approximately 100 indicators; results were complemented with background knowledge from qualitative interviews (n=24) with ERC Starting and Advanced grantees (Hoenig 2016, 2017, forthcoming). The CV sample (n=601) included top researchers from two age groups, six disciplines and twelve countries.

[6] The research presented here builds on findings from a small long-term project that has compared ERC's funding effects for a sample of twelve countries and six disciplines, combining qualitative and quantitative methods (Hoenig 2017).

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Table 1. Quantitative sample of ERC researchers' curriculum vitae in three roles (n=601)

ERC sample characteristics		Share in overall sample, in %	Share of females, in %
ERC roles	grantees	51.2	17
	panellists	34.6	28
	dual role incumbents	14.1	22
Grant types and domains	Starting	52.0	30* / 10**
	Advanced	47.0	20* / 10**
Institutional affiliations	public university	80.0	23
	non-university research organization	18.0	17
	academies of science	2.0	25
Sample disciplines	physics	16.8	14
	chemistry	16.8	19
	biotechnology	16.1	17
	economics	17.1	14
	sociology	16.5	37
	history	16.6	33

Note: *female shares for the domain of the social sciences and humanities (economics, sociology, history), *female shares for the domains of the physical and engineering sciences (physics, chemistry) and the life sciences (biotechnology)

Data given in Table 1 describe the sample of the curriculum vitae analyses in more detail, with respect to ERC roles, institutional affiliations, disciplinary background and grant type of the researchers. For all data, the share of females is given as well.

Sampling six scientific disciplines respective ERC panels was led by the criterion of their relative weight in the ERC overall funding of grants, resulting in sampling physics and chemistry in the domain of physical and engineering sciences and economics and history in the social sciences and humanities. Strategically, the more heterogeneous disciplines of biotechnology and sociology were of interest.

5. Results and Discussion

5.1 Comparing the ERC's Cultural and Social Structure

As part of the ERC gender equality policy, a Gender issues Working Group has been called into life in 2008 and installed as a permanent structure in order to monitor gender equality through the entire ERC funding processes; since then, it has formulated three strategy papers or gender equality plans (ERC 2010; 2014a; 2021). The Working Group is also responsible for a transparent implementation of gender equality in its

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institutional procedures. Assuming that women and men both are capable of developing frontier research (ERC 2010), the strategy aims at combatting structural disparities in functionally irrelevant status properties, to the advantage of innovative research. Equal opportunity goals are legally implemented as part of the Seventh Framework Programme by promoting awareness-raising measure, ‘with a focus on excellence’ (ERC 2010). Differences in peer review procedures and outcomes shall be identified and a balanced gender distribution among applicants, panellists and decision-making bodies shall be realized, with a participation of at least 40 percent of the underrepresented gender (ERC 2010). The second gender equality plan (ERC 2014a) specifies, however, that gender proportions of the underrepresented gender should correspond to the share among advanced or established senior researchers.

The ERC’s most recent gender equality plan, adopted in June 2021 (ERC 2021), follows the gender-relevant operational objectives defined in Horizon Europe so that the ERC can “support excellence frontier researchers across Europe, irrespective of nationality, gender or age” (ERC 2021: 2). As its preceding gender equality plans it mainly focuses on awareness raising measures for identifying and removing any potential gender bias in the evaluation procedure and continues monitoring potential gender differences in submittal and approval rates and researchers’ careers. It also aims at reaching a gender balance among ERC panel chairs, panellists and external reviewers.

The relationship between equal opportunities and excellence formulated in the gender equality strategy remains a ‘structurally ambivalent’ (Merton) one. Equal opportunities can be interpreted as constitute for a successful implementation of excellence criterion, but can also be seen as a competitive goal which should be relativized in the light of the goal of scientific excellence (cf. Hoenig 2016). At the end of the first programme period the ERC admitted the persisting gender differences in the application and evaluation process, insofar the approval rate among women reached at best 85 per cent of their male colleagues (ERC 2014b). Following policy documents define goals of equal opportunity and excellence as partly contradictory: ‘No positive discrimination, no affirmative action, no quotas – ERC awardees are selected based on EXCELLENCE only’ (ERC Scientific Council, undated, p. 3). Diversity and inclusion are interpreted by the ERC primarily as related to regional disparities, only 1.5 percent of ERC grants go to researchers from east European research institutions (HLEG 2015; Hoenig 2017).

Low application rates of female researchers the ERC considers as more problematic than unequal approval rates. More recently it extended its eligibility criteria by including credit periods for family leave. Since 2016 awareness-raising measures are implemented among ERC panellists and personnel of the ERC’s Executive Agency. ERC data show improved participation of female applicants, while their approval rates

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remain lower than among male colleagues. For the future the ERC intends to increase female application rates and also more diversity among panellists (ERC Scientific Council, undated). Regarding gender knowledge in content, apart from singular projects, there is no panel structure comparable to the existing structure of subpanels; thus, there is no reason to assume that the ERC deploys any systematic interest in interdisciplinary gender studies.

While the ERC does not formulate the goal of social justice, as part of its gender equality strategy, the Commission's recent gender equality strategy (EC 2020a) explicitly demands European actors to include intersectionality in its programming. It also builds on legal frameworks mostly set in place in the late 1990s, such as anti-discrimination strategies, which, however, are not specified for science, research and its funding.

Table 2. Female shares and approval rates among ERC researchers, by grant type and programme period, in percent. Source: ERC Statistics 2007-2017.

ERC roles	By grant type / by scientific domains	Female share by programme period, in %	
		2007-2013	2014-2017
Applications	Starting	31	35
	Advanced	15	16
Approval rates	Starting	80*	92
	Advanced	85	100
Approval rates	Life sciences	66	86
	Social sciences and humanities	80	100
	Physical and engineering sciences	82	100

*Note: Data designate approval rates of female researchers' applications as a share of approved male researchers' applications.

In order to assess to what extent gender equality policies were successfully implemented, existing ERC statistics and own data were analysed (see Table 2). According to the ERC (2018), between 2007 and 2017 the female share among panellists was a third among Starting and a quarter among Advanced grantees. Among applicants, since 2014, the female share improved to 35 respectively 16 percent, depending on the grant type. The strong domain-specific gender approval gap in the life sciences considerably decreased since 2014. Meanwhile female and male applicants from both the domains of the social sciences and humanities and the physical and engineering sciences enjoy the same chance of having their proposals approved by the ERC (Hoenig 2016, 2020).

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5.2 ERC Grantees' Careers and the Cognitive Integration of Gender Research

Curriculum vitae analyses can show gender disparities in scientific career's vertical mobility moves in universities and non-university research organizations[7]. Based on self-reported CV data of grantees, five distinct employment positions were defined and analysed for potential gender disparities in the median of employments, counted in years, when researchers were appointed in a particular scientific career position.

Table 3. Median of employments in years, by gender and position in ERC grantees' scientific careers.

Gender	Employments				
	first	second	third	fourth	fifth
Male	2.6	3.5	4.5	5.4	6.0
Female	2.2	3.0	3.7	4.6	5.1
Total	2.5	3.4	4.4	5.2	5.8
N	472	440	423	332	243

1= PhD student; 2= postdoc; 3= assistant professor; 4= associate professor; 5= substitute professor; 6= full professorship; 7= group leader; 8= director. Own calculations (Hoenig, forthcoming).

Table 3 shows that male ERC grantees more frequently self-reportedly started their career already as a post-doc, while female grantees both started being employed in a lower position and needed at least one employment more at postdoctoral level for reaching the same career stage as their male colleagues. That is, they climbed the academic ladder much slower than their male colleagues, both at the university and when affiliated to non-university research performing organizations. Since *early* promotion as well as non-promotion of researchers has significant effects for academic careers (Zuckerman 1977) this empirical evidence is particularly of interest. Female ERC grantees less frequently reach the position of full professorship or a leading role in non-university research organizations, such as a group leadership or directorship.

Regarding the cognitive representation of gender studies' themes in the ERC's panel structure, the most recent panel descriptors (status 2020) do not include any particular panel for assessing gender research. However, within the social sciences and humanities' panel SH2, addressing sociology, anthropology, social psychology, educational and communication sciences, issues of gender are mentioned. In the SH6 panel dedicated to the historical sciences, the notion of 'gender history' is found while no gender panel descriptor is mentioned in the domains of the life sciences or the physical and engineering sciences. It can be assumed, that across all panel groups less than one percent of all panellists have stated any expertise in gender studies for evaluating projects in interdisciplinary gender studies (see also Hoenig 2021). Thus,

[7] For a detailed account of the method, Hoenig 2017.

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although the ERC frequently underscores its interest in interdisciplinary research projects, this is not particularly visible with regard to making room for the innovative potential of gender research in its panel structure yet.

6 Provisional Conclusions: Assessing Structural Change in Gendering the European Research Area

This small study has scrutinized how and to what extent the ERC realizes its own excellence goals in terms of gender quality and social justice. Apart from detailed empirical findings on the research questions mentioned, the paper proposed a general conceptual approach, based on the Mertonian sociology of science, for assessing structural change in the ERA's gender equality policy, and complemented it with an appropriate methodology, combining qualitative and quantitative methods of social research. Empirical results from a documentary analysis of the ERC's normative gender equality plan were compared with actual empirical evidence, based on statistical data from various sources, of its realization.

Findings show that despite recent improvements in ERC's practices, structural ambivalence of scientific excellence and gender equality objectives prevail, due to the deeply gendered construction of scientific excellence in research performing and funding institutions as well. That the ERC regards interdisciplinarity as conducive to cognitive innovation could have a much clearer impact on the structural integration of gender studies in its panel structure. Latently, the ERC perpetuates an interpretation of gender equality and excellence as *competing* values of funding policies, instead of regarding equal opportunities as *constitutive* for scientific quality and thus as an integral part of scientific excellence. Female top researchers such as ERC grantees also experience a slower vertical mobility than their male colleagues in their academic careers. Findings show the importance of *early and ongoing* support for female researchers at organizational, discipline-specific and nation-state levels, in order to retain this scientific talent in Europe.

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Regional Development with RRI Approach

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Abstract. This contribution deals with regional development. The people affected synergies their innovation ecosystem in the region. The Responsible Research and Innovation (RRI) approach from the EU is a transparent and interactive process for the development of the foreseen region. The innovation ecosystem consists of the interaction between the actors. Forward looking methodologies align with the RRI approach and engage industry & business, science & research, education, public administration, and civil society. The engaged stakeholders co-create societal accepted, sustainable, and ethically justifiable innovations. The proposed approach familiarizes the society with science and the progress in technology development. This RRI concept, developed in the DigiTeRRI project, is applied for the transition of traditional industrial regions into digitalised territories. In this paper the focus is on the region Styria in Austria. The work is performed under EU H2020 project DigiTeRRI (GA 873010).

1 Introduction

"Regional development is a broad term but can be seen as a general effort to enhance well-being and living standards in all region types, from cities to rural areas, and improve their contribution to national performance and more inclusive, resilient societies."

(OECD, regional development policy[1])

The European Project DigiTeRRI (H2020, SwafS[2]) defines the development of a region according to OECD with emphasis on the general effort to enhance well-being and living standard and for improving its contribution to national performance and a more inclusive and resilient society. This implies a well working research and innovation ecosystem in a territory as a living foundation for young and old, for highly educated and uneducated persons, for science and research, for SMEs and big companies.

DigiTeRRI project deals with Responsible Research and Innovation (RRI) for the transition of a traditional regions into digitalised innovation ecosystems. The considered regions have a long history in steel, non-ferro metallurgy, and paper production, or in the automotive and aerospace industry. Such innovation economic

[1] https://www.oecd.org/regional/regionaldevelopment.htm

[2] SwafS – science with and for society programme

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systems are currently undergoing major changes into a digitalised industry. This transformation holds many opportunities for the region. However, experts also raise concerns that organizations might be unable to adapt to this revolution, which is flooding our lives, our societal, cultural, economic system, and the industries.

The DigiTeRRI approach is built on the theory of innovation ecosystems. DigiTeRRI has adapted the specific Responsible Research and Innovation (RRI) approach for regional development. It integrates forward looking methodologies with co-creation workshops with stakeholders.

This paper discusses first shortly the innovation ecosystem approach. Secondly, it presents the RRI approach in general. Thirdly, based on this understanding, the specific DigiTeRRI approach is discussed. In a next step the general outcome of this approach is presented and the specific case for Styria regarding the development of a vision statement is given. Finally, the limits of this approach are discussed.

Regional development is always linked to given regional strategies and to policy agendas, to planning on the national and European level. These aspects are not considered in this contribution. Here, we only focus on the co-creation approach with stakeholders in a region.

2 The Region and Its Innovation Ecosystem

The prosperity of a region depends on the successful interaction of the industry and business with science and research, as well as with the public authorities and the civil society. It is generally accepted that the prosperity of a region depends on the success of the innovation ecosystem there. The interplay between the actors, the knowledge flow and value creation between these actors is essential for a successful innovation ecosystem. Porter has already described the interlinkage of the knowledge flow of a territory and how the industry of a region competes with industries in the same sector and other regions (Porter 1990, 1998). Porter introduced the industry cluster approach for bringing a territory to prosperity by implementing a knowledge-based economy. Today, a broader approach is proposed, where not only industry, business, research, and science are addressed, but also public authorities as well as the civil society of a region. Cortright works out that a region with a high and rising standard of living depends upon creating a high-quality business environment (Cortright 2021). An economically flourishing region depends on strong innovation capacity and rising productivity in a region. However, the quality of life will be a priority in attracting people with knowledge, on which a regional innovation ecosystem is built on and continuously evolves. Thus, this unveils that all actors in a region with their interlinkages have to be integrated into the regional development. The innovation ecosystem is an important foundation and a living basis for a region. Furthermore, the innovation ecosystem of a

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region builds organisational spaces for co-creation of values through collaboration (Smorodinskaya et al. 2017). Collaborative networks and their ecosystems co-create these values through their common activities.

Knowledge interactions and all types of knowledge flows are crucial for the performance of the innovation system. Universities, research organisations, and companies are the main actors in most innovation systems. Searching for a unique definition of an innovation ecosystem fails because there isn't such a definition. There are various approaches. Freeman, for instance, defines an innovation system as "... the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies." (Freeman 1987). Fischer et al. (2001) describe an innovation system as consisting of actors and their interaction with one another. The entirety of private and public organisations and individuals contribute to building an innovation system by their activities and interactions, including the creation and diffusion of new technologies, new products, and new knowledge.

DigiTeRRI project defines an innovation ecosystem as an open system with growing dynamics and complexity. Innovation systems are complex systems. The complexity of innovation ecosystem is given by the differentiation of actors, the specialisation of organisations, the increasing dynamics of socio-economic and socio-technological systems, the growing complexity of socio-economic and socio-technological systems and of society, and the acceleration of the interdependences with actors around the globe. An open system describes the relationships between the organisations and their environment, which is linked for resources, personnel, and legitimacy (Boyle et al. 2001).

Figure 1 presents a scheme of a network in an innovation ecosystem. Knowledge interactions between the actors play a central role in stimulating and sustaining the knowledge flows within a research and innovation ecosystem.

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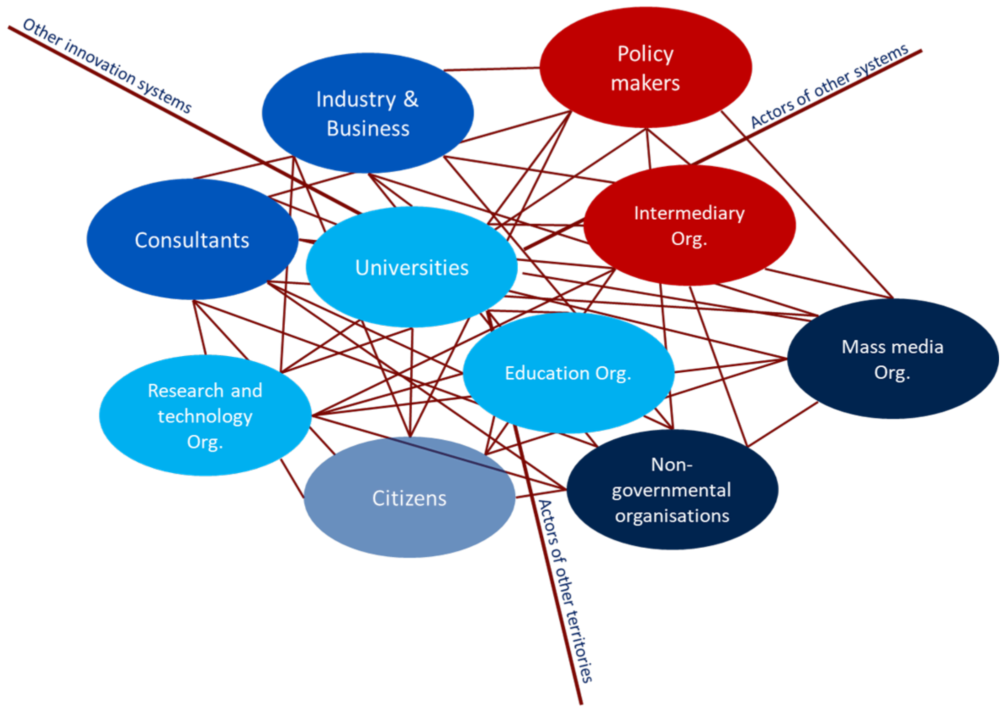

Source: Own representation (AIT, Center for Innovation Systems & Policy)

Figure 1: Network of actors in an (regional) innovation ecosystem

The further development of a region is built on these dynamics of the interactions and knowledge flow between the actors. In addition, a region depends on the commitment to the will for shifting its strategies to new forms of advantage, to render their old advantages irrelevant, before their competitors do it for them (Thurow 1999). This is a challenge. However, there is support also from the policy side.

The European Commission has developed strategies for Smart Specialisation. This is a political framework for finding ways to enhance the scale and effectiveness of entrepreneurial processes. This framework for Smart Specialisation is supposed to bring forth the specific potential and the capability inside the region and brought this to shine. It is a bottom-up approach for revealing a region's best scientific and technological competences. This approach is also a foundation for the work in DigiTeRRI if the transition into a digitalised territory can be considered as Smart Specialisation.

3 Responsible Research and Innovation (RRI)

Science and innovation for what? Science and innovation are for the society finally. Responsible Research and Innovation (RRI) has started to build an impetus across the research community in the European Horizon 2020 and there, especially, in the Science with and for Society (SwafS) programme.

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The RRI policy assumes that society has lost control over science and innovation despite the increasing direct and indirect public funding for stimulating and facilitating research and innovation. Research policy has become increasingly oriented towards scientific excellence. Innovation policy has oriented increasingly towards competitiveness. In this process, there is a risk that the social values of research and innovation get lost, or at least is increasingly up to researchers and innovators themselves to preserve.

RRI promoters maintain that political provision creates a framework which is insufficient to control the development of research and new technologies in potentially and ethically problematic areas, such as genetics, biosciences, and information technology including digitalisation. Creating new knowledge generates opportunities to develop new technologies. However, technology should not be developed for its own sake. The consideration of the impact on the society and on the environment would be a good basis for a worth living innovation ecosystem.

RRI is promoted and implemented in many projects for bridging the gap between science and research to society. RRI is a cross-cutting approach. This approach is more inclusive, participatory, transparent, interactive, reflective, and anticipatory than conventional research and innovation processes. RRI in connection with innovation ecosystems put innovation into a broader context with particular attention to responsibility and accountability, with ethics and sustainability, embedding science and technological progress into society.

RRI seeks to raise issues in the context with research and innovation in order to anticipate the consequences for the society and involve it. The RRI approach discusses how science and technology can help creating a society we would want for future generations. It emphasises that research and innovation must align with the values and needs of the affected society. The policy agenda for RRI, therefore, focuses on both mitigating the negative effects of research and innovation in areas with potentially adverse societal effects, as well as actively supporting research in areas where the societal benefit is high, for instance in addressing the grand societal challenges. RRI envisages that responsible researchers and innovators actively construct their 'responsibility', reflecting the needs for researchers to communicate and to discuss their results for building social support and permitting social guidance of their research efforts (Owen et al. 2012). Organising from a rational, natural, and open systems perspective provides insight on possible uses of RRI across and between types of organisations, with respect to the individual keys and dimensions (Wittrock et al. 2021).

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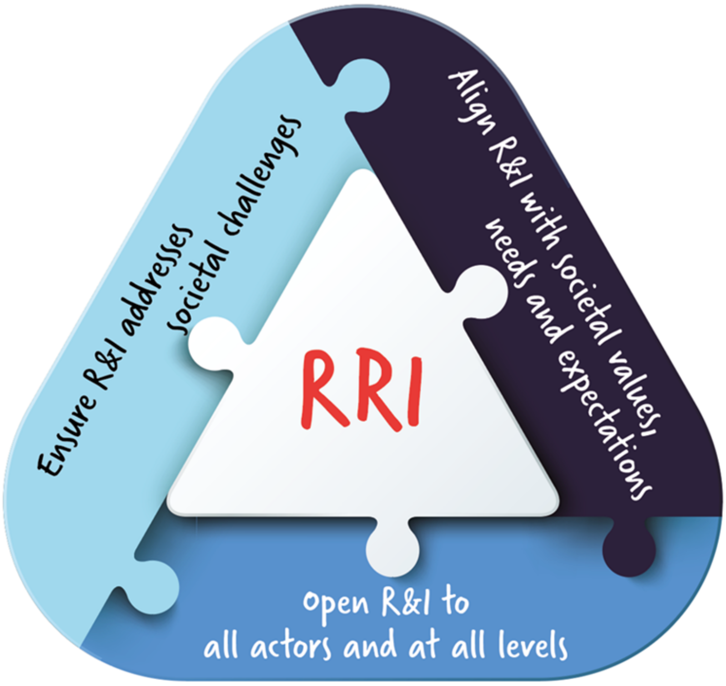

Source: DigiTeRRI representation (WeDo Project Intelligence Made Easy)

Figure 2: How RRI is presented in DigiTeRRI

An RRI process is anticipative and reflective, responsive and adaptive, open and transparent, diverse and inclusive. RRI engages representatives from science and research, from education, from industry and business, from policy makers, and from civil society (quadruple helix) for co-creating the future of a regions. This includes taking into account the RRI policy agendas (RRI keys) such as ethics, gender equality, science education, open access, and public engagement. Thus, it is obvious that RRI is a cross-cutting approach that aims to make research and innovation ethically responsible.

DigiTeRRI processes the transition into a digitalised region by the RRI by design, which means that RRI is implemented or realised by working with the stakeholders and anticipating the future with them. In the transition of old classical to new digitalised production, many unanswered and challenging questions will emerge. The development of a future strategy must involve both government and society, as well as science, research, and businesses. The transition into new technology opens new gates in the interaction with society and science and will offer an excellent environment for introducing and implementing RRI. Since the overall innovation system is undergoing a significant change by the transition into a digitalised system, the need for new solutions and thus the opportunity for implementing RRI actions is remarkably high. Self-organisation phenomena of complex systems reveal that constraints imposed from outside a system appear to be drivers for change.

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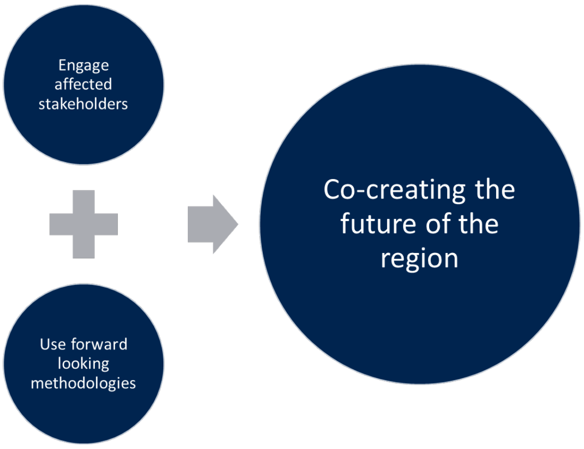
4 DigiTeRRI Project and Approach

The project DigiTeRRI elaborates a framework and develops a roadmap for a responsible transition of traditional industry regions into digitalised industrial self-sustaining R&I ecosystems by using an RRI approach. By the DigiTeRRI RRI approach the development of a region happens in a specific way. The roadmap development in DigiTeRRI is comprehensive and comprises the whole process from stocktaking and mapping to the identification of stakeholders, defining the framework, co-creating vision statements, to working out the goals, actions, milestones for a region, as well as implementing and monitoring of the actions and measures.

DigiTeRRI co-creates such a roadmap in three regions in Europe, in Värmland in Sweden, in Région Grand Est in France, and in Styria in Austria. In this paper, only the case of Styria in Austria is discussed, and first results presented. As already presented in previous chapters the project addresses the complexity of the challenges in the interplay between science, education, industry, government, and society. The interlinkages and collaborations within these actors of an innovation ecosystem generate and create innovation, products, economic success, governmental conditions for living and doing business.

DigiTeRRI combines stakeholder engagement with forward looking methodologies for co-creating the future of a region.



Source: Own representation (AIT, Center for Innovation Systems & Policy)

Figure 3: RRI approach in DigiTeRRI

4.1 Stakeholders

The stakeholders for the development of a region should come from various organisation types, from science and research, from education, from industry and business, from public administration, and from civil society organisations. Also, the RRI

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approach proposes these categories[3] of organisation types for the co-creation process. The representatives of these organisations, thus the engaged stakeholders, should have (1) the power to influence the organisation/territory, (2) the legitimacy for acting in the organisation/territory, (3) the urgency to claim measures (Mitchell 1997). This consideration is important when the developed strategies and actions also should be accepted and implemented. The balance in the stakeholder group is a further aspect for achieving acceptance for the developed actions. For instance, if there are 30 stakeholders engaged for this strategic process, six should come from science and research, six from education, six from industry and business, six from public administration and intermediaries, and six from civil society organisations. In addition, an equilibrium from young and old, from female and male stakeholders support the balance of diversity in the stakeholder group. Giving each stakeholder space and voice in the workshops is the challenge for the moderator. Of course, a well-designed workshop is an important basis for a successful group work, as well as properly informed stakeholders before the workshops.

DigiTeRRI tries to link the stakeholder identification as just described with the RRI keys, also known as RRI policy agendas. The following table gives an overview, how each RRI key can be linked with specific stakeholder features.

Table 1. Stakeholder linkage to RRI keys.

RRI Key	Comment	Stakeholder groups
Gender equality	Gender equality is seen primarily in the way in gaining the same conditions for males and females with respect to career position and salaries.	Any organisation dealing with gender equality or with the situation of females in society to get the same “professional” conditions for women as men.
Science education	Encouraging young people to take up a science education. With respect to a socio-economic system any kind of higher education in digitalisation.	Taking also into account organisation offering life-long learning programs or any organisation promoting higher education.
Ethics	Digitalisation asks for new considerations with respect to “digital ethics”.	Any organisation or panel dealing with ethical issues, especially focusing on digital ethics.
Open access	Open Access is seen as low barrier access to science	That can be organisations offering public repositories and access to

[3] https://rri-tools.eu/about-rri.

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RRI Key	Comment	Stakeholder groups
	publications for spreading knowledge. This also generated new groups of organisations offering repositories or access to literature, or editors for open access journals (media).	knowledge in kind of written or digital media. Often, libraries offer such services, but organisations offering share points or hubs can be relevant stakeholders too.
Public engagement	In most of the RRI literature NGO´s are mentioned as representatives for public engagement.	Within the DigiTeRRI project stakeholder representing the public will be rather local initiatives.

This approach for stakeholder identification and engagement, namely (1) representatives of the five actor types in a territory (science, education, industry, public authority, civil society), (2) stakeholders having the power, legitimacy, and the urgency, and (3) with the background of RRI keys, is a promising foundation for the success of regional co-creation of the future.

4.2 Roadmapping as One of the Forward-Looking Methodologies

The roadmap approach is applied because of the possible shorter timeframe. A roadmap considers the future of the next approximately five years. In case an implementation of actions, or a realisation of measures should happen in the near future, roadmapping is a proper instrument. In this way, first implementation actions can already be monitored during a project duration.

When considering a roadmap from a general point of view, we can say that a roadmap is an itinerary of paths that leads to some geographical space. A roadmap serves as a tool for travellers, which provides essential understanding, proximity, direction, and some degree of certainty in travel planning. A roadmap guides the driver of the vehicle to the destination.

In management literature, a roadmap is a metaphor for strategic planning. Roadmapping bridges the strategic planning with operational innovation management. Roadmapping describes the process of roadmap development. The earliest approaches to roadmapping date to the 1980s. Since then, roadmapping has become a standard methodology of future-oriented research.

The creation of roadmaps has its roots in technology-intensive companies. Due to the increasing complexity of products and processes, these companies faced the problem of how to keep track of important technologies. There was a shortage of explicit, framework-structured representations of future developments in products and

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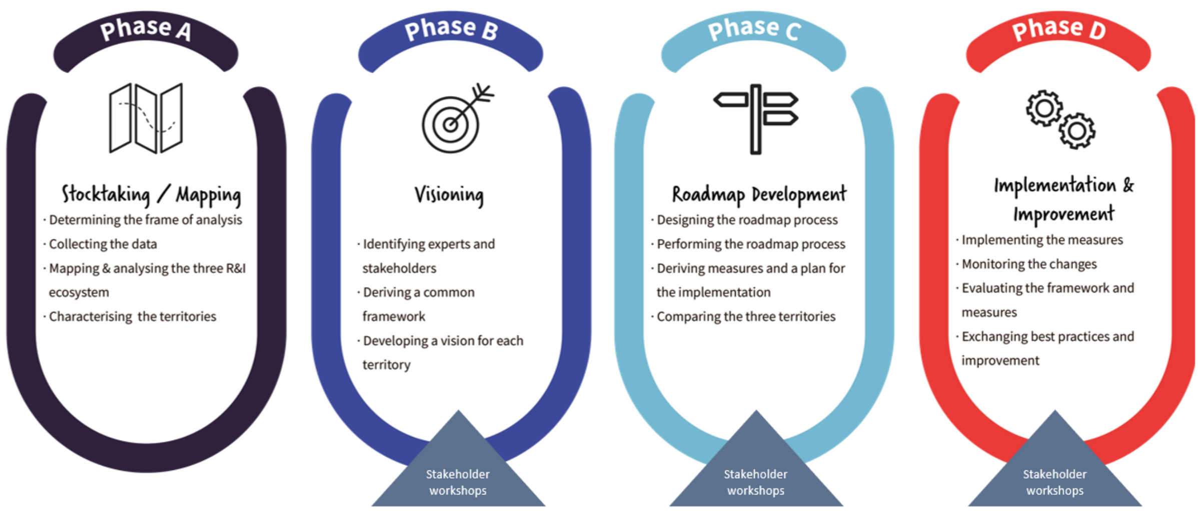
production processes for many organisations. Roadmapping offers an approach to address this challenge.



Source: Own representation (AIT, Center for Innovation Systems & Policy, adapted from International Energy Agency (2014).)

Figure 4: Roadmapping process in DigiTeRRI

The roadmapping process starts with the stocktaking and mapping, with collecting data for the mapping of the characteristics of the region. The next step is the visioning. The co-creation of a vision statement is crucial since it guides where to go. This step comprises the identification of experts and stakeholders, the deriving of a common framework, and the active co-creation of the vision statements in co-creation workshops. The next step deals with working out the roadmap itself. It co-creates the goals, tasks, milestones, action, and prioritises them. The last step implements the developed measures and actions. It also covers the monitoring of the changes, detecting best practices and improvement.

The co-creation is the foundation of the regional development. The group work with the stakeholders generates creative ideas. Furthermore, the group work creates an understanding of the colleague on the table, when done with stakeholders from different organisation types, and brings off awareness for the mindset of the colleagues. The different stakeholders (of one group) agree on common goals and work out actions, measures, milestones, and priorities. Finally, the actions and measures are implemented into the regional agendas.

On the one hand there are limits in implementation given by the power and legitimacy of the stakeholders committed to the co-creation actions. However, in case the stakeholders do have the power, legitimacy, and urgency, this approach is successful also in terms of the commitment of all participants of this co-creation work. The decisions are supported by a broader community.

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5 Outcome

Generally, the DigiTeRRI approach energizes the actors on an innovation ecosystem in a region[4]. Science & research organisations, industry & business, public authorities, and representatives from civil society have started to work together in each of the three regions of DigiTeRRI (Styria, Grand Est, and Värmland). This approach has started to develop a way for a worth living world in the region. It strengthens the relationships between stakeholders of the Quadruple Helix[5] thanks to the visioning and the road mapping processes. This includes well-functioning research, successful industry and economy, well-functioning public administration and a liveable living space for young and old, for highly educated and less educated people, for a diverse society. DigiTeRRI strengths relationships between academia, enterprises, and local authorities, and it implements methodologies for identifying and analysing RRI practices.

The DigiTeRRI approach enables robust exchanges between various stakeholders with more than 100 participants. It uncovers also the current fractured nature of how the actors work on the same or similar issues. The outputs of the co-creation workshops are being directly utilised within the regional work in relation to e.g. Smart Specialisation and the wider development of the regional work. It works on the operational and on political level within the regional authority. The DigiTeRRI stakeholder workshops are an excellent platform for discussing and learning about RRI and about various approaches how to implement RRI.

Each of the three DigiTeRRI regions has developed a vision statement. Due to the frame of this contribution the case Styria is presented. Before the vision statement is described, the region Styria is shortly drafted.

Styria is a federal province located in the south of Austria with a population of approximately 1.2 million inhabitants. Styria is traditionally both a resource-based and industry-oriented territory. It hosts automotive industry and electronics industry such as semiconductors or electronic components around the city of Graz with 284,000 inhabitants. In the northern part of Styria iron ore mining and metallurgy of iron and steel traditionally dominate the industry of this mountainous region, especially in the Mur-Mürz valley. Today, many suppliers or customers around the steel industry are settled in this area. The emphasis is on material production and other material producing segments such as polymer engineering, industrial logistics, or

[4] The mapping investigates the output of the innovation system in the regions. It unveils the current visible science activities, the collaboration networks of national and international projects, and the patent activities. The results are an important starting point. Presenting these results would, however, go far beyond the scope of this contribution.

[5] Quadruple Helix describes the organisation types „science & research”, “industry & business”, “public administration”, and “civil society”.

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environmental engineering. Regions with a tradition in metallurgy and steel industry have been facing crises repeatedly, so also in 2008. This crisis initiated a heavy loss of jobs in the region. This loss of jobs was correlated with a decrease in population especially with young people moving to urban centres. In 2017, the general employment rate of females was about 40%. When considering especially the industrial segments, the rate of female employees is lower than 35%. However, Styria has many universities. These universities collaborate closely with the industry. The innovation ecosystem in Styria is highly recognised as innovative region in Europe. This short draft about Styria should give the reader the possibility to get the starting point for the development of a vision statement for Styria.

The vision development in a stakeholder co-creation workshop resulted in the following vision statement:

"Upper Styria is an attractive and open living space for all generations. Digitalisation accelerates learning in the region and opens new perspectives in traditional and new fields. It is knowledge and business oriented. The pillars for international competitiveness and high quality of life are excellent research and innovation implemented with modern infrastructure and cooperation."

The vision statement was developed in German, translated into English, and further translated into the following image. This process itself is an excellent exercise for sharpening the vision statement.

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Source: The graphical translation into this picture is the work of Mario Magaña from WeDo in close cooperation with Julia Schmidbauer (MUL), Brigitte Kriszt (MUL), and Teresa Riedenbauer (ZAT).

Figure 5: The visualisation of the vision statement for Styria.

The vision statement development contributes to emphasis the commitment for the development of a common future inside the stakeholders in the region. A vision statement is needed for roadmapping because it guides the goals, tasks, action to be developed in the roadmap. This is the logical next step in DigiTeRRI. Describing the compendium of the whole roadmap would go beyond this paper. The concrete goals and measures are described in a next paper.

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6 Discussion

This DigiTeRRI approach is developed for a specific direction, namely for the digital transformation of a region. This approach works for specific topics, where many and various stakeholders are affected. Being affected make stakeholders engaged. This is a crucial aspect, getting the relevant stakeholders engaged. Besides the theoretical considerations in 4.1 also an excellent networker is needed for attracting the relevant stakeholders. However, the stakeholders are most relevant in this DigiTeRRI approach. The work for bringing the idea to many relevant stakeholders and to inspire them is hard work. This DigiTeRRI approach builds a bridge between the different stakeholders and creates awareness in the society.

The stakeholder discussion will uncover the different interests of stakeholders and their different and often very diverse expectations. Moderators and designers of such workshops should be prepared for dialogues with diverging contents. Emphasising the well-being of a broader society could support finding a solution. However, RRI in the context of industry and business which have to compete on the globe need smart ways for implementing RRI.

Building a core team with representatives of Triple Helix (science & research, industry & business, and public authorities) is an important success factor for working out the design, the process steps, the preparation of the workshops because understanding the different backgrounds and point of views are already depict inside the core group. Therefore, different opinions and ways are already known inside the core group as to be prepared for the stakeholder workshops.

A project such as DigiTeRRI initiates regional development. It opens the mind of decision makers and creates awareness. But for all that changing of culture and mind-sets need request time. Thus, DigiTeRRI and similar projects have the limits due to limited time and resources.

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Sustainability Transitions and Deep Institutional Innovation—Rethinking RRI

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Abstract. The scale and pace of technological change, alongside the socially disruptive consequences of new technologies, have created a growing perception that the future of work, democracy and other aspects of social order will require new forms of technology governance (Winickoff and Pfotenhauer, 2018). Responsible research and innovation (RRI) has emerged as an important approach and set of practices, aimed at integrating ethical and social issues more directly into innovation and into the governance of science, innovation and technology. RRI frameworks aim to foster science, technology and innovation through a process of anticipation, reflexivity, inclusion and responsiveness. RRI marks an advance in approaches to science and technology governance as it aims to affect upstream development and help direct the very trajectory of technology towards the solution of critical societal challenges. Nevertheless, existing RRI practices have focused largely on scientific and technological practices outside of their economic, social and political context. As such, they have not adequately come to terms with the complexity and multi-institutional nature of the challenges that technology development presents. More effective solutions must begin with the right models for deep institutional change. This paper outlines a new so-called DIIS model (Hughes et al. 2021) of technological change, which presents a re-conceptualisation of the role of technological change in societal transitions. The paper ultimately argues that while existing approaches to technology policy are moving in the right direction, they should seek to address technology more explicitly within its economic, political and social systems.

Keywords: Sustainability transitions; institutional change; technology governance; deep institutional innovation; responsible research and innovation

1 Introduction

While critical for addressing some of society's most pressing crises, innovation can also have negative consequences for individuals and societies, as witnessed in previous waves of industrial revolution or in current debates around digitization, data privacy, and artificial intelligence. In fact, the ambiguous societal implications of technologies bring them to the forefront of popular media and political debate. Indeed, the governance of AI, blockchain, autonomous vehicles and genome editing have emerged as issues of high concern.

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Responsible Research and Innovation (RRI) has emerged as a set of principles and practices aimed at governing technology for the public good (see e.g. Owen et al., 2012; Burget et al., 2017). RRI has arisen from concerns about detrimental impacts of existing and emerging technologies. At the same time, the development of RRI is happening at a time of not only accelerating technological change, but of profound environmental, political, and social change. Climate change has been acknowledged as a planetary phenomenon that threatens the climatic and ecological balance of the planet, with severe consequences for humanity. And climate change is but one of a series of crises, which also include environmental degradation, species extinction, crises of economic and political inequality, democratic malaise, the rise of authoritarian populism, rising geopolitical tensions, the persistence of extreme poverty, and pervasive levels of violence. All of these changes feature technology as constituent elements.

This article examines RRI principles and practices in the context of this particular historic moment of these cascading crises and puts the analysis in the broader context of deep transitions and theories of systems innovation. The outline of the article is as follows. Using artificial intelligence (AI) as a leading case, Section 2 illustrates the array of governance challenges presented by emerging technologies which RRI aims to address. These concerns range from the need to control disruptive transformative technologies, defend against existential threats, steering RDI to address societal challenges, and a democratic imperative that people should participate in decisions that profoundly impact them.

In Section 3, we briefly review existing RRI principles and practices, including Stilgoe et al.'s (2013) framework for RRI and their four dimensions of responsible innovation - anticipation, reflexivity, inclusion and responsiveness - that provide a framework for raising, discussing and responding to the diverse challenges raised by many existing and emerging technologies. We highlight some of the challenges that existing RRI faces in effectively placing ethical boundaries on technology development, including the need for systemic application of RRI instruments both to a diverse range of innovation actors and across the entire R&I cycle.

In Section 4, we step back to look at the larger context within which RRI is being developed and applied. We briefly outline two existing theories of sociotechnical change that both seek to understand technological change and its wider societal drivers, influences and impacts. These theories are the Multi-Level Perspective (MLP) of Geels (2005), and the Deep Transition theory of Schot and Kanger (2018). Both of these theories examine the dynamics of transition from one socio-technical system to another (the transition from a carbon-based energy system for example to a renewable energy system). While the MLP focuses mainly on the transition of single sociotechnical systems, deep transition theory attempts to explain the dynamics of the emergence of entire socio-technical paradigms, particularly the existing paradigm of industrial modernity. Finally in this Section, we introduce our new framing for societal transformation, the model of Deep Institutional Innovation for Sustainability and Human Development (DIIS) which aims to situate technology as a social institution embedded within a range of other social institutions including economics, politics, gender, religion and education, with which the technology system co-evolves.

In Section 5, we return to critique existing principles and practices of RRI in the light of the DIIS model of whole of society transformation. We conclude that while RRI tends to address the problem of science and technology governance through the micro-practices and contexts of the innovation system – and therefore provides a necessary intervention -- the deep embeddedness of innovation within political, economic and cultural systems is left largely unaddressed. In short, as a general matter, RRI may be working without the correct model of a complex and interconnected innovation system. Recent models of technological and societal change that diagnose the deeper drivers of the current moment of crisis may offer a necessary foundation for the development of a new innovation policy.

2 Challenges for Governing Emerging Technology: The Case of AI

In order to illustrate the high stakes of emerging technologies for basic human values, and therefore governance, Artificial Intelligence is an excellent example. AI is a potentially powerful general-purpose technology (GPT) with the ability to cause broad transformation of the economy and society (OECD, 2019, Trajtenberg, 2019). It is anticipated that progress could be rapid, with potential major advances in medicine and health (Goodman et al., 2020), energy (Ahmad et al., 2021), transportation (Abduljabbar et al., 2019), education (Owoc et al., 2021), innovation (Cockburn et al., 2018), and sustainable development (Vinuesa et al., 2020). The risks, however, are substantial and diverse.

2.1 Labour Displacement

One prominent issue of concern is the future of work: AI carries the potential to transform production systems and to replace human labour in many sectors of the economy. The displacement of labour by AI is predicted to be significant in the future and may result in levels of unemployment that could undermine social cohesion and stability. Recent estimates by the OECD are that 14% of all jobs across 32 OECD countries have a high risk of automation (Nedelkoska and Quintini, 2018), while a further 32% of jobs may experience significant changes to how they are carried out. There is an emerging consensus that artificial intelligence is likely to represent a new

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employment paradigm (OECD, 2018) with far reaching consequences for individuals and societies.

2.2 Inequality

There are concerns also about the impact of AI on inequality, between firms, in terms of exacerbating existing inequalities, and between generations. Current AI research and development activity is concentrated within a small number of companies, raising fears that rapid breakthroughs in AI could result in unprecedented increases in capital accrual by those firms. According to O'Keefe et al. (2020), the growth in economic wealth from advanced AI could be unprecedented in magnitude and speed, potentially disrupting the structure of the global economy and resulting in the rapid creation of an oligopolistic global market structure.

AI could also replicate or even exacerbate the existing inequalities that have already emerged in terms of the digital divide between demographics within society who do and do not have access to digital technologies (Van Dijk, 2017). A rapid transition to AI could also potentially result in increased inequality between generations. According to Sachs and Kotlikoff (2012), since AI is designed, owned and run by skilled workers, who are typically mid-career, AI is likely to impact detrimentally on young unskilled labour, while benefiting older skilled labour, thereby depressing the wages and savings of the next and future generations.

2.3 Range of Safety Concerns

AI raises an array of safety concerns. 'Narrowly competent' AI systems are already being applied across a wide range of domains from transport to energy to banking and finance and beyond. In applications like self-driving cars, automated trading systems, air traffic control, or control of the power grid, AI system failures could lead to severe disruptions or mass casualties.

In addition, the potential for AI to disrupt political systems is already impacting, for example, through the emergence of deep fakes that make it difficult to distinguish between truth and misinformation. The deployment of mass surveillance systems based on AI also highlights the misapplication of AI to reinforce authoritarian forms of government (Wright, 2018). Yet another danger is the emerging arms race in lethal autonomous weapons (Haner and Garcia, 2019).

2.4 Existential Threats—'SuperIntelligence'

The possibility of AI posing an existential threat to humanity constitutes another thread in AI literature. Bostrom (2014, 52) uses the term 'superintelligence' to refer to "intellects that greatly outperform the best current human minds across many very general cognitive domains". At present, AI systems are specialised 'narrowly

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competent' systems that perform specific, restricted tasks that approximate to, or in some cases exceed, human capacities in those restricted areas. The future evolution of AI systems, however, may see advances towards 'general intelligence' (AGI), that replicates human intelligence is its generality. The key concern regarding AGI research is the development of autonomous artificially intelligent agents which are much more intelligent than humans, and which pursue goals that conflict with our own, perhaps even leading to our own demise. While the feasibility of AGI remains controversial (Fjelland, 2020), one survey of AI experts reflects the belief that there is a significant (>25%) chance that superhuman capabilities in strategic domains could be developed within the next thirty years (Grace et al., 2018).

2.5 Systemic Impacts

This short review of the concerns surrounding the development of AI show that the range of issues of concern are diverse and far reaching. When the focus is broadened to other new and emerging technologies such as biotechnology, neurotechnology, nanotechnology and online digital technologies, the scope, breadth and critical nature of the governance challenges can be seen to be daunting. The development of these new and emerging technologies essentially constitutes what Callon calls 'society in the making' (Callon, 1987). As such, the impacts of R&I are potentially deeply 'systemic' and reach far beyond those stakeholders who are directly involved, such a researchers and funding agencies. In terms of governance, new and emerging technologies therefore raise a number of fundamental difficulties.

First, the ubiquity of their potential impacts raises the question as to who should have a say in R&I, and what processes might possibly be put in place to direct and control such changes.

Second, as Hajer (2003) points out, disruptive technologies typically fall into an 'institutional void', where there are few agreed structures or rules that govern them. Their novelty and ubiquity mean that new applications and their diffusion take place globally in ways that conventional policy find difficult to control (Hajer, 2003). Callon et al. (2011) use the metaphor of science and technology 'overflowing' the boundaries of existing scientific regulatory institutional frameworks and describe this context as one of relative 'lawlessness'.

Third, current forms of regulatory governance offer little scope for broad ethical reflection on the purposes of science or innovation and can do little to identify in advance many of the most profound impacts that may emerge through innovation (Stilgoe et al., 2013).

And fourth, and finally, current forms of technology governance also provide little scope for reflection on the deeply interconnected systems of politics, economics,

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gender, education and religion in which technology systems are embedded and which deeply influence the path dependence of technological development.

3 Overview of RRI as a Process to Address the Diverse Challenges of Technology Governance

To address some of the concerns around the governance of STI, the European Commission has sought to institutionalise notions of “responsibility”, “responsible development” and “responsible innovation” for science and technology under the banner of “Responsible Research and Innovation” (Tancoigne et al., 2016). Other international organisations including UNESCO have adopted Responsible Research and Innovation as a tool for steering entire innovation systems in ethical directions and as a means of addressing global challenges such as climate change. As a general matter, the RRI framework aims to widen the scope of formal processes of ethics review for research and innovation into a more open approach that addresses wider societal implications of science, services and products. Given this array of demands on RRI, this section turns to briefly outline the range of principles and practices that currently constitute RRI with a view to judging whether existing RRI can meet the critical challenges demanded of it.

There is not one canonical definition or approach to RRI (see Table 1 below). As a general matter, RRI can be seen as the attempt to design and implement an inclusive process for ongoing collective deliberation and decision making to address the multiple and diverse goals that research and innovation are presenting, and to constrain technology development within agreed ethical boundaries.

In one influential exploration of the field, Stilgoe et al. (2013) propose four dimensions of responsible innovation - anticipation, reflexivity, inclusion and responsiveness - to provide a framework for raising, discussing and responding to the diverse challenges raised by many new and emerging technologies.

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Table 1: Understandings of “Responsible Research and Innovation”

- “An on-going process of aligning research and innovation to the values, needs and expectations of society.” Rome Declaration on Responsible Research and Innovation in Europe, issued under the Italian Presidency of the Council of the European Union, 21 November 2014 (European Commission, 2014).
- “RRI can be viewed as being as much about fostering practices and cultures amongst those engaged in supporting and pursuing innovation as a concern with appropriate regulatory and governance structures. The engagement of publics in determining what the desirable ends of research are, and how innovation processes can achieve these, is also often seen as a crucial part of responsible practice" (Nuffield Council on Bioethics, 2013).
- “A science policy framework that attempts to import broad social values into technological innovation processes whilst supporting institutional decision-making under conditions of uncertainty and ambiguity. In this respect, RRI re-focuses technological governance from standard debates on risks to discussions about the ethical stewardship of innovation” (Schroeder and Ladikas, 2015).
- “A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and social desirability of the innovation process and its marketable products (in order to allow a proper embedding and technological advances in our society)” (von Schomberg, 2013).

Anticipation involves systematic thinking on possible consequences of research and innovation. Techniques that have been developed to embed anticipation in R&I processes include upstream public engagement (Wilsdon and Willis, 2004), Constructive Technology Assessment (Rip et al., 1995), and ‘Real-Time Technology Assessment’ (Guston and Sarewitz, 2002). These techniques involve anticipatory discussions of possible and desirable futures.

Reflexivity. According to Schuurbiers (2011), RRI requires deep reflexivity, in which the value systems and theories that shape science, innovation and their governance are themselves scrutinised. Such self-scrutiny and critique need to be public and conducted not only by researchers and innovators, but also at a systemic level involving all stakeholders who are part of the R&I system, including citizens.

Inclusiveness. The participation of diverse stakeholders, including citizens, is a central tenet of RRI. Techniques aimed at including end users in the innovation process

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include user-driven innovation (Hippel, 2005), open innovation (Chesbrough, 2003), open source innovation (Raymond, 1999), participatory innovation (Buur and Matthews, 2008) and networked innovation (Powell et al., 1996). Small-group processes of public dialogue, described as 'mini-publics' by Goodin and Dryzek (2006), have also been developed including consensus conferences, citizens' juries, deliberative mapping, deliberative polling and focus groups. Such mini-publics aim to include public deliberation as an upstream input in the innovation process.

Responsiveness. Responsiveness means that technology governance responds effectively to the knowledge that results from improved anticipation, reflexivity and inclusion. The mechanisms that might enable responsiveness include, for example, the application of the precautionary principle, a moratorium, or a code of conduct. The implementation of such mechanisms requires hard choices, including challenging dominant norms and values, and overcoming powerful interests that advocate particular technological solutions. RRI requires systemic application of these principles and holistic coordination of multiple individual mechanisms along the entire innovation process. As Stilgoe et al. emphasise, institutional commitment to a framework that integrates all four dimensions (anticipation, reflexivity, inclusion and responsiveness) is vital for effective technology governance within agreed ethical boundaries.

4 Models of Technological/Societal Change

While individual mechanisms such as mini-publics, research integrity, risk management and other RRI instruments may target parts of the governance of innovation, they do not represent a coherent and effective RRI governance system unless they are aligned with and work systemically with other RRI mechanisms. Indeed, as others have pointed out, this is a significant challenge (Stilgoe et al., 2013). The possibility of such coordination of multiple instruments for effective RRI governance is in some doubt. In the following Section we therefore step back to outline two existing models of socio-technical transition and introduce our new model of Deep Institutional Innovation for Sustainability and Human Development (DIIS) which seeks to position technology development within a holistic context.

4.1 Evolution of R&I Policy in the Face of Grand Challenges

For decades, innovation policy makers have been developing innovation models and policy instruments to target investments in science and technology to maximise the impacts of those investments. Until recently, the dominant model of technological change was the so-called linear model of innovation, whereby governments play an active role in financing scientific research on the premise that new scientific discoveries will be taken up by firms to produce new technologies, new industries, economic growth and jobs (Godin, 2006). Over time, this linear model was supplemented by the national innovation system (NIS) approach to innovation in which creating linkages between the various actors in the system, along with building their innovative capacities, are critical (Nelson, 1993).

In the last decade or so, owing to the scale of contemporary grand challenges, the linear model and the NIS model have increasingly been supplemented by a third innovation model, namely the model of System Innovation (SI). While the linear model and NIS both aim to strengthen and enhance the productivity of an existing innovation system, SI recognises that many of our current socio-technical systems are no longer sustainable, and that the optimization of existing systems is no longer sufficient. Instead, the SI approach aims to bring about fundamental change in the socio-technical systems that provide us with energy, food, and transport, among others.

The fundamental reorientation of R&I policy currently taking place has also been accompanied by the emergence of new models for understanding socio-technical transitions, most prominent among them the Multi-Level Perspective (MLP) (Geels, 2005, Grin, et al., 2010.), and the model of Deep Transition (Schot and Kanger, 2018).

4.2 The Multilevel Perspective (MLP) of Socio-technical Transition

The Multilevel Perspective (MLP) focuses on understanding large scale and long-term shifts that take decades to unfold, from one socio-technical system to another. Socio-technical systems are defined as configurations of actors, technologies and institutions that fulfil critical societal functions, such as the energy system, the food system, the transport system etc., that form the material backbone of modern societies.

The basic components making up the multi-level framework are niches, socio-technical regimes and socio-technical landscape, and socio-technical change is typically seen as resulting from interactions at each of these three levels:

1. The micro-level involves innovative experiments, for example by firms and communities developing and adopting new technologies and lifestyle practices. Compared to dominant regimes, the actors in niches are few, their interrelations are limited, and the new technologies and practices are still developing.
2. The meso - level is the existing technological paradigm, for example the existing technologies and practices that make up the current fossil-based energy system.
3. The macro-level landscape comprises high level mega-trends, rules and values, such as long-term changes in technology, the social acceptability of technologies, and the political landscape that supports or opposes change. As Schot and Kanger (2018) point out, this varied set of factors can be combined in a single ‘landscape’ category because they form an external context that

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niche and regime actors cannot influence in the short run, but that do influence activities at the niche and paradigm levels.

According to the MLP model of system change, for new innovations to break through and replace an existing paradigm, multiple policies are needed to overcome current technological infrastructures and practices. A key insight of the MLP perspective is that the transition from one socio-technical system to another results from the interaction of events on all three levels—niche, regime and landscape—and occurs through a specific combination and sequence of endogenous and exogenous sources of change.

4.3 Deep Transition

Schot and Kanger (2018) build on the MLP perspective to provide additional insights into an understanding of long-term socio-technological change. In their model of Deep Transition, Schot and Kanger point out that individual socio-technical systems (for food, energy, transport, production etc) are not free standing, but are instead interconnected, particularly in terms of the meta-rules that are common across them. Their model focuses on understanding the parallel evolution of multiple (as opposed to single) socio-technical systems, complexes of socio-technical systems, and the resulting broader and long-term transformations of industrial societies as a whole.

The Deep Transition model plays particular attention to the role of rule-systems (called regimes and meta-regimes) in driving the directionality of the entire process. Schot and Kanger's hypothesis is that throughout the centuries' long process of industrialization, sociotechnical systems have generated their own macro-level selection environment that impacts on the evolution of individual socio-technical systems. They call this macro-level selection environment, which has been evolving since the Industrial Revolution to become the dominant contemporary socio-technical selection environment, 'Industrial Modernity'.

A Deep Transition is formally defined as a series of connected and sustained fundamental transformations of a wide range of socio-technical systems in a similar direction. Kanger and Schot (2019) cite a number of examples of this directionality, e.g., the move towards increased labour productivity, mechanization, reliance on fossil fuels, resource-intensity, energy-intensity, and reliance on global value chains. Among the beliefs and guiding meta- rules of Industrial Modernity that have emerged during this time, and which continue to shape technological development, Kanger and Schot identify those set out in Table 2.

In addition, Schot and Kanger put forward the following propositions on the macro-dynamics of Deep Transitions:

- The first Deep Transition has comprised successive waves of technological development (Perez, 2002, Freeman and Louca, 2001) that have led to a long-

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term path dependency and a powerful selection environment, called Industrial Modernity' within which current technological developments are occurring.

Table 2: Meta-rules and values in the landscape of Industrial Modernity

Separation of Nature and Society	Modern industrial society is separate from, and above, nature
Dominance over nature	• nature as a resource to be exploited • control over nature as a desirable goal
Techno-optimism	Belief that societal problems can be solved through STI
Techno-neutrality	STI as inherently value free
Externality of environmental consequences	• Belief in limitless supply of resources • Assumption that waste is not a fundamental problem
Primacy of material progress over other forms of progress	Material progress would lead to emancipation, empowerment and self-realization
Market orientation	Belief in firms as primary drivers of innovation
Productivity	Belief that any human task should be substituted with technologies to increase productivity

- The landscape of Industrial Modernity, with its value and beliefs shown in Table 1, its reliance on fossil fuels, and relentless pursuit of productivity, mechanization, competition etc. have contributed to and intensified the twin challenges of environmental degradation and social inequality.
- The grand challenges that we now face, which have been created in large part by the processes of the First Deep Transition, cannot be definitively fixed within the framework created by this very transition.
- The Second Deep Transition towards sustainability and greater equality will only occur when there is a disruption in the meta-rules and meta-values that constitute the landscape within which technology development is occurring.

The model of Deep Transition adds a new understanding of landscape in the MLP framing and its influence on current technological development. As Schot and Kanger point out, the Deep Transition framing suggests that the expansion or optimization of existing socio-technical systems, or the stimulation of radical niches to promote transitions in single systems, will not be even remotely enough. Only when the broad selection environment of Industrial Modernity itself is transformed can it stimulate the interaction between niches, regimes and meta-regimes in a manner that would alter the directionality of evolution of the broad range of socio-technical systems which constitute the backbone of industrial societies.

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In other words, what is needed for transitions to sustainability and greater social and economic equality is a rupture in Industrial Modernity, and the creation of a fundamentally different macro-level selection environment for the future evolution of socio-technical systems: a different type of, or alternative to, Industrial Modernity.

4.4 Deep Institutional Innovation for Sustainability and Human Development (DIIS)

We now present a new model for societal transition that views technology as but one of a set of deeply interconnected social institutions that are currently undergoing profound change. The Deep Institutional Innovation for Sustainability and Human Development (DIIS) model (Hughes et al. 2021) broadens further the conceptualisation of the role of technological change in transitions by placing it firmly within the context of whole of society change. The DIIS model is illustrated schematically in Figure 1.

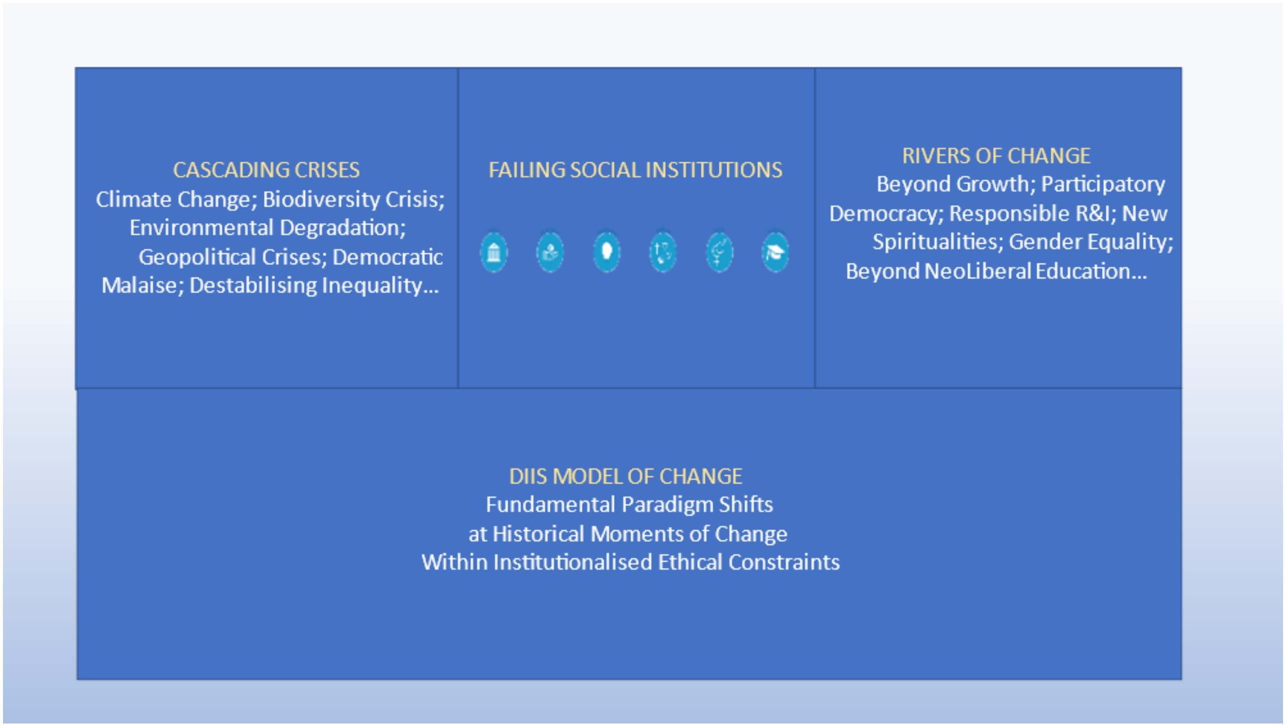

Figure 1: Model of Deep Institutional Innovation for Sustainability and Human Development (DIIS)

The top left part of Figure 1 represents the 'cascading crises' that currently afflict humanity. These crises include climate change, extreme biodiversity loss, environmental degradation, destabilising levels of poverty and economic inequality, persistent levels of social and economic inequality, the rise of authoritarian populism, the erosion of democracy, the challenges of digitalisation and emerging technologies, rising international tensions, and the prospect of globally devastating wars.

The top central portion of Figure 1 represents six major social institutions that have traditionally provided stability and direction for societies. While there is no single definitive definition of social institution, the DIIS model adopts the following broad characteristics of social institutions: they play a central and important role in society; they are typically meta-institutions, i.e., systems of ideas, organisations and practices; and being central and important to a society, they are usually long lasting, typically trans-generational. In the DIIS framing, social institutions are taken to span the ideological, material organisational, and 'social practices' aspects of the social systems considered (see Glatz-Schmallegger et al., 2021). In general, social institutions are characterized by continuity, pattern maintenance and social reproduction, rather than by deep structural change, innovation or transformation. The DIIS model identifies six major social institutions: politics, economics, technology, religion, gender, and education.

Since technology spans ideological, material institutional, and social practices aspects, technology qualifies within the DIIS framing as a major social institution. Although technology may change and develop, and in fact, as we will argue, will need to change for the transition to sustainability to take place, the ideology and system aspects of innovation have remained constant for some time. As the Deep Transition framework, as well as work in the field of Science and Technology Studies suggests, stable technological production systems, assumptions and ideologies help constitute our contemporary moment of industrial modernity (e.g., Jasanoff 2004).

That the technology system is deeply intertwined with the other social systems considered in the DIIS model is readily apparent from contemporary discussions within RRI itself. The interconnection between technology, economics and politics is clear, for example, in the central role of technological innovation in economic growth and in the role of governments in setting framework conditions for innovation, including regulation. The intersection of technology and religion is apparent in ethical debates on technologies including gene editing and potential developments in neurotechnology. Gender and technology is an area of focus in RRI, including the consequences of gender imbalances on the outcomes of research and innovation. Education too is deeply interconnected with technology in multiple ways, including the current dominant educational paradigm of skills production for jobs and economic growth.

The DIIS model is focused on understanding the processes of deep structural and functional change within social institutions at historic tipping points, such as the present. The model posits that existing social institutions have both contributed to the cascading series of crises in Figure 1, and are incapable in their present form of resolving the crises they have contributed to creating.

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The top left portion of Figure 1 reflects the fact that global movements are already in place that are advocating for, and taking action to create, social institutions more aligned with goals of sustainability and more equitable human development, and more able to address the crises facing humanity. In the realm of politics, movements for participatory democracy, for greater protections against authoritarianism, and for the inclusion of the interests of future generations are growing in strength. In economics, there has been an increasing acknowledgment of the shortcomings of the current dominant neoliberal economic model (OECD, 2020), alongside the development of alternative economic models (Raworth, 2017; Jackson, 2019; Folbre, 2008). In technology, as this paper attests, concerns about the adverse impacts of technologies have prompted the development of normative frameworks and practices such as RRI, as well as movements advocating greater foresight, regulation and accountability of transformative technologies. While religion is often viewed as immutable, the refiguration of religion and spirituality in the context of contemporary cascading crises, including climate change, is evidenced by the contemporary proliferation of religious schisms and emerging spiritualisms. Gender equality, and the social construction of gender, are pervasive issues across all of the major social institutions in society (Smiler, 2019). Finally, education plays a foundational role in terms of enabling (or preventing) deep system change. Education, particularly higher education, can either replicate the status quo in terms of paradigms of knowledge, epistemology, methodologies etc., or can act as enabling institutions, from within which deep system change may emerge. In this regard, movements which question the compartmentalisation of knowledge and research, and the dominant 'skills-based' paradigm of education, are gaining momentum in higher education internationally.

The bottom portion of Figure 1 represents the underlying DIIS model for understanding deep societal transformation that results from the simultaneous transformation of multiple contemporary social institutions. This model is outlined in detail in a previous paper (Hughes et al., 2021) and can only be briefly outlined here. The DIIS model posits that deep societal transformations occur at specific moments in history when underlying changes lead to tipping points that necessitate whole-of-society systemic change. It is the premise of the model that we are now at such a historical tipping point. Such moments of change are characterized by the breakdown of social institutions, experienced as periods of liminality, extreme contestation, social unrest and deep institutional innovation. A key focus of the DIIS model is that at such historical moments, the prevalence of particular sources of danger, if they are not restrained within institutionalised ethical constraints, can tip the balance of the transformation to outcomes that are severely detrimental to the public good. Such potential sources of danger include destructive leadership, ideologies of exclusion and blame, and social institutions that prioritise dominance values of hierarchy, inequality,

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coercion and private gain, over partnership values of equity, cooperation, and public good (Eisler and Fry, 2019).

The four components in Figure 1 together indicate the need for a whole of society paradigm shift, and that such a shift must be constrained within ethical boundaries if it is to result in outcomes that contribute to the common good, particularly increased sustainability and human development.

In summary, the DIIS model can be stated in four primary axioms:

1. achieving planetary sustainability requires deep institutional change across multiple social institutions (technology, politics, economics, gender, religion, education)
2. ongoing deep institutional changes are currently occurring across these social institutions, spurred by, and occurring within the context of, multiple cascading contemporary crises
3. transformation in one institutional arena (e.g., technology) is occurring in deeply coupled interactions with other social institutions (politics, economy, gender, religion, education), and
4. transformations, both within individual social institutions and their summation across society, must be constrained within ethical boundaries if the outcomes are to be in the direction of increased sustainability and greater human development.

5. Discussion and Conclusion—Implications of DIIS for RRI

RRI has emerged as a set of principles and practices aimed at enabling the governance of new and emerging technologies for the public good. The concerns that RRI seeks to address are diverse and critical, ranging from safety concerns over the application of new technologies, their environmental and societal consequences, the potentially existential threats that some technologies may pose, the desire to steer R&I towards the solution of existential threats such as climate change, and the imperative in democratic societies that citizens should have an input into decisions that may profoundly impact their lives. RRI has particular significance at the present moment given the range of crises that humanity is facing, most or all of which involve technology both as their cause and (in part) their potential solution. Current RRI approaches are based on accepted principles of anticipation, reflexivity, inclusion and responsiveness, and comprise multiple instruments which target individual parts of the R&I process. Effective RRI however requires systemic application of these principles and holistic coordination of multiple individual mechanisms along the entire innovation process. Such a coordinated approach has been difficult to achieve because RRI arguably lacks

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a theory of complex institutional systems. Here the RRI model of change could be enriched by the perspectives on system change outlined above.

The MLP, Deep Transition and DIIS models build on each other, supporting the deep understanding needed to address the cascading crisis we face. The MLP highlights the fact that transition in individual socio-technical systems occurs through the dynamic interplay of changes at the multiple levels of niche, paradigm and landscape. The Deep Transition model shows how the historical development of the multiple sociotechnical systems that underpin modern societies has resulted in a landscape of meta-rules and values that constitute Industrial Modernity. These meta-rules and values in turn acts as a deeply constraining influence on the further development of technology. The DIIS model aims to highlight the fact that technology, in turn, is part of a much wider set of social institutions, comprising politics, economics, gender, religion, and education, which also deeply influence the development pathways of technology. The models suggest therefore that the levers of action for RRI are more varied and pervasive, but also more institutionally embedded and potentially more intransigent. While the MLP and Deep Transitions frameworks both conceptualize the embeddedness of technology and innovation in wider social systems, the DIIS model approaches the technological system as inextricably intertwined with, influencing, and influenced by the other social systems which DIIS is addressing. This parallel conceptualisation and analysis of multiple systems in the DIIS approach significantly broadens both the research questions that present themselves and the transdisciplinary inclusiveness of the analysis required. For the purposes of the current paper, for example, the DIIS approach widens Schot and Kanger's conceptualisation of landscape from 'Industrial Modernity' to a much broader framing of landscape as 'Postmodernity', which can include sociological, psychoanalytical, and feminist perspectives, among others, in the framing. Further development of the DIIS model will aim to acquire a deeper understanding of the systemic intersectionality of the various social institutions included in the DIIS framing (Choo and Ferree, 2010), as well as further research on the simultaneous ideational, structural and process elements of multiple system change.

The perspective brought by the Deep Transition and DIIS models suggests three areas of further research for existing RRI that could potentially deepen the capacity of RRI as norms and practices to help steer technology in ways that support social change for the public good.

First, a potential limitation of RRI is that it views the world from within the STI system. Current RRI practices operate within an incomplete model of change and a limited view of complexity. This arguably limits RRI's capacity to enhance the responsiveness to science and technology, one of RRI's core values as discussed above. True responsiveness requires a systemic diagnosis of the problem and likely solutions. The

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capacity to respond is limited if the scope is too trained upon itself. Further discussion on the wider whole-of-society contexts within which RRI is being developed and applied, as highlighted by the DIIS model, is warranted.

Second, RRI focuses on behaviour at the niche rather than structural systemic level. As a result, the RRI agenda, as important as it is, may be frustrated in its aspirations to help drive critical R&I transitions. DIIS, alongside the MLP and Deep Transition models, by showing the multi-level and inter-connected nature of the major social systems influencing technology, could provide new and important levers and targets for RRI.

Finally, it is questionable whether RRI—as it focuses squarely on the STI system alone—can aim at the deep systemic changes that are needed for transitions without rethinking innovation itself. Both the Deep Transition and DIIS models assert that a rupture with the landscape of meta-rules and values of industrial modernity is necessary for transitions at this historic moment. The point of intervention of existing models of RRI, which aim to bring about changes to the governance of technology within existing landscape meta-rules and values, might therefore be insufficient to effectively channel technological development for the public good. For these reasons, some commentators argue that RRI may be working with an oversimplified model of innovation itself and may need to rework some of its foundational assumptions (Blok and Lemmens 2015).

The preceding discussion suggests, therefore, that the responsiveness of the science and technology system to social challenges will require a greater appreciation of the complexity of the multiple systems that need to change and the integral role of technology within this broader context. RRI might usefully engage the theories discussed above in order to deepen its capacity to affect social changes that are sorely needed.

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The Company as an Innovation Niche: Towards a Sustainable Food System in Bulgaria

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Abstract. This case study presents a thriving Bulgarian food company (Harmonica) as a successful example of ongoing transformations in the national food system. Starting out as a small organic yogurt brand, the company has developed into a transnational corporation operating in over 20 countries in Europe, Asia and the Middle East. I offer a social-technical interpretation of economic value chains approaches to describe the process of creating new food production and consumption practices. Co Viewing environmental, social and technological issues through the competences of the actors involved in a start-up business, provides an example of a company that generates economic value, but also re-invents traditional food technologies and tastes, thus demonstrating the embeddedness (Granovetter 1985) of the food chain transformation in the local political, social, economical, technological and environmental context. Surprisingly, sustainable values are seen only as a necessary, but not sufficient condition for the innovation process. The re-construction and re-invention of traditional food tastes (on the demand side) coupled with applying traditional craft technologies (on the supply side) gained much more significance in changing social practices, thus fostering innovations and entrepreneurship not only in the food sector. The main reservoir for sustainable innovations is new combinations (relations) of existing competences and their faster utilization within the value chains.

Keywords: sustainability transition, value chains, organic food industry, innovations

1 Introduction

In recent years, sustainable transition studies have become a broad interdisciplinary field incorporating science and technology studies, sociology, political science, economics, geography, management, and history. The efforts of the scientific community are gradually moving towards improving policies and decision-making and supporting practitioners in the pursuit of incremental change (learning by doing) in the field of sustainable entrepreneurship.

I offer a sociological view of the predominant economic perspective on processes of value chain creation seen mainly as a competitive advantage in the global economy in order to gain a deeper understanding of emerging new forms of production and consumption and develop a possible model (prescriptive) for the development of sustainable innovations and entrepreneurship. Opening the “black box” of innovative practices based on the strong normative (environmental) values of the actors involved seems to be the key to redefining the relationship between culture and nature. In

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general, it is assumed that social capital, understood as the ability to mobilize the various competences of the actors (internal perspective) and client-oriented experiences (external perspective) drive the value creation process. Thus, my hypothesis is that new technical (scientific) inventions are not the main reservoir for sustainable innovations (Schumpeter, 1954), but rather new combinations of existing knowledge and skills and their faster utilization in the value chains.

This case study presents a successful Bulgarian food company (Harmonica) as an example of the ongoing transformation of the national food system, which originated as a small organic yogurt brand but has since developed into a transnational business operating in over 20 countries in Europe, Asia and the Middle East.

2 Theoretical Approach

2.1 The Niche Formation

As one of the prominent theories in contemporary sustainable transition debates, the multi-level perspective approach (MLP) (Geels, 2002; Smith et al., 2005; Geels et al., 2016) is a good starting point for theoretical extension.

The MLP approach differentiates three main levels of analysis: landscape developments, socio-technical regimes and niches. Thus, transitions take place when coupling occurs between landscape pressure, niche-innovations and regime responses to these. Central actors in this process are incumbents from the socio-technical regime and newcomers from other regimes or niche-innovators. The socio-technical regimes are perceived as a central unit of analysis, in view of the embeddedness of technologies and firms within the socio-economic context (Smith et al., 2005). In our view, more attention should be paid to the processes of “niche-in-the-making” (Paschen et al. in El Bilali 2019) and interactions between different actors. Thus, opening the “black box” of niche formation and early-stage developments could bring better understanding of the complex processes of sustainable transitions.

Thus, by the end of the 1990s the strategic niche management approach (SNM) was developed as a research model (Kemp et al. 1998; Weber et al. 1999) “*to import insights from constructivist science and technology studies into evolutionary economics as developed by Nelson and Winter (1982) and Dosi (1982”*” (Schot & Geels 2008: 539) and later as a policy approach aimed at managing “*(1) socially desirable innovations serving long-term goals such as sustainability, (2) radical novelties that face a mismatch with regard to existing infrastructure, user practices, regulations, etc.*”(ibid.) within so-called niches.

Hence, SNM is defined as ‘the creation, development and controlled phase out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim of (1) learning about the desirability of the new

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technology and (2) enhancing the rate of application of the new technology' (Kemp et al. 1998: 186). Weber et al. (1999: 17) summarized three key processes in niche formation:

- coupling of expectations;
- learning about problems, needs and potentialities; and
- network formation.

Starting from the question, how technological regime shifts occur, Kemp et al. (1998) provide historical evidence that "entrepreneurs/system builders and niches play an important role in the transition process" (ibid.: 183). They conclude that niches are crucial for the development of a new regime. Without a niche the entrepreneurs/system builders won't be able to innovate. The general understanding is that niche formation is coupled with certain policies to deal with different barriers during the process. Thus, the "niche" is seen as an interactive space outside any particular organization—a meso level, which even needs governmental support and top-down navigation. Nonetheless, the authors admit that there are some open questions and risks that should be taken into account with strategic niche formation. Certainly, the approach is useful but in our view it does not stress enough the incentives and certainly the stakes in terms of agency and the "leadership" within that process.

Thus, we need again to go back to the roots – the entrepreneur as a central figure (Schumpeter 1912)—and acknowledge that the "right" place where innovation occurs is the company (the micro level). The role of innovator-entrepreneurs in combining all necessary types of knowledge, skills, resources and capabilities (Fagerberg et al.) is crucial in terms of the question of leadership and system change. Of course, focusing on the micro level we do not want to juxtapose the different levels. The interplay between companies and different networks of innovators in terms of developing strong and weak ties (Granovetter 1985) has already been analyzed and belongs to the "standard" view of the systemic nature of innovations. Instead, we would like to shed light on the process of innovation in relation to the process of business development as Schumpeter (1934) differentiates in terms of:

1. The discovery of a new source of raw materials or semi-finished products
2. Creating a new product or giving a new quality to a product
3. The introduction of a new way of production
4. The creation of new markets
5. The creation of a new organizational form and / or the acquisition of a leading (monopoly) market position.

Thus, we would like to focus on the process of value creation instead of solely on innovation considering it as an outcome of this process.

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2.2 The Value Chains Approach

The concept of value chains originated in the field of business management. Introduced in 1985 by Michael Porter in his book *Competitive Advantage: Creating and Sustaining Superior Performance* (Porter 1985), it is based on the idea of the procedural nature of the business organization. Each company builds a specific system in which, in order to create and place on the market a product or service in return for a certain value (price), it must invest and acquire certain resources (money, labor, materials, machinery, etc.) and transform and process them to the final outcome. How well this chain functions and is organized determines how profitable a business is, how efficiently it works and what levels of profit and return are achieved.

Porter (1985) categorizes the types of activities that characterize value chains in order to give the company a competitive advantage. The interesting thing in this case is that the secondary activities proposed by him include human resource management and technological development, unlike, for example, logistics, marketing and sales—mentioned as primary. This demonstrates the main disadvantage of the concept that the (added) value is understood only in terms of the capitalized (financial) one. Accordingly, the last three areas have an advantage because, at first glance, their financial result is utilized more directly. Therefore, a broader understanding of value—not only in quantitative, purely economic indicators (profit, efficiency, etc.), but its inclusion and expansion with other (quantitative and qualitative) dimensions such as technological, environmental, and social factors - offers an opportunity for new ways of analysis and management of entrepreneurial endeavours.

2.3 The Value Capture vs. Value Creation Process

One possible direction proposed by Gereffi et al. (2005) concentrates on the global production and consumption patterns in different economic sectors. The approach looks at the value process in macroeconomic terms by postulating production-driven and consumer-driven value-added commodity chains (Gereffi, 1999). Global value chains consist of a set of inter-organizational networks grouped around a single product or service, connecting households, businesses and countries in a global economy. These networks are situation-specific, socially constructed and locally integrated, emphasizing the social inclusion of the economic organization. The specific segments in each chain are represented as nodes in a network. Each subsequent node in the chain includes the acquisition and/or organization of contributions (raw materials or semi-finished products), labor, transport, distribution and consumption. Chains are characterized by four main dimensions: an input-output structure (various value-added capacities, whether tangible or intangible), connecting actors in a given industry or related industries; territorially attached activities; management structure, determining

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the flow, speed and direction of movement of goods, capital, resources, etc.; institutional framework (political regimes, formal and informal “rules of the game”) in a national and international context.

In practice, however, Gereffi focuses on only one of his analytical dimensions, namely the management structure of commodity chains, i.e. on the final product, with a partial exception in the input-output interactions in its analysis of the footwear and textile industries. On this basis, he derives two ideal types of value-added chains: production-driven and consumer-driven commodity chains. Based on the sectoral organization of production, he postulated that the first type of integrated production systems were typical of multinational companies in such capital- and technology-intensive sectors as automotive, computer hardware, semiconductor, aircraft, power generation and other heavy electronic equipment. Corporate power in these systems is seen through the prism of vertical exercise from headquarters to divisions, with the value produced “flowing” in the opposite direction. The other ideal type of 'consumer-driven commodity chains' demonstrates that there are 'non-factory producers' who organize the global production process on the basis of consumer control, mainly through brand names and distribution networks.

This approach is important because it takes into account the global division of labor within the sectoral specialization of a particular national economy and the ways in which it “connects” with the world economy by identifying several different strategies for catching up industrialization. At the same time, Gereffi acknowledges that none of the countries surveyed follows exactly the same path. The interaction among geopolitical factors, cultural heritage, existing political regimes, government policy, local institutions and structures, etc. creates unique paths for development.

In sum, the global value chain approach seems to be more interested in the utilization of the end product/commodity within the global networks of different economic sectors and the control that global players exercise on its distribution. Thus, this approach is more relevant in explaining well-established industries and their global structural organization more in terms of value capture/distributions than value creation. It seems to be understood and described more as a linear process from product or service development through production, marketing, sales and distribution. In this way the strategy of the companies is to concentrate on what they have done, to analyze backwards and improve the process to find one “optimal” way of doing things. Thus, the industrial age value chain even at the level of management focuses more on value capture rather than value creation:

> “More than 80 percent of our management tools, systems, and techniques are for value-capture efforts, not for value creation; this includes techniques such as total quality management (TQM), enterprise resource planning (ERP), Six Sigma, Lean Startup, and Agile Systems. These tools are valuable for keeping an enterprise

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running smoothly. But we should be focusing on value creation rather than value capture alone." (Mootee 2013: 59)

Kaplan and Norton (2004) conclude that companies pay more attention to the past and what they have as tangible assets and less to the intangibles, which actually determine what they have to do now and in the future.

"That's why there's been little emphasis on managing intangible assets. However, they're the resources that make up the foundation for tomorrow's financial success. Before we go further, let's understand what we mean by an intangible asset. It can be the knowledge that exists in an organization to create differential advantage — and to satisfy customer needs. Intangible assets consist of things like employee capabilities, databases, information systems, customer relationships, quality, responsiveness, and products or services. Generally, a company's intangible assets account for 75 percent or more of its market value. Conversely, its tangible assets represent less than 25 percent." (ibid.)

2.4 The Value Creation Process

The value creation process within the company is already identified as a practice that brings additional competitive advantage. The difference between the optimizing and innovative companies has been studied (Lazonick 2004). The "resource-based" approaches to the company's management have been taught in business schools since the 1980s. Following newly adopted Design thinking approaches (Mootee 2013) and Porter's (1985) internal and external perspective for innovation strategy in companies I propose the following analytical schema in addition to the SNM approach:

1. **Coupling of competences** (internal process perspective) – connect (team) knowledge, skills, competences to value creation process. I categorize the following 5 general competences (Ivanov, Varbanova 2016, Varbanova 2019):
   - Entrepreneurial
   - Craft (technical, sector specific)
   - Human-centered (client-oriented)
   - Process-oriented (technological)
   - Organizational (logistical)

Thus, in respect to Schumpeter (1954), as already mentioned, the leadership in the value creation process is directly connected to the entrepreneurial capabilities of the company's management and its competences to identify innovation possibilities. Schumpeter stresses overcoming social and even psychological barriers towards innovation as a main prerequisite in process formation.

2. **Customer value identification** (external process perspective) – connect (user) experiences to value creation. To this second dimension, again Schumpeter

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(ibid.) points out the need for a suitable environment to meet the needs of the customers/users.

3. **Experimenting** (prototyping and testing) – connect (internal) knowledge and (external) experience to value and prove value creation usefulness. This phase is an important step in value creation process. Design thinking methodology emphasizes its importance and “fail fast” strategy. Prototyping and testing should be timely and costs restricted.
4. **Network formation** (scaling up) – evolve value creation process and expand to others.

This final point is the most important step in securing success of the innovation. As Schumpeter (ibid.) already recognized, without the encouragement of other entrepreneurs to take the risk and lead them along the new path there can be no change.

3 Case Study of Transforming the Bulgarian Food System

In the framework of this article, a case study will be presented as an example for reconstructing the process of value creation in the field of sustainable development. The company in question is in the Bulgarian food sector and a pioneer in organic food production. The case study is part of a broader ongoing research project that combines both quantitative and qualitative methods of analysis. Media publications, interviews and other publicly available sources in the field of eco-entrepreneurship in recent years are analyzed. Mapping of the eco-entrepreneurial ecosystem was carried out with the aim of maximum coverage of eco-entrepreneurs in the country. The decision to present the case is based on its importance for the food industry itself and its successful expansion.

3.1 Background

The founders of the company are Lyubomir Nokov, his wife—former Bulgarian tennis player Magdalena Maleeva, and Metodi Metodiev. The company, Harmonica, was founded in 2008 and started with the production of organic milk and yogurt. The story begins in 2004 or 2005, when Bulgarian farmers were trained and supported to move to organic production under a project of the Biouniverse Foundation, supported by a Swiss donor program. Two of the farmers at a dairy farm near Troyan (electrical engineers by education, but hereditary breeders) had graduated from the project and produced bio-yogurt, which they sold in Sofia. Interested in the product, which at that time few Bulgarians were aware of, the founders of Harmonica out of curiosity and as customers visited the dairy farm and became acquainted with the production process of Bulgarian organic yogurt.

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3.2 Coupling of Competences

Nokov remembers:

> "I was very sceptical and I said it was absurd in Bulgaria, we had never heard of anything organic and suddenly we decided to go and see it on the spot and got in the car, went to a farm and found it through Google Maps…just as customers. And we went to the farm and a breeder, I now know that he is a breeder, then I did not know what he was, he came and said: please come out now we will milk them and they are worried when there are outsiders. And we were impressed that the farm was super clean, without any such unpleasant ... and we went out and met them the next day, we talked a lot and then we became friends with the farmers and gradually decided to help them just to have the milk, because they were in a situation where they had done everything, but there was no market, simply because no one knew what it was all about." (in-depth interview with L. Nokov, 2018)

It turns out that the organization of the production itself is a complex task. Adhering to environmental standards is an important frame in the value creation process, from the natural resources (grazing, straw, cows, milk) to the final product (yoghurt). This rather short chain requires actually quite complex capital and labor-intensive decision-making with practical application of specific know-how. The prerequisites were there. The farmers' electrical engineering education is an indicator of process-oriented (technological) and organizational (logistical) competences and the hereditary experience in animal husbandry sets the normative (environmental) framework, but also of course the specific craft competences. The animals are not just a resource; they have a certain inherited attitude. They even dictate the situation: "Please come out, because they are worried about outsiders," says the farmer. There is an attitude in which the farmers have become spokesmen for the interests of non-humans. On the other hand, it is noticeable that there is a combination of the industrial (modern) paradigm with the traditional (livestock) one. The dairy farm is well organized and clean, the processes are structured and the environment is protected. At the same time within the value creation process the human-human interaction seems essential, that invisible, social bond, when the actors in their reconstruction of past events point out: "The next day we met, we talked a lot and then we became friends" (ibid.).

3.3 Customer Value Identification

As we see in this case, in the process of value creation, it is not simply a matter of economic interests and rationality—the *homo oeconomicus*, who is cold, calculating gains and profits. They are preceded by (social) accumulations, but also by the practical mastery of a certain matter (know-how) in this case, organic animal husbandry. It turns out that in the specific Bulgarian context as the farmers started in

2004 this was not enough. Without the external perspective, the value proposition to the potential costumers, there could be no viable solution. Here, our actors are testing and proposing an additional value chain, which is not just a matter of finding a market for this quality and environmentally friendly product: "...It was a bit of a coincidence, and then we decided to just help them get into the shops and such a good product, if they sell it in two shops in Sofia the work is done. It was not so easy. At one point, together with a friend of mine, who was in the food industry, with whom I discussed everything at the time, I decided to take this work more seriously, to take up marketing, then it turned out that we had to also take over the production part" (ibid.).

Our actors added their client-oriented perspective to the puzzle, but also in terms of food production, opening their own dairy: "...Then in 2008 we must have opened this small dairy here near Sofia, in Malo Buchino, and step by step something began to develop, i.e. from the idea of just having it on the market, to help them, because they couldn't do everything bio... certification consultants... everything was very difficult for them, there was no way it could be sustainable and it took years, after we left, by beginning to utilize the milk and to sustain the whole undertaking"(ibid.).

It turns out that they were "forced" to do so, "because we had a lot of milk left from the farms, which we could not sell" (ibid.). Thus, the utilization of the added value, combined with the normative (ecological) attitude, acts as an accelerator in the prototyping phase of the value creation process. And although the production of yoghurt itself still ran at a loss, the actors continued with the idea of a second product (test and prototype) for the remaining milk: "...And we decided to build a cheese plant in our dairy to use the rest of the milk. We urgently needed a partner in cheese-making and we found a very decent one, in Saedinenie, and that helped a lot, because suddenly we had a second product. We had to deal with a very difficult situation and then we decided that this is a very good way to develop, one that would engage many more people and give us access to much more knowledge and experience" (ibid.). Thus, even in the phase of testing we see that this is not a linear process. Network formation and value chain organization is an open process, with additional competences brought into it from "outsiders".

3.4 Experimenting

In the initial phase of testing and prototyping the social aspect provides the glue for the connections running through the economic, technological and organizational logic. The flow of know-how and competences seems to be crucial for sustaining the value process, when the whole endeavour is operating at a loss economically. Thus, in the beginning the idea was to support the development of a product—organic yogurt; but in the partner network the need soon crystallized (from the customer point of view) to enter production, even though the competencies of the founders were more in sales

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and marketing. Market logic (working at a loss) and the normative principle of recovery (a surplus of ecologically pure fresh milk) led to the search for a partner with additional (technical/craft) competencies (in cheese-making). Thus, the network grew: "In the beginning we thought we would make yoghurt, we never thought of doing anything more, let alone a brand or a portfolio, etc., but we actually saw that we could create a network that would allow many more farmers to switch to organic production. We gave up on the idea of building a cheese plant. It made no sense. It would be neither better nor cheaper. Instead, we started to develop this network, in fact from different farmers, partners, technologists, nutritionists, all kinds of people" (ibid.).

3.5 Network Formation

At a certain point the value chain creation expanded, and the local value network began to be integrated into global production networks through global retail chains entering the Bulgarian market (2009)—"Billa", "Piccadilly", etc., with their European headquarters understood that there would be growing interest in organic products. Starting something completely new, even without the necessary capacity to meet demand from the market, the actors created a new model for outsourced production, which became the basis for the development of "Bio Bulgaria"—a business that in 2019 generated BGN 8 million revenue: "We have tried to work without unnecessary investments and to use facilities that already exist. It is also good for business from an environmental point of view. If there are dairies with free capacity, we would not invest in cheese production" (Interview with *Forbes Bulgaria*, 2020, in Bulgarian).

3.6 Continuing Innovation—the Taste of Food is Leading

It turns out that by imposing this way of working, in which Harmonica was responsible for the quality of the final product, although the ownership is different, thus building a value chain that operationalized not only pure ecological production, but also a socially constructed concept of taste: "At one point we stopped emphasizing organic, organic became the mandatory minimum, we wanted Harmonica to mean much more, i.e. bio is one of the characteristics, it is our leading one, but we want Harmonica to mean many more things, to mean good taste, tradition, ... care for quality." And the definition of good taste is "when you eat something, you want to eat it again..." (in-depth interview), i.e., something that is recognizable and considered traditionally authentic is sought.

All this allowed them a lot of flexibility and the opportunity to experiment. The positive experience with yogurt, which has the taste from the past, was transferred to *boza* (a traditional beverage produced from rye). It took two years to test recipes. Nokov went around the producers of *boza* and asked how to make *boza* with sugar and fermentation in a bottle, as it used to be made in the past. They told him it was

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impossible, caps would explode, it would spoil. The status quo has imposed a cheap product with sugar substitutes and without fermentation. He continued to look for variants, even when his *boza*, instead of fermenting, stratified and congealed. “We made a difficult decision not to stop, even though angry people called every day that the *boza* didn't look like anything. But we could not solve the problem without working. If we had stopped, this product would have disappeared. It finally became fantastic.” (Forbes Bulgaria 2020).

3.7 Symbolic (Normative) Innovation—the Name Debate

The three founders had a discussion about what to call the yoghurt because when they started it was not yet known which word would work well in Bulgaria. In English-speaking countries, these products are called organic; in Germany and France they use bio or even eco. “Actually, we chose to call yogurt bio, it wasn't approved then, and people called us. You made a big mistake, you named organic bio and everyone will think it's GMO, because they'll think about biotechnology.” From the very beginning they opened their own small store for organic food—gradually other producers and mostly traders importing organic products appeared and the shelves began to fill up. The store served as a showcase for the new market niche and gave direct access to customers, thus providing the necessary feedback. They opened two more organic stores and stopped at three. The path had already been paved in Sofia. Many seemingly impossible things began to happen because of the way the brand was managed. Small shops, hotels, restaurants and cafes started to stock up on organic products. “It was also our idea - to show that quality food can go anywhere. We wanted more farmers to be certified for organic production and to attract more producers to see the meaning in organic products,” says Nokov (ibid.).

3.8 Constant Innovations to Stay Independent and Competitive

A very important principle of independence gradually crystallized in the company’s commercial policy if distribution through the big retailers becomes a large percentage of the business, efforts were made to develop alternative distribution channels. Enter the then new field of online commerce. Direct deliveries are “a very important part of the whole chain because of the direct contact with customers and the knowledge they give about the market” (ibid.). Exports are another channel of independence that provides support to more farmers. All the while, decisions are not based on trends and fashions or the way the “big ones” fit, but everything is tested in practice. What is gradually becoming mainstream for retail chains—shortening supply chains, promoting local production and more—is already successfully practiced by the innovative company “Bio Bulgaria”, owner of the brand Harmonica: "Now we are increasing the range across the board all the time and ... we want to work more with…we want to do

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two things, one is to find a way to work with smaller producers with more specific products that are seasonal, that are very small in capacity, insufficient for stores and that's why we developed a system for direct deliveries, a box of Harmonica, where we can work with a small seasonal producer.” It takes time to find out what products to include in international exhibitions, because yogurt and *boza* are impossible to export. However, waffles are in greater demand from customers in the Middle East and Europe. Bio Bulgaria sells waffles in Italy and Spain under the logo of a well-known brand on the local market.

3.9 Competition and Followers—a Criterion for Successful Innovation

“Our goal is to lead the way and let others start doing good things ... by coming in with a good waffle and others starting to make good waffles. If everyone starts doing things the way we do, it will be great…We will not stand alone on the shelf and it will become clear why we are more expensive” (in-depth interview). The perception of the evolving market is again counterintuitive, not to look for the lowest price, but to make the price (value) an indicator of quality. Thus, successful innovations, as well as discoveries, find their “imitators” and through competition in the newly created markets needs are satisfied and continuing ways to meet needs are improved and further developed in the most effective way.

4 Conclusion

This paper offers an attempt to broaden the theoretical perspective of, on the one hand, economic approaches dealing with value chain creation and, on the other hand, socio-technical approaches providing useful tools for innovation processes in the niche formation phase. A case study of the transformation of the food system in Bulgaria showed that the innovation process within a new (start-up) business could be seen as part of value chain creation as long as the company is preoccupied not with optimizing activities (improving effectiveness) but rather with improving its own resources. Another important insight is that the external (client-oriented) perspective of the value creation process in terms of fast prototyping and testing of proposed solutions is essential to their implementation. Specifically for the transformation of the food system in Bulgaria it turned out that the strong sustainable (normative) orientation of the actors involved did not match with what was demanded on the market. This was not a barrier for innovation; on the contrary, organic food production re-discovered traditional tastes (on the demand side) and re-invented traditional craft production (on the supply side). This re-construction and re-invention of production and consumption practices gained much more significance in the process of social change, thus fostering innovations and

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entrepreneurship not only in the food sector. The main reservoir for (sustainable) innovations in the food sector is rather new combinations (relations) of existing competences and their faster utilization within newly created value chains.

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Agent-based Modelling for Responsible Research and Innovation in Additive Manufacturing Innovation Value Chains: From SKIN to IAMRRI Model

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Abstract. This paper describes an agent-based model, the IAMRRI model, which includes market, innovation network, knowledge transfer, innovation value chain, dual industries, and responsible research and innovation features. Empirical data collected from the additive manufacturing industry as well as an extensive review of existing literature were used for designing the model. The IAMRRI model can be used for studying the interplays between the areas described above. A cursory implementation of the model is under development and will be released as an open-source software project. Limitations and suggestions for further research are described.

1 Introduction

The knowledge creation presented in this paper was made possible by the IAMRRI-project[1]. The project investigates webs of innovation value chains (WIVCs) in additive manufacturing (AM) and identifies openings for responsible research and innovation (RRI). Its aim is to develop a complex network model of AM innovation chains and the associated processes that are potentially relevant for RRI. There are two different industries in which AM is being used in the model—the automotive and medical industry. Knowledge transfer dynamics between broker agents in these two industries are designed.

The development of the model itself took place over three stages, all of which required extensive data collection from fieldwork, case studies and statistical data from multiple levels of observation and analysis. The first phase was 1) an extensive literature review and associated synthesis which 2) provided information that was used as a foundation for designing a conceptual network model of AM innovation chains and the associated processes. During the final stage 3) the model was implemented and adapted so that it could be used to answer the specific questions which the IAMRRI-project aimed to answer.

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This paper covers the second stage in-depth and addresses the following research question: *"How can webs of innovation value chains and RRI be most accurately described through an agent-based model?"* That is, this paper addresses the IAMRRI conceptual model. The IAMRRI model uses the SKIN[2] model as a foundation. Space limitations prohibits us from describing the selection criteria that finally led us to choosing the SKIN model as a foundation, but it involved a careful literature review starting with screening of 1864 published (and sometimes unpublished) works in academic journals, books, theses, and so on. For readers not familiar with the SKIN model, a brief description is provided. It is followed by a description of adaptations and extensions which comprise the IAMRRI model. Differences between base SKIN and the IAMRRI model are described. The product is a complex network model of AM innovation chains and their associated processes, including RRI mechanisms.

This paper and the model provided contributes to the innovation network literature by providing a mechanism of network formation and learning through its IVC extensions, the introduction of a double-industry feature that allows modellers to examine knowledge transfer dynamics between industries, and, finally, RRI mechanisms that allow modellers to simulate the effects of RRI on innovation networks, innovation value chain formation, learning, and performance.

2 Theoretical Background

2.1 Innovation Value Chains and Webs of Innovation Value Chains

Innovation value chains (IVCs) have been studied on both the abstract theoretical level and in specific industries. An Innovation Value Chain (IVC) can be understood as "a sequential, three-phase process that involves idea generation, idea development, and the diffusion of developed concepts (Hansen and Birkinshaw, 2007, p. 3). Martinsuo et al. (2019) suggest that such IVCs may co-exist and that members can take part in multiple IVCs, either at the same time or sequentially. This creates interrelated networks where innovation in one area can affect multiple innovations in other areas through knowledge transfer between participants. These supra-IVCs are termed Webs of Innovation Value Chains, or WIVCs for short.

Current studies of IVCs have substantial weaknesses. For example, Schlaile et al. (2018) showed in his review that studies of such innovation processes show little regard to bounded rationality and conflicting interests. Other weaknesses include missing such processes' dynamic nature (Chen et al., 2018), complexity (Roper et al., 2008), and multi-stakeholder nature (Olson, 2014). These weaknesses can partly be

[2] SKIN is an agent-based model of innovation networks in knowledge-intensive industries (Ahrweiler, 2017; e.g., Ahrweiler et al., 2015; Gilbert et al., 2018).

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explained by several methodological challenges. Use of panel data (Chen et al., 2018) and cross-sectional analysis (Ganotakis and Love, 2012) are useful, but also limited to shorter time horizons and unable to capture IVC dynamics. These limitations in state-of-the-art research become even more apparent when studying WIVCs.

Agent-based models are particularly useful for dealing with such issues, which is one of the reasons we decided on designing an agent-based model instead of other model types.

2.2 Responsible Research and Innovation (RRI)

The European Commission states that “Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society” (European Commission, 2014). RRI was initially an amalgamation of different fields such as political science, innovation studies, gender studies, ethics, and many others, but has since come into its own as a field of research.

Readers unfamiliar with RRI research but familiar with European policy might suspect that RRI is a policy-only concept, but in fact the concept of RRI been evolving concurrently in two parallel tracks—one academic and one political (Burget et al., 2017). Whereas the political track has been pragmatic and focused on political agendas (such as gender equality and science education), the academic track has focused on abstract and conceptual issues with RRI. These tracks have inspired and informed each other in the sense that the political agendas arise from issues deemed important by the public (e.g., gender equality) and these agendas provide empirical contexts and phenomena for researchers to study (e.g., what affects gender equality dynamics).

RRI is often divided into five thematic foci (European Commission, 2014): public engagement, open access, gender, science education, and ethics. These thematic foci are considered to represent particularly salient areas where improvements can provide the greatest societal benefits. In short, public engagement can be considered to be the degree to which societal actors work together; open access refers to the degree to which knowledge is shared openly - often in an open access fashion; science education refers to the extent citizens are able to understand scientific and technological developments and therefore participate in democratic processes related to them; gender typically refers to gender equality; and finally, ethics, or “systematizing, defending, and recommending concepts of right and wrong behavior” (Fieser, 2021) has several cross-cutting concerns across all the other foci.

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In the IAMRRI model, these foci act as phenomena that are included in the model (e.g., firms publish open access, actors make ethical judgements, representatives from the public engage in innovation processes, and so on).

3 Method – Agent-based Modelling

Much of the IVC literature is rooted in Neoclassical economics depicting managers as rational individuals (Hansen & Birkinshaw, 2007) while the recent studies point at bounded rationality and conflicting interests of the agents involved in innovation processes (see Schlaile, Mueller, Schramm, & Pyka, 2018 for a review). Presenting innovation as a linear process may be oversimplification of the constantly evolving system of emerging interactions of micro entities involved in the innovation process. Moreover, the existing literature could significantly benefit form more dynamic (Chen, Liu, & Zhu, 2018) and complex (Roper, Du, & Love, 2008) studies encompassing a multi-stakeholder perspective (Olson, 2014). These deficit of complexity in our understanding of IVC can be, at least partly, explained by the methodological challenges. Use of panel data (Chen et al., 2018) and cross-sectional analysis (Ganotakis & Love, 2012) set limits to exploring longer time-horizons required to capture the whole process of IVC development.

Even the most advanced equation-based models of IVC (Roper et al., 2008) lack temporal sophistication needed to allow for lagged innovation effects or simultaneity. These limitations of the modern state-of-the-art research become even more obvious if we move from studying single IVCs towards research on the multiple interrelated IVCs. Indeed, innovation activities cross industry boundaries (see Bornkessel, Bröring, & Omta, 2014 for a review). Cross-industry relationships along innovation value chains are argued to take a form of technological, regulatory, knowledge, market, and competence convergence (Bornkessel et al., 2014). The resulting dynamic and adaptive webs of IVCs (WIVCs) are complex to the degree that makes many traditional research methods, as, for example, causal modelling (Williams, Edwards, & Vadenberg, 2003) or equation-based modelling (Van Dyke Parunak, Savit, & Riolo, 1998), inappropriate.

This study suggests looking at WIVCs from a complexity theory perspective. Agent-based simulation is argued to be an adequate methodological approach to considering such a complex adaptive system.

ABM is “a form of computational modelling whereby a phenomenon is modelled in terms of agents and their interactions”, where an agent is defined as “an autonomous computational individual or object with particular properties and actions” (Wilensky and Rand, 2015, p. 1). There are three primary reasons we chose an ABM approach (Wilensky and Rand, 2015):

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First, by agent-based modelling one can model a heterogeneous population of actors who interact with each other and with the environment in a complex system with unpredictable results. Additive manufacturing is an emerging technology used in a fast-changing environment involving interactions among a multitude of actors. An innovation system (specifically in the AM industry) is a complex system. Thus, the advantages offered by ABM make this method well suited to modelling the additive manufacturing ecosystem consisting of multiple agents interacting with each other and their environment.

Second, ABM does not require any knowledge or assumptions about higher level phenomena resulting from the agents' activities; only individual-level behaviour is specified in the model. Since additive manufacturing is an emerging technology, little is known about the operating mechanisms of the additive manufacturing industry at the aggregate (industry or market) level. It is easier to describe the characteristics of individual actors than to create a causal description of the whole system. This makes ABM a natural choice of method for studying this field.

ABM enables us to "move beyond a static snapshot of the system and toward a dynamic understanding of the system's behaviour", providing us with a "rich and detailed account of the process of a system's unfolding in time, and not just the final state of the system" (Wilensky and Rand, 2015, p. 36). One key requirement of our model is that it should capture the *dynamics* of WIVCs. The ABM method fits well with this requirement.

3.1 SKIN as a base for the IAMRRI model

As described in the introduction, the choice of the SKIN model as a base for the IAMRRI model was founded on a screening/review of 1864 publications. The number of publications were carefully reduced through a multistep screening procedure. This left us with 383 publications that could be relevant for inclusion. These were further reduced as illustrated in **figure 1**. The remaining 6 publications were evaluated based technical, relevance, adaptability, track record, and commensurability merits. As a result of these evaluations, we chose the SKIN model as a base for the IAMRRI model.

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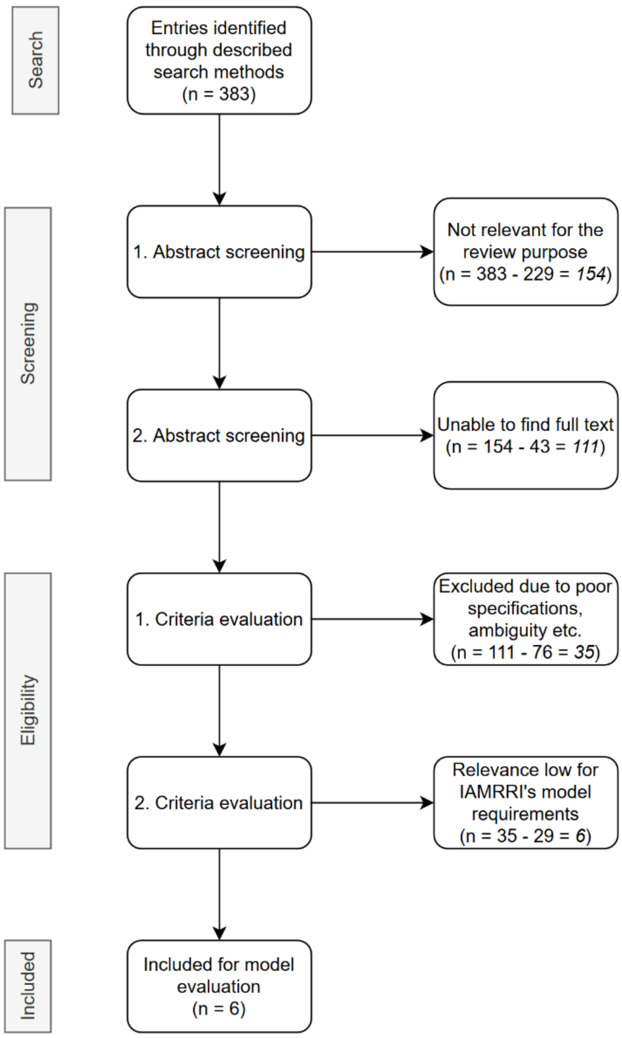

Fig. 6. Review process flowchart

SKIN is a recognized model for studying innovation networks, well documented and tested in various contexts, and has been actively used in policy-oriented research (Ahrweiler, 2017; e.g., Ahrweiler et al., 2015; Gilbert et al., 2018). SKIN is open-source and has a strong and vibrant community, something which has enabled the model to remain current on recent theoretical developments which is impressive given its long history. The basic elements of SKIN such as “kenes” (the set of competences and knowledge an organization possesses), market mechanisms and innovation processes are immediately useful for studying innovation value chains. The original SKIN model is briefly described here. However, the main value proposition of this paper is its adaptations and extensions. Therefore, due to space limitations, we refer to the extensive literature on the base SKIN model for more details on its mechanisms.

Fundamentally, SKIN is an agent-based model of innovation networks in knowledge-intensive industries grounded in empirical research and theoretical frameworks from innovation economics and economic sociology. The agents in SKIN represent

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innovative firms who try to sell their newly developed products to other agents and end users but who also must buy raw materials or more sophisticated inputs from other agents (or material suppliers) to produce their outputs. The model has a representation of the knowledge dynamics in and between the firms. Each firm tries to improve its innovation performance and its sales by improving its knowledge base through adaptation to user needs, incremental or radical learning, and co-operation and networking with other agents.

For thorough descriptions of the SKIN model, we refer to papers dedicated to the topic (Ahrweiler, 2017; Ahrweiler et al., 2011a; Gilbert et al., 2007, 2001; Pyka et al., 2007). When explaining the adaptations and extensions we refer to mechanisms in the base SKIN model.

4 Description of IAMRRI extensions

In this section we describe extensions to the SKIN model so that it will fit the aim of the IAMRRI project. First, we describe the concepts introduced in the adaptations, then we describe the \`flow' of the model. The flowcharts presented in **Figures 2** and **3** are useful companions throughout this section.

There are 3 major thematic area s where extensions are suggested: the introduction of a double industry model (to allow for knowledge transfer dynamics between industries through broker agents); RRI (as to examine the effects of RRI on IVCs and resulting innovation networks); and IVCs (allowing for complex innovation value chains). To provide for these thematic extensions, some adjustments must be performed to the model and agent initialization (representing the starting conditions, the agents in the model, and the surrounding environment). **Figure 2** below provides an overview of the base SKIN model and these adjustments.

In base SKIN an agent (a firm) is, during the creation of the model, given one of two levels of resources—high or low, are provided with a (semi)random knowledge base (encapsulated in a ‘kene’), and are tasked with creating an ‘innovation hypothesis’ which represents a product idea. This idea is created based on the innovation hypothesis. When the innovation hypothesis has been created, the firm creates an ‘advertisement.’ This advertisement can be understood as a signal to other organizations that will be read when other organizations are searching for partners for partnerships in the future. The third and last phase of the agent initialization starts with when the agents produce a good based on the innovation hypothesis, and then adjust their expertise upwards as they have gained experience in producing the specific product. With the initialization over, the model starts, and firms take part in the market and adjust their behaviour according to market feedback.

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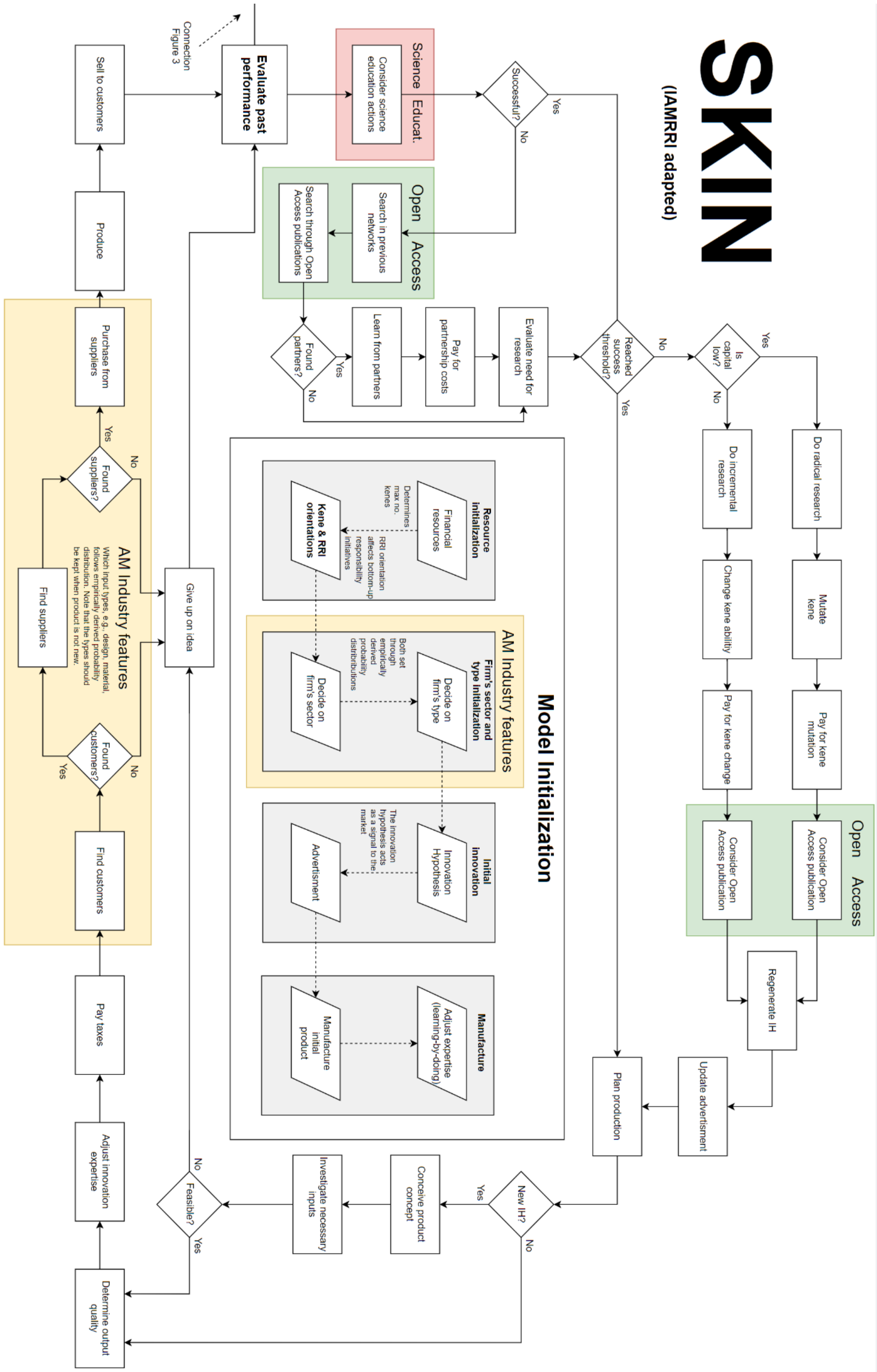

Fig. 7. The SKIN model extended with IAMRRI features.

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In IAMRRI SKIN, agents are also assigned to types common in the AM industry (e.g., software provider, AM material producer). Each agent is given a set of 4 RRI variables with (semi)random values reflecting the mean differences between the types of agents. Kenes are distributed by considering the agent type and the role the agent may play in an IVC.

With these changes to the initialization in mind, we can proceed to describing the three thematic extensions: the double industry model, RRI, and IVCs.

4.2 RRI: Societal Benefits, Ethics, Science Education, Open Access, Funding, Governance, And Public Engagement

In this section we describe several extensions that must be considered together to understand the extension's underpinning logic. The section describes an interplay between organizations taking societal responsibility themselves (in essence 'bottom-up' RRI) and thereby internalize externalities or costs that does not yield them immediate benefit, delayed positive effects of this internalization, and the role of public funding as a catalyst or inhibitor in this process (in essence 'top-down' RRI). Figure 3 illustrates the extensions of the original SKIN model.

The model focuses on four dimensions of RRI: open access, public engagement, ethics, and science education. These 4 RRI keys are modelled as 4 respective variables for each agent. These RRI variables have values ranging between 0 and 1, where 0 means that the agent is not concerned with the particular RRI aspect at all, whereas 1 means that the agent weights this RRI key to the maximum in decision processes involving RRI.

As described below, RRI values for individual agents may change over time. This means that average RRI key for a particular type of agents vary and the new agents appearing during the model run will get initial values that are correlated to the current average for the type.

4.2.1 Learning RRI keys

We model RRI key value changes through the following mechanisms:

First, when an agent is involved into a network or IVC where the average RRI value (of any of the 4 RRI keys) for all partners is higher than his own, the agents RRI key value increases to the level between his own value and the average value for the network. This increase may be conditioned on the results of networking (negative effect, decrease in RRI values) when networking results is positive resultant and positive when results are positive.

Second, under certain scenarios, the exogenous regulators may set a minimum level for certain RRI key (mimicking the impact of RRI key "governance", or the consumers/end-users may require some minimum level). In this case, the firms are

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forced to increase their RRI values gradually. The firms unable to reach the required minimum level are first blocked from networks and then dissolved.

4.2.2 Societal benefits

It is important to conceptualize and define societal benefits so that we can explain how we intend to measure it in the model. We take societal benefit to mean impacts on society that are beneficial in their very nature. Two examples of this provided by the industrial partners in the IAMRRI project are medical implant that help patients in ways that conventional approaches cannot and automotive parts that can drastically reduce the harm to pedestrians in case of a car crash. From this understanding and empirical data collected during the project there are four obvious ways as to how societal benefits manifest themselves: (1) through market demand of products that are more beneficial to society, (2) through AM organizations taking upon themselves to do good in society, manifesting itself through a higher likelihood of wanting to participate in such projects, placing emphasis on CSO (civil society organization) involvement, and a higher likelihood of withdrawing from an IVC if the generated or developed idea turns out to not be beneficial to society or even detrimental to society—this can be thought of us a bottom-up driving force for RRI, (3) an increased likelihood of receiving funding from the public sources if one is attempting to develop innovations that are beneficial to society or receiving more resources and/or on better terms, and (4) through an increased number of youth and students willing to become part of the AM workforce as they see that the AM industry are producing tangible results that are beneficial to society as a whole.

4.2.3 Ethics

Organizations may, due to strategic or simply altruistic reasons, decide to accept higher levels of risk and lower levels of potential profits if they come to understand that their products will likely have more than usual societal benefits. For example, a firm inventing a technology that may lead to medical implants that bring benefits to patients that are not helped by existing technologies--such as one case from our industrial partners—may take it upon themselves to bear the opportunity costs associated with investing in an innovation process that have higher risks and potentially lower profits. If done altruistically, this is simply done as the organization acts according to their established responsibility to society. If done strategically, it may be due to wanting to appear responsible or expectations of future market demands. The behaviour will likely be the same. While this may lead to more products that can help such patients, it may also lead to financial distress of the firm in question, especially if they are in a vulnerable financial situation. If more societally beneficial products are brought to market, it will likely increase the perception of AM in the society. In that sense, taking

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this risk represents an internalization of the externality of profitability at the cost of societal benefit.

4.2.4 Science education

As with organizationally ethical behaviour, some agents may take it upon themselves to encourage youth and students to learn more about AM, or even begin this knowledge transfer themselves. This can also be considered an internalization of the externality of lacking a stable labour pool in the AM industry. Since the industry is still young, there is a chicken-and-egg problem where there is still hesitation among students whether a career in AM is a good option, and at the same that hesitation is itself limiting the attractiveness of the industry since it itself cannot grow without a growing labour pool. By educating youths and students about AM, it is likely that more of them will be aware of the benefits of AM and therefore either become more conscious consumers of AM products or undertake an education that allows them to work in the AM industry. In short, the organization can take it upon themselves to do science education at little immediate benefit and at some cost, but the whole industry can benefit from this in the future.

4.2.5 Open access

The base SKIN model does not support any functionality for open access publications. It is important to note that not all organizations are in a position, or are likely, to publish open access. This may be due to the nature of the R&D efforts—R&D in a design company will likely entail a very different process than R&D in an AM technology company. Whereas the latter's R&D efforts are more likely to lead to tangible results that are more publication friendly, the former may be and harder to translate into an open access publication. Since R&D entails costs, the agents have reduced their financial holdings during the R&D process. Therefore, the first step is to check their holdings to ascertain whether they are in a position to afford publishing open access. If the answer is no, the open access publication consideration is terminated. If the agent can afford to publish open access, the agent will weigh their ethics and open access orientation and decide on whether to publish. While the weights have a strong effect on this decision, there is also an element of randomness to the decision, representing other factors influencing the decision maker. If the decision is negative, the publication consideration is terminated. If the decision is positive, the publication takes place, and the agent pays the open access fee.

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4.2.6 Funding

A common policy measure for avoiding negative externalities from industry are coercive pressures in the form of regulations (and associated fines in cases of non-compliance). Another policy measure is supporting industry actors that are doing the right thing. While this practice may be controversial, e.g., one might disagree that policy makers support organizations that would act to societies benefit due to profit motives alone, in some cases the profit motives are not present, at least not for the individual firm. In such cases, policies may be put in place to partially, or fully, internalize the externality on behalf of the organization attempting to do the right thing. For example, policy makers can mandate that public procurement processes should give a higher score to firms choosing to only use ethically sourced products, or firms that encourage gender balance in their work force. If this becomes common place and a societal norm, private industry may start to make the same demands. For example, many large institutional investors (such as the Government Pension Fund of Norway) actively pursue a policy of “ethical investing”. Funding in such instances can be seen as both a ‘top-down’ RRI measure, but it can possibly also be considered as a catalyst of the bottom-up efforts presented above. This outcome is not obvious and ought to be examined in the model.

4.2.7 Governance

We suggest a simple mechanism for governance only related to regulations and public reactions. The latter is an expanded understanding of the term governance inspired by Schlaile et al. (2018) but has similar effects in that the public can react by boycotts, seeking prohibitive injunctions, and similar. While we do not make a hard distinction between the two, we note that involvement by CSO at the Idea Generation phase will lower the likelihood of any adverse governance effects at this stage. This represents an advantage of involving CSO during the early phase of the IVC that does not manifest itself until later.

4.2.8 Public engagement

Public engagement refers to the inclusion of multi-stakeholder in the research and innovation process. We understand that public engagement works through two mechanisms in the IAMRRI model: (1) CSOs involvement to represent society’s interests in the IVC; and (2) market effects due to providing society with societally beneficial innovations. In this section we describe the first mechanism, while the second is described in the section on consumer markets effects in the model. In addition, a study using the SKIN model to explore university-industry links has shown that having universities in the co-operating population of actors raises the competence

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level of the whole population and increases innovation diffusion in terms of quantity and speed (Ahrweiler et al., 2011b p.218).

We suggest that CSOs act as ‘guardians’ against potential societally detrimental effects that are tied to innovation ideas. Examples of this could be products that, while technically feasible, may run afoul of societal expectations and considerations. We suggest that, if involving the public at an early stage, the idea will be less likely to invoke reactions from the government or the public.

For the model implementation, we suggest implementing a ‘veiled’ boolean variable representing societally detrimental features of the idea that CSOs are particularly apt at uncovering. While CSO involvement can reduce development speed, their ability to predict adverse as the ones described above during the transition from the Idea Development to Diffusion stage, may make them an important IVC member addition even if it leads to increased short-term costs.

4.3 IVCs

Extending SKIN with IVC support requires several sub-extensions: supporting many organization types, a representation of IVCs, rethinking the duration of steps in the model, and refining parts of the kene concept from the SKIN model so that it supports multiple organization types.

4.3.1 Supporting many organization types

The base SKIN model does not support creating organizations that are different in type. There is some distinction between material providers, producers, and consumers (Gilbert et al., 2007). However, these agents are parts of supply chains, not IVCs. (For a more technical description of how this is implemented in base SKIN, see Gilbert et al. (2001).)

4.3.2 Representing IVCs in the model – adapting SKIN’s network organizations

It is assumed that mechanisms and determinants affecting the structural evolution of networks are industry-specific and strongly dependent on the industry life-cycle stage (Buchmann et al., 2014). Therefore, the networking procedures from the original SKIN are adapted to the AM industry. The base SKIN model supports the notion of network organizations—organizations that are composed of resources pooled from network partners with the aim of inventing and getting a new product on the market – but these network organizations does not take part in an IVC in the traditional sense of the word. Instead, when the network organization are created, the composing organizations’ kenes are put together which will generate an innovation hypothesis which in turn is developed into a product which will be made (assuming it will profitable and inputs for

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the product is found in the market) and sold on the market *all in one turn*. This is not suitable for the IAMRRI model as we rely on studying the different steps in IVCs that take differing amounts of time, e.g., idea iteration loops or warnings issued by CSOs. The existing network implementation, however, is a natural point of departure for implementing the notion of IVCs in a way where participation in the IVC is considered as a collaboration *project*. This allows us to study the performance of the IVC in relation to the organization and allows us to create several IVCs that any given firm can belong to.

4.3.3 Veiled Innovation Hypotheses

One prime reason to start an IVC and invite members to it, is that an idea has been sparked, but the initiating firm (1) lacks the capabilities and abilities to develop it by their own, and (2) parts of the idea is inherently still unknown. Since the IVC is a process that goes through several stages, and possibly through several iterations in each phase, the idea must somehow be developed. In SKIN parlance this can be thought of as the unveiling of an innovation hypothesis. The organizations involved in the IVC phase are likely to influence the nature of the idea as it is developed—in technical term this can entail the IVC members imprinting part of their kene on the innovation hypothesis. (This mechanism is readily adapted from the already existing algorithm for innovation hypothesis generation in the base SKIN model.) Note that once the firm has imprinted part(s) of their kene on the innovation hypothesis, the part is no longer associated with the firm type. The logic behind this ties to that while the idea requires different inputs from different firm types, e.g., design, once the design is in place, the other firms in the IVC does not need to understand how the design came to be—it is simply enough to know how use the design (and this knowledge in turn will naturally be conveyed within the IVC to other members as part of the development). Therefore, an innovation hypothesis that has been developed in part by an AM design company during idea generation does not require the AM design company for, e.g., diffusion. Once all the parts have been 'unveiled' the idea is ready for the next phase. As the idea transitions between phases, so does the innovation hypothesis through adding more features that must be unveiled. This reflects the complexity of an innovation that requires an IVC and the empirical observation that other firm types are required for subsequent IVC phases. Because of this, some of the firms' participation may no longer be required, and they will naturally transition out of the IVC, while others must be found either through remaining members existing networks or through searching for relevant capabilities and abilities in open access publications. If the idea makes it all the way to the diffusion stage, base SKIN mechanisms take over (see description of the three phases below).

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4.3.4 The IVC stages and timing

The base SKIN model also assumes that an organization's research, prototyping, production, and market related activities can all take place, for a specific product, during one step of the model. Since the IVC process can take several steps and are not necessarily equally long for any given innovation, it is necessary to adapt the SKIN so that innovation processes can take more time than what is currently represented in one step in the SKIN model. The IAMRRI model deals with this issue by letting each step represent a shorter amount of time. Both theoretical publications and input form participants indicates that dividing innovation process into three phases is necessary. These phases are Idea Generation, Product Development, and Innovation Diffusion.

The original SKIN implicitly contains processes of the idea (innovation hypothesis—IH) generation and development in a single step. This process is influenced solely by kenes of firms and IH is randomly generated from the set of available kenes. In the extended version, new IH will be more likely to appear when a new raw material, software or other input is developed on the demand from another firm. Appearance of new IH may be initiated by the actors other than the firms, such as universities, regulating organs, and open innovation sources.

The Product idea development phase is not explicitly presented in the original SKIN model. The extended version suggests that the innovation hypotheses may be developed further in two ways: 1) if the necessary input is absent, the firm owing IH asks other firms to develop this kind of input and 2) if IH is not feasible, the firm may try to adjust it internally or in partnership with, for example, Research Institutes.

In the original SKIN Innovation diffusion means selling to the market depending on costs while demand is essentially fixed. Customers choose the cheapest product or, if the price is equal for several products, the products with highest quality. In the extended version, additional factors influence the product choice. RRI values are inherited by the product from the firms involved into relevant IVC. Customers with relatively high RRI values may choose products that are high on RRI values, even if they are more expensive than alternative products or have lower quality.

Idea generation phase: It is suggested in the modelling literature that creative ideas can be generated locally (within a unit), across different units, or obtained from external sources (Kusiak, 2009). During the idea generation phase a firm of random type may come up with an idea that requires an IVC in order to be developed. In modelling terms, this can be represented as an innovation hypothesis that has hidden parts that can only be unveiled through idea iterations together with IVC partners. This is illustrated in the lower corner of **figure 3** in the box labelled "Generation of incomplete IVC IH". Throughout this section and the next, **figure 3** can be a useful as it illustrates the circular nature of some of the mechanisms explained in the text.

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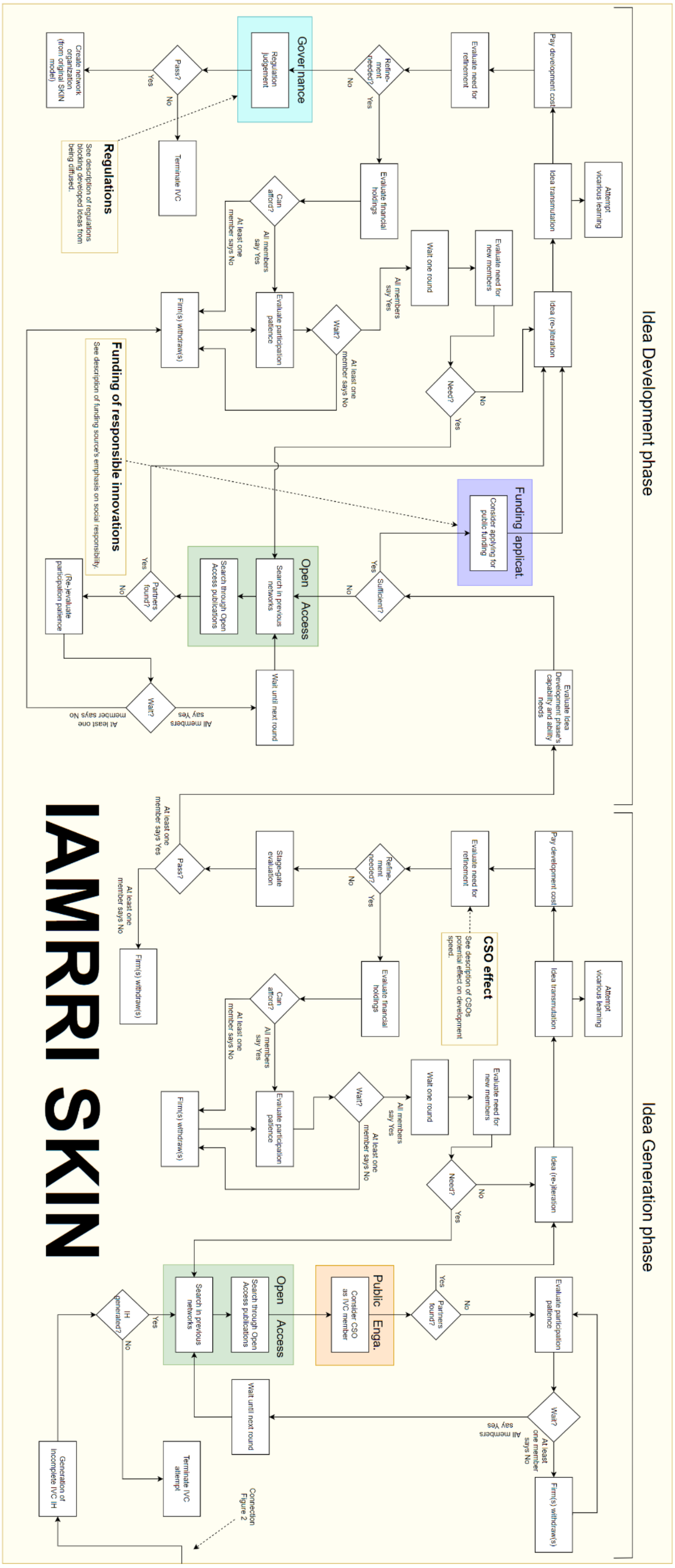

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Fig. 3. IAMRRI's IVC and RRI extensions of the SKIN model

For the agent to start the IVC proper, it must find IVC partners. In base SKIN, one search feature is the firms' previous networks. These networks are, in base SKIN, developed as firms are unable to achieve success in the market with a particular product and therefore attempts to learn from another agent so that they can create a new product that may be more successful. We suggest that this mechanism be modified such that partnerships are still the preferred channel for IVC member search, but that searching through open access publications that signal a particular set of skills. One may assume that open access' primary function is knowledge sharing, but from interviews and workshops with AM stakeholders we came to understand that much of the information contained within AM publications would be prohibitively difficult to make use of oneself.

During this phase, firm preferences come into play. Since both ethics and public engagement are closely tied to the norms and behaviours of AM actors, we suggest that firms' decision to join the IVC are strongly influenced by their Ethical orientation and Public engagement orientation. In addition to these evaluations, the agent will also take financial risk and opportunity cost into consideration.

In cases where not enough partners are found, the partners that have been found, as well as the Idea Generation instigator, will evaluate their participation patience. Their patience will be related to whether firm perceives that ethical and public engagement requirements are met and financial risk and opportunity costs are low. In addition, their patience will be affected by the number of partners in the IVC so that the more partners there are in the IVC the lower the likelihood of leaving. This reasoning is based on group size conformity effects, a well-known effect from social psychology explaining how individuals, in this case those representing their firm in the IVC, are less likely to leave a group if it is above a certain size. In short, this represents a group-think-like effect that makes on second-guess ones one judgement if making a different judgement than the rest of the group (Campbell and Fairey, 1989). This has the potential to create a cascading effect where if one firm leaves, others are more likely to leave. Therefore, we suggest that this is modelled in a cyclical fashion until no more firms are willing to leave. Those firms that are willing to stay, will reduce their patience for each round they chose to stay, so that the longer they have been on hold, the less likely they are to remain. If the IVC is not dissolved after these determinations, the IVC is put on hold until next round of the model.

When the funding decision has been made, the IVC members iterate on the idea. This entails a stochastically determined outcome of unveiling one of the columns of the innovation hypothesis. If they, e.g., find that ideas must be iterated over a long period of time, the likelihood of unveiling a part of the innovation hypothesis would be lower

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than if ideas quickly transition into the idea development stage. During this iteration phase, agents have the possibility to learn from the other IVC members. Being involved in this idea iteration incurs costs to the agents involved. When learning from each other the partners are more likely to learn from the firms with kenes that are relatively alike their own (Shou and Sun, 2010).

After the idea has been iterated over, in cases where CSOs are involved, the CSO may warn of potential issues that must be dealt with before the IVC should proceed. This represents the ‘guardian’ role CSOs can have if unethical or otherwise socially undesirable ideas are being developed, highlighting the potential drawbacks of involving CSOs. If such a warning is issued, this ensures that the idea must be reiterated over, increasing costs, and possibly leading to IVC members withdrawing from the IVC. The inclusion of CSOs is not without its advantages on the IVC level—it can lower the likelihood of adverse effects in the future (see the next section on the Idea Development phase). This reiteration does not occur only due to CSO warnings: it will also occur if the innovation hypothesis has not been sufficiently unveiled for it to proceed to the idea development phase. In any case, this reiteration is similar in effect to the partner involvement patience evaluation presented earlier.

If the iterations complete and the idea is ready for the next phase, idea development, then the firms will perform a stage-gate evaluation. We suggest a simple mechanism: the agents involved will examine their participation in the idea development phase in much the same way they would any other reiteration as they are described above. If no firms are left after this iteration, the IVC will be terminated. That does not mean that the IVC has been unable to provide any useful outcomes: the increased knowledge among the agents that have participated may lead to other IVC participations at a later stage and can help the agents as they develop their own innovation hypotheses independent of the IVC. While it may seem counter-intuitive that the whole IVC is terminated at this point, it is more reasonable when considering that none of the agents receive any financial gains when participating in the IVC: their primary gain at this stage is the knowledge from idea iteration together with the participating partners.

Idea development phase: For the sake of brevity, we will not explain the search process as it is identical to the one described in the idea generation phase with one exception—there is the opportunity for funding at this stage. Early during the idea development phase, the agents will consider applying for public funding. This is illustrated by the box labelled “Funding applicat.” in figure 3. We suggest a mechanism in which RRI dimensions are weighted so that those ideas that are more RRI oriented are more likely to receive funding. Also, if the IVC members involved CSOs during the idea generation phase and are developing an idea that is inherently socially beneficial, they are more likely to receive funding. This has the consequence of reducing the financial risk going forward, and the likelihood of firms having to withdraw from future

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idea iteration due to financial constraints. Note that this represents an interaction between bottom-up RRI efforts—caring about CSO involvement on the firm level and being concerned with ethics—and top-down efforts—preferring to fund ideas that are more closely aligned to RRI keys and ideals.

Most of the other parts of the idea development phase is identical to the idea generation phase—that is not to say that the same actions occur in the field, but rather that it follows the same circular pattern of iteration, possible refinement, possibly partners leaving, new partners coming into the IVC, then reiteration if sufficient members are found. One important part (besides funding) differs, however, and that is the possibility of regulation or other interventions by either the public, e.g., in forms of prohibitive injunctions to stop sale or diffusion of products, or the government, e.g., the government interprets the idea as going against existing laws or it considers creating new regulations and laws preventing the sale or diffusion of the resulting product or service. The likelihood of this happening is considerably lower if an CSO has been involved at an earlier stage. In other words, the involvement of CSOs at the idea generation phase can lower the likelihood of adverse events in the transition from the idea development phase to the idea diffusion phase.

If the idea development phase is successful, the IVC transitions into the diffusion phase:

Diffusion phase: The diffusion stage in IAMRRI SKIN is similar to the network organization already implemented in base SKIN. The major exception is the requirement of the participating firms already having partnered with each other. We propose that the transition from the Idea Development phase into the Diffusion phase follows the same logic as from the Idea Generation phase to the Idea Development stage. If the necessary agents are found they take part in forming a network organization as described in the base SKIN model. How this transition is done has not yet been determined. This is fertile grounds for research. We suggest that the creation of the network not only hinges on the idea being successfully developed, but also on the feasibility of the product in the market. This feasibility search can readily be coupled with the existing market mechanisms in base SKIN—if any products were attempted bought, but not supplied, in the market during the previous round, a network is more likely formed to handle the diffusion. An experienced SKIN modeler will notice that this seems to be incompatible with the way base SKIN handles how agents behave after not being able to find inputs (they will immediately—in the following round—attempt to produce something else). This is an issue that should also be researched further.

Significant changes to the base SKIN model are summarized in **table 1**.

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Table 1. Brief overview of changes from the original SKIN model

Original SKIN	IAMRRI SKIN
Model initialization	
Single industry.	Double industry.
One to two types of agents.	Max. 9 types of agents, but simplification groupings are suggested.
No RRI.	4 RRI keys assigned to each agent.
Kenes randomly assigned to agents.	Purposeful assignment of Kenes to different types of agents.
IVCs and Veiled Innovation hypothesis	
Innovation hypothesis (IH) is static and readily formed based on single firms' kene, except in network organizations.	In addition to IHs in original SKIN, IHs in IVCs are initially incomplete and developed over time borrowing the missing kene elements from other agents. The innovation idea goes through three stages (idea generation, development, and diffusion; diffusion is similar to the network organization agent 'collective' in original SKIN).
Time frame	
All stages of innovation process performed in one tick. No delays happen.	Innovation processes stretch over time. Innovation idea goes consequently through generation, development, and diffusion phases over multiple ticks. Delays happen.
Networks	
Network organization is created, the composing organizations' kenes are put together, a new innovation hypothesis is developed into a product which will be made and sold on the market *all in one turn.*	Participation in the IVC is considered as a *project* in the firms starting the network organization (networked project).
A firm may participate in only one network at a time.	A firm may participate in multiple network projects at a time (but keeping the network concept from SKIN as a separate concept).
The search for potential network firm partners is limited to those a firm has already had a partnership with in the past.	Firms' can also search partners through open access.

5 Conclusions and Suggestions for Further Research

In this paper we presented extensions to the SKIN model so that it can support the simulation of more than one industry, innovation value chains, and RRI. The model was built based on theoretical as well as empirical insights provided through the IAMRRI project.

While the model represents a step forward on the path to understanding innovation processes, work remains. First, while the model has begun to prove itself in the context of additive manufacturing, the question of whether it is generally applicable remains unanswered. Second, while this paper does not show an implementation of the IAMRRI model, such an implementation does exist. However, this implementation is tailored to answer specific research questions in the IAMRRI project. Therefore, some of the extensions described here, specifically those in the market section of the model, have yet to be implemented. Implementing the full model and releasing it as an open-source project would benefit modellers interested in innovation networks, innovation value chains, industry dynamics, and RRI who could then use the model to test specific theories and hypothesis. Third, sections of the IAMRRI model are underdeveloped. For example, the diffusion phase of the innovation value chain is not able to deal with more complex intellectual property issues. We know from empirical data that intellectual property rights issues can have large ramifications for the market diffusion of technologies developed inside of innovation value chains.

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Exploring Gender Bias in Austrian Education: Seeing What Students are Exposed to

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Abstract. With the rapid development of technology and science, the STEM job market has significantly expanded, while the gender gap in STEM is still a constant issue. Numerous studies and educational interventions have been explored to better understand and regulate this phenomenon, so far showing only limited success. This might be partly attributed to the complexity of the problem. From very early on, individuals are exposed to stereotypical gender roles that remain ubiquitous in societal structures. Thus, individuals might experience stereotype threat and fear of confirming the existing stereotype, which can be overcome through exposure to positive role models. This paper examines two types of materials that young students are exposed to before and at the time of choosing a course of study: EFL textbooks used in Austria and marketing material of Austrian Universities. We hypothesise that these materials, amongst others, impact students in their attitudes towards STEM. We report stereotypical representations of gender roles and careers in the analysed textbooks. University marketing material on the other hand, shows significant overrepresentation of female students while at the same time lacking diversity in terms of gender representation. These results indicate that students are exposed to stereotyped ideas about gender and careers from an early age on. While universities are making efforts to design gender-responsive marketing materials, aspects of diversity are still lacking.

1 Introduction

Those who pursue science, technology, engineering and mathematics (STEM) are the modern drivers of innovation. With the recent rise in digitalization and the perpetual emergence of new technological areas, the STEM job market is further growing. Consequently, choosing a STEM career promises lower unemployment rates and higher salaries (Langdon et al., 2013). Despite these advantages, engagement levels in STEM subjects are still falling and women, in particular, do not opt for STEM careers. Numerous initiatives to increase interest in STEM and reduce the gender imbalance have not yet shown any change (Smith, 2011; Indicators, 2016).

Over the past two decades, a vast amount of research has been conducted, aiming to increase our understanding of the processes and causes that lead to the evident gender gap. One line of research considers the stereotype threat as root of the problem. Research in social psychology and neurophysiological studies have shown

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that stereotype threat may become a considerable factor influencing interest and performance of learners in negatively stereotyped domains. Stereotype threat describes the phenomenon that people who belong to a negatively stereotyped group (e.g., young women in the field of STEM) show poorer performance and less interest in the subject than other equally qualified people (e.g., young men). This is often explained by the fear to confirm the stereotype which impacts an individual's working memory capacity (Beilock et al., 2007; Steele, Spencer and Aronson, 2002). Although stereotypes affect all kinds of people within various domains, research particularly emphasises on women and other minorities (Régner, 2014). Cheryan et al. (2011) who investigated the influence of stereotyping through role models report that already one role model can significantly influence a person's beliefs in respect to their success in a field. While studies have shown little impact of teacher’s genders on their students’ STEM grades and attitudes (e.g., Carrington, Tymms and Merell, 2008; Ehrenberg, Goldhaber, and Brewer, 1995), female researchers for instance could embody such role models (Bettinger and Long, 2005). The reflective identification with a STEM role model (e.g., introduced by reading biographies) even leads to a higher degree of identification, sense of belonging and an increased intention to pursue STEM subjects (Van Camp, Gilbert and Brien, 2019).

However, the perception of dissimilarity to stereotypical role models (e.g., nerds in engineering) can cause women to reinforce their doubts regarding their abilities in a specific field (Cheryan et al., 2011). Following this argument, the efficacy of a role model is based on the perceived similarity to its observer. Interestingly, females rate their own computer science relevant abilities lower than males, and the prototypical computer scientist's ability higher than men do. Also, women perceive themselves less like the prototypical computer scientist or an engineer than men do. This needs to be taken into account, as it correlates with lower interest in pursuing computer science courses and careers (Ehrlinger et al., 2018). Moreover, the lack of role models with whom marginalized group identify with, leads to students being discouraged from participating in STEM (Simpson et al., 2020).

The perception of similarity to an individual may depend on a wide set of characteristics that essentially exceed gender and underlines the need for diversity. These characteristics include physical appearance, role behaviours, personality traits and occupations and form a multidimensional structure of a gender stereotype (Sainz et al., 2019). The subject of multidimensional representations of gender is fairly new to STEM research. However, it is known that young women long for diversity-sensitive didactic materials and a manifestation of STEM women in educational and public communication (Gaisch and Rammer, 2018). A positive perception of scientists and science classes leads to higher performance in these classes and impacts the students' preparation for their future careers. Textbooks for instance can provide

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relatable examples of scientists that increase students' science identity and performance. An additional benefit is expected from an adaptation of educational materials and curricula towards a more diverse illustration of STEM characters in respect to gender, sexuality and disabilities (Simpson et al., 2020).

With this work we aim to contribute towards a better understanding of what gender roles students are exposed to on a daily basis in two different contexts, i.e., language education and college admission, as this impacts their perception of STEM subjects and subsequently their career choices.

1.1 Gender Imbalance in Educational Resources

Gender-biased representation in textbooks has become of broader interest in research as gender-based and stereotypical representations can have a lasting effect on learners' success beliefs, values and attitudes (e.g., McKown and Weinstein, 2003; Söğüt, 2018). Sunderland et al. (2000) describes three main forms in which women are commonly biased against in textbook representation - exclusion (underrepresentation), subordination and distortion (men represented in a greater range and more powerful occupations) and degradation (women being stereotypically emotional).

One type of textbooks that has received a lot of attention in gender studies are coursebooks for language learning, as they typically deal with persons in every-day life situations. Ebadi and Shahbazian (2015), for instance, analysed gender bias in English as a foreign language (EFL) coursebooks. The authors examined two coursebooks with respect to occupational roles, sports and household duties (i.e., "Right Path to English" and "Basic 2"). While in "Basic 2" female and male characters had a similar variety of occupations, in "Right Path to English" the distribution of male and female characters with regards to occupational roles were found to be unbalanced and stereotypical: male characters hold the majority of occupations and are shown as doctors, bus drivers, farmers. Women are shown with stereotypical occupations such as teachers and mothers. Furthermore, all the sports mentioned were associated with male characters (playing football, swimming, running, etc.) while none were attributed to female characters. Household duties were solely attributed to female characters (washing dishes, cooking, cleaning, helping mother in the kitchen). Similarly, Sögüt (2018) found a smaller variety of occupations associated with female than male characters, in EFL coursebooks used in the Turkish educational context. From 102 occupations represented, women were performing 32, while men were found to perform 70. The adjectives commonly attributed to women were such as "unhappy, stressed, bored, interested, inexperienced, bossy, kind, thin, rude, alone, optimistic" while the adjectives attributed to men were such as "faithful, excellent, talented, successful, the wisest, the angriest, brilliant". Women were associated more often than

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men with traditional, indoor jobs, such as teacher, nurse, dancer, waitress, while men were related to outdoor and high prestigious jobs, such as professor, researcher, astronomer, director, etc. Goyal and Rose (2020) compared two editions of an English business textbook in order to establish whether the gender portrayal improved with the more recent edition. In contrast to other works that focus on images and text only, also audio files were investigated. The speech was analysed according to talk time with an additional focus on firstness in explicit social interaction. Results point to an improvement in the representation and equality of gendered characters, however, the gender imbalance is still greatly present in many of the analysed aspects, such as the total representation, professional roles, senior titles, authentic news articles, number of speakers in the audio tracks as well as the number of single gender tracks.

Specifically focusing on STEM, Kerkhoven et al. (2016) studied gender bias in the visual content of online science education resources for primary school children, extracted from the websites of Scientix and OERcommons. Their analysis showed that among 3191 characters depicted in the resources, 33.7% were boys, 29.9% girls, 22.7% men and 13.7% women. Furthermore, the authors found that significantly more male characters (75%) were depicted having a science profession, while more females were depicted as teachers (63.9%). When it comes to activities, more men than women were found in most categories (presenting, experiment, hands-on activity), except for teaching where there were more women. The analysis of Greek high school computer science textbooks by Papadakis (2018) took into account the illustrations, but also the language used. They identified linguistic sexism (i.e., the use of masculine form to denote both genders), that among 23 images used in the first-grade textbook, 16 depicted men, where all mentions of an informatics teacher were related to the male gender.

Summing up, in both foreign language and science textbooks, there has mainly been found to be an underrepresentation of female characters, fewer occupations associated with female than with male characters, and an association of both genders (male, female) with stereotypical occupations.

As part of this paper, we contribute to the existing literature on gender biases in EFL textbooks, by focusing on the chapters dealing with professions and occupations found in eight EFL textbooks used in Austrian education (ages 10-18).

1.2 Marketing Material

Marketing material is used at universities to advertise and inform prospective students about study programmes. The portrayal of gender in these university marketing materials plays a vivid role, as it is what (female) students are presented and potentially influenced with, when deciding to enrol in a particular academic program and institution.

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Common marketing tools are college viewbooks that often provide the initial perception of an institution. Viewbooks are promotional brochures designed by marketing experts for the purpose of “selling” a particular university to potential students and their families (Osei-Kofi et al, 2015). Henslee et al. (2017) investigated the Indiana University-Purdue University of Indiana`s (IUPUI) viewbooks in regard to opinions and perspectives of IUPUI students on the representation of their cultural backgrounds and identities. The majority of 225 questioned undergraduate students felt well represented in the viewbooks and valued in terms of their cultural background and identity, which is linked to an improved sense of belonging. However, students felt that the viewbooks promoted more diversity than seen on campus. This is described as tokenism, which occurs when students are displayed as tokens for institutional gain, which can have a negative effect on marginalised students’ sense of cultural validation (Fletcher, 2012).

Pippert, Essenburg and Matchett (2013) investigated 165 recruitment materials from four-year institutions in the US, the authors concluded that within each brochure there is a common thread of images with standardized motifs such as a picturesque background, students studying in the outdoors, animated professors, fans cheering on a sports court. Race and gender of students are equally distributed. The authors tested the accuracy of these images by conducting content analysis of 10000 photographs of students, which are found in 165 viewbooks. A comparison of racial and ethnic groups in the images with the actual distribution at the corresponding academic institutions found that 81.2% of viewbooks demonstrated a significant overrepresentation of African-American students (9.4%). Thus, the viewbooks presented an idealistic image of campus diversity. This agrees with Pippert et al. (2013), who suggest the use of viewbooks to define and represent diversity in a broader way instead of exactly mirroring the student body.

A more extensive visual textual analysis of STEM university viewbooks was conducted by Osei-Kofi and Torres (2015). They analysed gender and race representations in 20 viewbooks related to STEM education. The authors developed codes (e.g., gendered, sexualized, active, passive, etc.) and applied it to individual images and sections of text. This was further interpreted using theoretical frameworks. Results identify the most common narrative as stereotypical white heroic male with superior abilities, a dedication to science, willingness to take risks and advance human progress. When it comes to the representation of women, they are primarily illustrated as white and associated with the attributes friendly, easy-going and attractive (“brainy babe”). Furthermore, women and people of colour are often found in roles of sidekicks, represented in a subordinate way to white men. The authors argue that such visual representations suggest that women and people of colour are “allowed” to have a part in STEM but are not expected to lead.

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Stachl and Baranger (2020) explore the sense of belonging at higher levels of academia in order to determine a possible correlation with the diminishing representation of women and minorities in STEM fields. The study uncovers factors specific to the academic graduate community, such as the difficulty of feeling accepted and valued, viewed as a serious scholar, being a good mentor or a lack of a supportive social network. Once again, the study highlights the necessity of stronger administrative efforts to foster sense of belonging and allow a more diverse community of scientists to be built and maintained.

Considering the impact that representation of diversity can have on peoples' sense of belonging and furthermore on academic performance, we take a look into Austrian universities' marketing materials in order to understand currently promoted STEM role models and illustrations. With research outlined in this paper we contribute to existing work on viewbooks and their diversity representation with a focus on Austrian (technical) universities. Additionally, we provide a glimpse on gender representation at TU Graz homepage information sites, as a sample for online promotion material.

2 Gender Representation in Austrian EFL Textbooks

Textbooks reach a wide audience within our society. Their portrayal of gender identity as well as occupation-specific gender roles influences perceptions of the social norm from a young age, but also affects parents and teachers and their actions (Kherkovern et al., 2016, Söğüt, 2018). To reach a better understanding of stereotypical representations young people are exposed to, we investigate gender portrayal in Austrian schoolbooks. Primarily, this pilot study focuses on the gender representation in foreign language textbooks, and specifically on the gender distribution in respect to the representations of jobs and careers. More concretely, the study is dedicated to the following questions: is the distribution between male and female characters equal in the textbooks? Secondly, is there a gender bias in the visuals and text representing and referring to characters and their careers?

2.1 Data

The visual and textual data analysed was conducted on chapters revolving exclusively around work life, careers and jobs in eight EFL textbooks listed in Table 1. One of the analysed textbooks, "Cutting Edge" by Peter Araminta, is applicable for both junior high and high school students, while all the others are aimed for use in high schools and at higher language proficiency levels. Within the listed textbooks, 43 visual and textual gender representations were found. In this context, we defined gender representations based on images and textual references to male and female figures and characters.

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Table 2. Gender representation distribution in EFL textbooks

Textbook	Authors	Level	Number of gender representations
New Headway	Soars, Liz and John	B1 (intermediate)	3
New Headway	Soars, Liz and John	C1 (advanced)	3
Innovations	Hocking, Cheryl	B1 (intermediate)	8
Innovations	Hocking, Cheryl	B2 (upper-intermediate)	4
Cutting Edge	Araminta, Peter	A2 (pre-intermidiate)	11
Focus	Kay, Jones, Berlis, Brayshaw, Russel	B1 (intermediate)	4
Focus	Kay, Jones, Berlis, Brayshaw, Russel	B1 (intermediate)	4
Focus	Kay, Jones, Berlis, Brayshaw, Russel	B2 (upper-intermediate)	6

2.2 Methodology

A visual-content analysis was conducted on the sample of eight EFL textbooks which are currently used or have been used in Austrian schools. The analysis and categorization of careers was conducted according to Sögüt (2018) and Kerkhoven et al. (2016). The visual and textual analysis was done manually by one coder. Each resource was scanned for the presence of visual or textual content with the topic or related to "career choice", "summer jobs" and "professions". After that, each visual or textual representation pertaining to those topics was checked for the number of female and male characters. Additionally, the activity of each character was checked to determine whether characters were associated with stereotypically gendered careers. Furthermore, gender distribution in STEM and non-STEM professions was analysed.

2.3 Findings

The analysis was based on two research questions: Firstly, is there an equal distribution of male and female characters in the context of careers? Secondly, is there a gender bias in the visual and textual representations of characters in the context of careers and jobs?

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Table 3. Distribution of female and male characters in the textbooks

Percentage of male characters	Percentage of female characters
54%	46%

The percentage differences between male and female characters, as can be seen in Table 2, was quite low (9% difference) which demonstrates a fairly equal representation of male to female characters.

Table 4**.** Professions attributed to characters in textbooks

Careers/ professions attributed to male characters	Number of appearances	Careers/ professions attributed to female characters	Number of appearances
cowboy	2	Trapeze artist	1
hunter	1	boxer	1
builder	2	drugs worker	1
banker	1	secretary	1
doctor	3	teacher	1
Olympian	1	Stay-at-home mother	1
rower	1	housewife	1
footballer	1	dancing queen	1
engineer	1	ballerina	1
waiter	1	singer	1
musician	1	lawyer	2
police officer	1	businesswoman	1
actor	1	shop assistant	1
fitness app designer	1	fashion app designer	1
mowing lawns	1	waitress	1
dentist	1	hairdresser	1
technician	1	nurse	1
plumber	1		
computer programmer	1		

From the career attributes associated with each gender (Table 3), we observed that female characters preform indoor jobs, as well as traditionally female ones (Sögüt, 2018), such as “teacher”, “stay-at-home mother”, “housewife”, “nurse” and “hairdresser”. On the other hand, male characters tend to be associated with more prestigious occupations, such as “doctor”, “dentist”, “police officer” and “banker” or

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outdoor occupations, such as “builder”, "footballer", “cowboy” and “hunter”, etc. Some occupations can be considered as gender neutral, since they have been associated with both genders—such as “waiter” and “waitress” as well as “musician” and “singer” which can be considered equivalent. When it comes to careers from the domain of sport, female characters were associated with stereotypically female sports such as ballet and dance, while male characters were connected to traditionally masculine sports, such as football and rowing. A male character was connected with the attribute “Olympian” which can be considered a highly prestigious occupation in sport, while no female character was associated with any similar tag. Furthermore, a female character was associated with a non-traditional sport, such as boxing. However, the female boxer was introduced in an article with the topic of whether the character should be banned from boxing, as it is not a sport that is traditionally connected with female athletes.

Furthermore, out of 23 male characters, seven were associated with STEM occupations (“technician”, “engineer”, “computer programmer”, “doctor”, “app designer”), while only one out of 17 female characters had a STEM job (“app designer”). Even though “app designer” was connected to both genders, the app associated with the female character had the topic of a “boutique” and the app the male character created was an “exercise app”, which further plays into gender stereotypes.

3 Gender Representation in Austrian University Marketing Material

There are many ways in which a university can represent itself to potential students e.g., career fairs, open houses, summer programmes. However, the internet has become the primary source of information on university enrolment (Hartley and Morphew, 2008). In addition to web information pages, Austrian universities provide brochures or viewbooks to download, as an information and recruitment tool. Such materials typically include photos of current students and teachers, who represent alleged role models. To better understand what prospective students are exposed to and thus, might be influenced with, we investigated images in the promotional material of university bachelor programs. We hypothesise that these materials are a potential resource in attracting women and generally a more diverse audience to STEM programmes. Our focus is twofold. First, it lies on investigating the symbolic portrayal of gender diversity in Austrian university *viewbooks*. Second, we took a deeper look on *web information material* found at the TU Graz homepage and analyse visual attributes of student representations.

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3.1 Viewbooks

3.1.1 Data

We retrieved viewbooks from the websites of three universities that offer exclusively STEM bachelor programmes: Vienna University of Technology (TU Wien, 2019), Graz University of Technology (TU Graz, 2019), the University of Leoben (Montanuniversität Leoben, 2019) and two non-technical universities: Vienna University of Economics and Business (WU Wien, 2019) and Uni Graz (REWI Uni Graz, 2019). This adds up to a number of 52 viewbooks collected as follows: 13 TU Wien, 19 TU Graz, 12 Montanuniversität Leoben, 7 WU Wien and 1 by Uni Graz.

3.1.2 Methodology

The visual content representation of Austrian university viewbooks was analysed in order to determine the gender distribution and representation. The methodology was based on Pippert et al. (2013) who examined photographic portrayal of racial and ethnic diversity in university recruitment materials. Every available photograph was used as a unit of analysis, where each illustrated person was identified in gender (i.e., male or female) and role (i.e., student or lecturer). Small images such as crowd shots were excluded from the analysis. Ambiguous depictions would have been noted, if encountered, as that would speak for the visual diversity of the representations in the viewbooks. However, such depictions were not identified.

3.1.2 Findings

In TU Wien viewbooks we found a noteworthy difference in the numeric representation of male and female students (68% vs. 29%), as well as male and female professors (3% vs 0%). The gender distribution of student representations in viewbooks of TU Graz and Montanuniversität Leoben was significantly more balanced (TU Graz - 51.5% male and 43.5% female students, Montanuniversität Leoben—56% male and 44% female students) than in the viewbooks of the remaining universities at glance. Sill there was a notable difference in the male vs. female lecturer ratio in TU Graz viewbooks (4% vs. 1%), not displayed in non-technical university viewbooks.

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Table 5. Paired differences of actual and photographic representation of gender diversity

University	Photographic mean (male students)	Student body mean (male students)	Difference (male students)	Photographic mean (female students)	Student body mean (female students)	Difference (female students)
TU Graz	54.3%	69.6%	-15.4%	45.7%	30.4%	15.3%
WU Wien	41.7%	52.0%	-10.3%	58.3%	48.0%	10.3%
TU Wien	70.5%	71.1%	-0.6%	29.5%	28.9%	0.6%
Montan Universität Leoben	56.3%	75.8%	-19.5%	43.7%	24.2%	19.5%
UNI Graz (REWI)	50.0%	41.1%	11.1%	50.0%	58.9%	-8.9%

In general, the study reveals an under-representation of the male student body and an over-representation of the female student body. As presented in Table 4 this is true for all universities except REWI. For instance, when taking into account the actual student body at TU Graz and the representation of the male population in the viewbooks, there is a -15% mean difference, which signifies under-representation. Furthermore, there is a similar mean difference with regard to the female population at TU Graz, as the analysis of the viewbooks resulted in a 15.3% over- representation.

3.2 Web Information Material

3.2.1 Data

In order to analyse the representation of gender in a career information context at the TU Graz, we collected photos of the web information page of the bachelor's degree programmes[1]. The first subject of our investigation was cover photos. Each programme uses a cover photo to link to their subpage, presenting detailed information on the subject. The cover photos either show research objects, or human actors (i.e., groups or single individuals). We extracted the pictures that show human actors. This led to a collection of seven group pictures and eight portrait photos. For the second collection of pictures, we looked into the programme descriptions. Here we selected the nine most popular programmes (i.e., programmes with at least 400 students enrolled): Mechanical Engineering, Electrical Engineering, Information and Computer

[1] https://www.tugraz.at/en/studying-and-teaching/degree-and-certificate-programmes/bachelors-degree-programmes/overview-bachelors-degree-programmes/

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Engineering, Mechanical Engineering and Business Economics, Computer Science, Software Engineering and Management, Civil Engineering Sciences and Construction Management, Biomedical Engineering, Architecture. This collection results in 17 portrait photos.

Table 6**.** Distribution of gender in cover photos

Type	Count	Females
Cover Photo Group	7	7
Cover Photo Single P.	8	7
Portrait Photo	17	8

3.2.2 Methodology

The parameters that were selected for observation were based on Sülflow and Esser (2014), who compared the stereotypes of politicians in different countries. In line with related literature (Kinnerbrock and Knieper, 2014), the approach assumes that there is a silent agreement on what certain mimics, gestures and postures mean within a society.

Mimics: Facial expressions transport different messages. For instance, joyful, smiling, laughing is related to being successful and self-confident. Frowning, tense facial expressions or drooping corners of the mouth suggest dissatisfaction and discomfort.

Gesture: As positive we considered gestures like handshakes that stand for solidarity (Fleissner, 2004), or thumbs up, waving and victory signs that incorporate victory poses. A bent upper body or forward moving gestures stand for assertiveness and dynamics. Negatively perceived are rigid postures, leaning on to something, crossed arms, or hands in front of the face.

Context: Other factors that might influence how we perceive a person is the context in which the person is visualised. For instance, clothing, age and skin colour are factors that influence our sense of relation. Does the person look sportive, young, approachable or rather serious and professional? Other factors are the position of a person and the background colours of the picture.

3.2.3 Findings

Our analysis of the TU Graz web information page on bachelor’s degree programmes showed a strong over-representation of female student portraits. This indicates that the TU Graz aims to exploit such mediums to endorse the growth in female student population. A closer look, however, revealed a number of potential shortcomings such as i) a very distinctive presentation of gender roles (i.e., illustrated females are overly attractive, with long, straight, “darkish” hair and a skinny body shape, whereas males

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have short, straight hair, mostly dark, and a standard body shape; skin colour indicates European heritage), ii) the complete absence of physically impaired people and iii) the depiction of people presumably older than thirty solely as males in teaching roles. The remainder of this section provides an overview of the analysis structured by presentation types and observed characteristics.

Cover Photos. In group photos, we found a perceived equal representation of female and male students. In cover photos featuring only one person, the female representation was 87.5%. Furthermore, we observed:

- Two photos show someone explaining something. Those are men.
- Two photos show student groups in spontaneous postures: Architecture and GeoScience.
- Five of seven pictures are obviously setup.

Cover Photos Featuring One Person. We found 8 cover photos that feature only one person, seven female and one male. This is a very strong overrepresentation of females. Four could be assessed as overly attractive. One picture does not show the woman's face. Three out of four women depicted working show a tense facial expression, which is connoted negatively.

Portraits. In the portrait section of the nine selected bachelor programmes, we discovered the photos of eight female and nine male students.

Overall Picture. A comparison of female and male as well as cover and portrait photos is illustrated in Table 6.

1 Mimics: There is no difference between genders but in respect to cover or portrait photos. In portrait photos 65% of people are laughing or smiling. In cover photos facial expressions are distributed through the categories.
2 Gesture: Male students are more often displayed in dynamic positions (bend upper body) and with crossed arms, while females in occasionally lean on to something.
3 Context: Presentation of gender is very clear. Women are overly attractive, with long, straight, "darkish" hair, skinny, successful and European (light skin colour). Men have short, straight hair, mostly dark, a standard body shape and light skin colour.
4 The illustration of physically impaired people is completely missing.
5 People that look older than thirty are male and solely depicted in teaching roles.
6 The information material over-represents women in six of the nine study programmes.

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Table 7. Representation of gender in cover photos

		Female (%)	Male (%)	Cover (%)	Portrait (%)
Mimics					
	smiling/laughing	53	60	37	65
	neutral	27	20	25	24
	tense	20	20	38	12
Gesture					
	bend upper body	13	40	13	29
	leaning on something	20	0	13	12
	crossed arms	0	20	0	12
Context					
Clothing	business	73	60	75	65
	casual/sporty	27	40	25	35
Haircut	short	0	100	13	53
	middle	20	0	13	12
	long	80	0	75	35
Hair-colour	dark	27	70	38	47
	brunette	67	10	63	35
	blond	7	20	0	18
Hair-style	straight	87	90	86	88
	curls	13	10	13	12
Body-shape	skinny	87	20	75	53
	average	13	60	13	41
	chubby	0	20	13	6
Skin-colour	light	93	90	100	88

4 Discussion and Future Work

This paper is motivated by the inherent economic need for qualified STEM personnel and the existing gender imbalance in STEM fields that substantially contributes to the problem. We hypothesize that role model representations in educational material can intensify effects of stereotype threat and thus, lower the likelihood of women to pursue STEM subjects. To better understand factors that influence Austrian's young people in their career choices, we examine existing i) educational materials and ii) university marketing material. In respect to educational material, we investigate eight EFL textbooks used in Austrian schools. Even though, we find the distribution of gender representation in the material to be fairly equal, the analysis shows a gender bias with regard to the relationship of gender and career choice as well as occupation and jobs.

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Female characters are associated with stereotypical, traditional jobs, while STEM occupations are almost exclusively associated with male characters. These results add to a significant body of prior research (e.g., Goyal and Rose,2020; Söğüt, 2018, Papadakis, 2018) on implicit gender bias in primary and secondary school textbooks. Biased depictions potentially trigger stereotypical thinking in both the students and the teachers (Kherkovern et al., 2016, Söğüt, 2018), which in the long run might cause a lower interest of female students in STEM related fields (Ehrlinger, 2018). A promising approach is suggested by Söğüt (2018) who asks for a higher involvement from teachers; in a sense of recognising, pointing to and correcting gender-biased content in the textbooks and so prevent the formation of stereotypical values and practice.

The analysis of marketing material was addressed in two parts. First, the analysis of Austrian university viewbooks revealed a noteworthy difference in the numeric representations of male and female students in the viewbooks by TU Wien. Viewbooks by WU Wien, TU Graz, Montanuniversität Leoben and UNI Graz showed a balanced gender distribution. However, the analysis has pointed to a significant overrepresentation of the female student body and an underrepresentation of male students in the cases of TU Graz and Montanuniversität Leoben. The opposite was true in the UNI Graz viewbook, with an overrepresentation of the male student body. The viewbooks show an unrealistic image of campus diversity created to attract more students from the minority groups, striving to balance an existing gap. Instances of overrepresentation of minority groups in university viewbooks seem to be a common practice (Pippert et al, 2013). Even though this is a popular marketing strategy, such representations of diversity may have a contrary effect, by making the students feel as "tokens" for institutional gain (Henslee et al., 2017; Fletcher, 2012; Pippert et al., 2013). As Pippert et al. (2013) suggested, we also believe that even though the answer might not be to perfectly mirror the campus reality in the marketing materials, universities should strive to define and represent diversity in a broader way. Furthermore, female professors (unlike their male counter-parts) were notably under-represented in the technical fields. As previous research (Gaisch and Rammer, 2018; Simpson et al.,2020) proposes, positive role models of the same gender potentially attract female students to STEM and thus there is a necessity that female professors are as represented as their male colleagues.

The second part, a glimpse on the gender representation of the TU Graz web information page on bachelor's degree programmes showed an even stronger over-representation of female student portraits. This underlines the existing efforts of TU Graz to use marketing materials to attract female students. A closer look, however, revealed a number of potential shortcomings such as i) a very distinctive presentation of gender roles (i.e., illustrated females are overly attractive, with long, straight, "darkish" hair and a skinny body shape, whereas males have short, straight hair, mostly

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dark, and a standard body shape; skin colour indicates European heritage), ii) the complete absence of physically impaired people and iii) the depiction of people presumably older than thirty solely as males in teaching roles. This lack of diverse representation can affect an individual’s sense of belonging (Stachel and Baranger, 2020) and therefore influence their choice of discipline and/or lead to lower academic achievements (Stachel and Baranger, 2020).

With this contribution we add to the current body of research on the representations of gender and diversity in Austrian textbooks. Furthermore, we expand the outlook on marketing materials students receive after finishing high school, in hopes of understanding the influences and processes that lead to the growing gender gap in STEM.

In future we will expand our analysis of educational and marketing materials, with an investigation on how readers and particularly students perceive the gender representations found within these textbooks and viewbooks. In line with related research, leading questions will encompass effects on student’s sense of belonging, self-confidence, interest on and likelihood to pursue a certain subject. We expect the results to deepen our understanding of the impact of role model representations portrayed in educational and marketing materials on students' career choices. We will also explore the influence of diversity aspects that go beyond the attribute of gender.

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Ensure Value Sensitive Design Responsibly for Social Sustainability: A Case of E-Vehicle Design in Delhi, India

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Abstract. Pre-existing value-biases of the socio-technical landscapes percolate through the innovation process to the 'design' itself. This results in a skewed user pattern, as is the case with less visibility of women in India's emerging e-mobility system. The compromised 'social sustainability of the upcoming e-vehicles has an economic cost to innovators and an environmental cost to society. There is a need to identify these biases and anticipate the desired values from the stakeholder's perspective, to provide reflexive feedback to the innovators. This study's primary **objective** is to anticipate the gender-sensitive desired values from the women's perspective for future e-vehicles. This research study has used both secondary and primary data. For collecting primary data, a field study was conducted in Delhi. The research was designed by using the modified **RI Framework**. The RI framework was modified to make it conducive to the need of developing countries like India. Universe of the study included **stakeholders**- women, e-vehicle innovators & manufacturers, e-vehicle drivers. Survey and semi-structured interviews were conducted among the identified stakeholders along with a Focused Group Discussion with experts. Collected responses were transcribed and analyzed. The study has revealed the desired values of the- comfort, safety, aesthetics, cost, convenience, support & service quality. Each of these values has been defined based on the responses from the field study to make them practical, relevant, applicable, and ready to be embedded in the e-vehicle innovation process. These anticipated values need to be considered from the ideation level of the design of the future e-vehicles.

1 Introduction

The chronic transport poverty of Indian women is no hidden secret. There is plenty of work available regarding unsafe gender conditions in public transportation (Chowdhary, 2019). However, even a cursory observation of public transport systems shows the striking difference between the number of men and women commuters, the latter being far less. Transport poverty (Lucas et al., 2016) translates into poor gender development indicators, including access to education, employment, health facilities, and recreational activities. Case studies spread over the globe also indicate the existing subtle or explicit gender biases in the existing public transportations (Abenoza et al., 2018; Joseph et al., 2014; Kaufman et al., 2018). This brings us to the continuous social reproduction of the gender inequalities in transportation technologies resulting in compromised social sustainability. It is well established that along with

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environmental and economic aspects; the social aspect is equally important for having practical and effective sustainable technologies (Axelsson et al., 2013; Larsen and Jensen, 2019; Mehan and Soflaei, 2017; Missimer, 2015). Against this backdrop, the upcoming technologies in the transportation sectors are crucial for countering and disrupting the conveniently existing gender biases. The emerging E-Mobility-based transportation system is one such area of deep inquiry and action, especially in the current situation of the COVID-19 pandemic.

Public transport the world over is still suffering from the COVID-19 pandemic shock. The highly contagious nature and high mortality had an eroding effect on the safety perception of public transportation. Unfortunately, the pandemic hit hard the public transport when policymakers worldwide recognized it as a key strategic area of action for achieving the Sustainable Development Goals (SDGs). However, this rude shock to public transportation translated differently for men and women. It is well known that the mobility patterns and needs of women are different from that of men. For instance, the ‘care mobility’ (primarily by women) requires more ‘trip chaining’ than regular work trips (Mahadevia, 2017; Mahadevia and Advani, 2016). As a result, women need access to multiple modes of transportation for trip chaining. Further, due to patriarchy-guided cultural norms, the first right to a private vehicle and its use goes to the ‘male head’ of the family (Verma et al., 2016). In the same way, last-mile connectivity through affordable means of transportation is crucial for the smooth mobility of women commuters (Uteng and Cresswell, 2016). Thus, women being more dependent on Public transportation for mobility needs has been more severely affected by the impact of COVID-19 on public transportation. Even among women users of public transportation, the choices are shifting.

The COVID-19 induced norms of ‘social distancing are dictating the transportation choices of the commuters. The preference and demand shift is towards ‘individual mobility’, which is way more expensive than ‘collective mobility’ through public transportation (Bhaduri et al., 2020; Borkowski et al., 2021, p. 19; Dandapat et al., 2020, p. 19; Gajendran, 2020, p. 19). This situation is even more unique to Delhi, where the field survey was conducted. In Delhi, as a part of the government’s strategy to enhance women's safety in public transportation, all public buses were made free for women. The argument was that with more affordability, more women would choose public buses, and inclusion of more women commuters in public buses would lead to gender-sensitivity in public transportation (“Free rides for women in public transport is part of Delhi govt’s push to make city safe | The Indian Express,” n.d.). However, the COVID-19 has a drastic impact on the notion of safety, leading to an exponential rise

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in the demand for Hygiene[1]. On the other hand, there is legitimate skepticism towards public transport's (especially public bus transport system) capacity towards achieving hygiene standards or maintain the social-distancing norms. Private vehicle-based mobility models increasingly occupy this gap between demand and supply. The latest data on car sales in Delhi has shown a steep rise despite the economic slowdown ("India," n.d.). Further, families are planning to purchase a second vehicle to address the need for private individual mobility. Similarly, popular taxi operators like OLA and Uber are aggressively campaigning for their superior hygiene standards. The individual mobility-based mode of transportation is environmentally unsustainable as vehicular pollution is already identified as the most crucial factor behind Delhi's air pollution woe (Bhalla et al., 2019). Thus, there is a need to think about affordable and sustainable models of transportation.

Initial trends in emerging E-Mobility systems have exhibited the promise of addressing multiple concerns. On the face of it, battery-operated vehicles are considered environmentally friendly. The smaller affordable vehicles are also considered a solution for the last mile connectivity for congested city lanes. In view of the approaching timeline of SDG's government is also promoting E-Mobility with various policy incentives (Delhi, 2015; "Union Budget 2019-20: Steps taken to boost production of electric vehicles," n.d.). An excellent example is e-rikshaws in India, which has become the most important transportation mode for last-mile connectivity in big cities, remote and smaller towns having a fair share of women in big cities and smaller towns users (Singh et al., 2021). However, the gender bias is clear from the fact that nearly all e-rikshaw drivers are male. Similarly, the e-bike and e-cars, ownership, and use exhibit strong gender biases, which have been discussed in detail later in this paper. This indicates the embedding of the social biases in the upcoming E-Mobility sector in terms of technology, design, and economy. Despite being functional to everyday practical needs, the gender response towards the e-vehicles has not been enthusiastic. Even in affordable e-vehicle rental services like Yulu[2], the

[1] Hygeine: In the context of ongoing pandemic of COCID-19, hygeine has become an important criterion for transportation choice influencing criteria in comparison the pre-pandemic time. The concept hygeine also broadened as earlier it was related with the general cleanliness, but now regular sanitization, social-distancing norms and availability of masks and hand sanitizers are also the part of the hygeine. These indicators of hygeine have an overlapping with indicators of safety and comfort of the commuters.

[2] Yulu bikes: Yulu bike service was launched in September 2019 in Delhi. Yulu provides the rent-based e-bike service for which the customer needs to download the companies App and pay the rent online on hourly bases. After use the e-bike needed to be dropped at fixed dropout points. Yulu bike is a single seat vehicle without any carriage and have maximum speed of 20 KM per hour. Yulu has opened up near metro stations but very few people are seen riding this e-bike and women riders are even more rare. Most of the Yulu users are young students.

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women's ridership is very low. Since E-Mobility can address present challenges for sustainable transportation, the natural question is why the diffusion of E-vehicles among women is slow? There is a need to identify the gender-sensitive values from the women's own perspective for the value-sensitive design of the upcoming e-vehicle. This could be a win-win situation for women commuters as well as innovators. The current transition phase in transportation towards E-Mobility offers the opportunity to embed gender-sensitive values in the innovation process itself (Kumari and Singh, 2019). It is crucial to identify the gender concerns, needs, and demands, even wishes for having a gender-sensitive mobility system in the future. The following section has discussed the research design and methods used to identify the relevant values for a socially sustainable E-Mobility system.

2 Research Design and Methods

A field survey was conducted in Delhi to collect the relevant primary data. The Responsible Innovation (RI) framework is used to design the research. However, there are multiple types of RI frameworks (Armstrong et al., 2012; Blaskó et al., 2014; Burget et al., 2017; Fitjar et al., 2019; Von Schomberg and Hankins, 2019), a particular RI framework (Singh and Kroesen, 2012a) specific to the needs of developing countries is adopted for this research. This specific framework of RI has the simultaneous dimensions of, Anticipation, Responsiveness, Reflexivity, Deliberation, and Participation for achieving sustainability in technological innovations (Singh and Kroesen, 2012b). It must be noted that in the RI framework, sustainability includes not only economic sustainability and environmental sustainability but also social sustainability. The focus of the adopted RI framework is identifying the relevant values from the stakeholder's perspective and embed identified values at the ideation level of the innovations. Thus, resulting in the inherently value-sensitive design of the upcoming technologies. For this research work, a field survey was designed by keeping the five dimensions in mind. The universe of the study is the women users of public transport in Delhi, and the sample size is 500. A semi-structured questionnaire was administered to the selected sample. The questionnaire broadly had two types of questions. First related to Identifying the barriers in the diffusion of e-vehicles from women's own perspective, and second related to future expectations from the e-vehicles. Within the emerging E-Mobility system, questions focused on e-rikshaw, e-bikes (rental and private), and e-cars. The collected responses were analyzed for anticipation of the desired values for the future e-vehicles. Focused Group Discussion (FGD) with relevant field experts was also utilized to identify the pathways for value-sensitive future e-vehicles. Six experts from sustainability, science policy, NGO working for women safety, innovating firm, and public health expert participated in the

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FGD. In the spirit of the RI framework, this work has used some methodological novelties to maintain reflexivity and participation. For instance, the field survey is three tired- the first round 500 women respondents were approached twice again for their feedback on the findings. For the second and third rounds, the response rate is 38% and 86%, respectively. This method kept the feedback loop live throughout the research and maintained the reflexivity and responsiveness of the research process. The following section discusses the significant findings from the field survey.

3 Findings and Discussion

The findings from the field study are arranged into three broader categories as- Identifying the barriers in the adoption of e-vehicles from women's perspective, anticipated desired values for future e-vehicles, and pathways for faster adoption of e-vehicles among women.

3.1 Barriers in Adoption of E-vehicles

The respondents were asked to list the issues with e-vehicles and rate these issues regarding the significance of a specific issue. Issues listed by most of the respondents are related to Design, Economy, Charging Infrastructure, Weather, Speed, and Hygiene. The ratings of the various identified barriers are given below in figure 1.

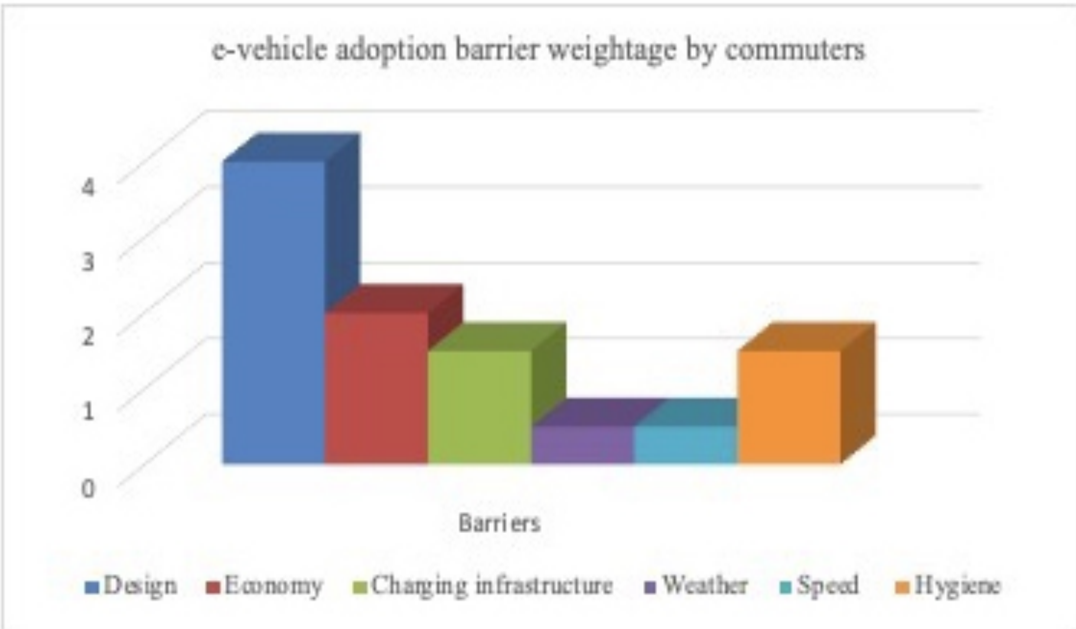

Fig.1. Rating of various barriers by respondents.

It is interesting to note that none of the respondents own an e-car, and very few were interested in buying it shortly. For example, a young student respondent stated that

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"*buying an e-car is like keeping a white elephant; it's expansive, very slow, and there is no charging infrastructure in my parking lot. It may be environment friendly, but petrol cars are more functional*". This reflects the general attitude of the majority of respondents, as they acknowledge the environmental benefits of e-vehicles but do not consider them adequate for everyday needs related to mobility.

However, the case of the e-rikshaws is very different as most of the respondents consider it an affordable and safe solution for mobility needs of short distances. But, when women respondents asked whether they would prefer to drive an e-rikshaw (as occupation), the majority response was negative, and the reason for such reaction can be easily traced to the identified barriers. To quote one former e-rikshaw driver, woman respondent, "*e-rikshaw is not designed for women drivers, it's open from all sides with no privacy. There is no protection from heat, cold, or even monsoon rains. But, most importantly, the charging stations were dominated by male drivers. I was the only female driver, and it felt very uncomfortable; in the end, I gave up*". Similarly, the respondents were not enthusiastic about e-bike rental services mostly located near metro and bus stations for last-mile connectivity functions. Yulu bike is one of such rental bike services studied for this research. Responding women were primarily critical of the bike's design as it does not have any attached carrier basket or second seat. The requirement of care mobility is not kept in mind while designing the e-bike. Thus, many women termed e-bikes as a 'fun' vehicle than being a utility vehicle. One respondent stated that "*first, I need to download the app then pay online, its expansive, I wear sari it is tough to sit crossed leg, and without a second seat, I can't take my child with me. They should know our culture and needs beforehand*". However, few respondents thought of e-bikes as more hygienic (in the context of COVID-19) as it provides the affordable individual mobility option compared to the shared mobility of e-rikshaws. Yet, almost all respondents expressed a desire for a better design of the e-bikes.

3.2 Anticipated Desired Values

The responding women were asked about their expectations and wishes from the future e-vehicle. Identification of such expectations is crucial for meaningful input to the innovating firms and making e-vehicles more appealing to the women commuters (Kumari, 2017). The initial response was towards the changes in the designs of existing e-vehicles (e-bikes & e-rikshaws) and cutting down on the costs of the e-cars. In the second and third rounds of feedback, more specific details related to the design of the e-vehicles became clear. All the responses are clubbed together in terms of the specific values, which are defined based on the responses collected. The identified values include Safety, Affordability, Hygiene, Comfort, and Support. These values are not mutually exclusive and are having some overlapping indicators. For instance, Hygiene

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is also part of Safety and Comfort, yet it has some specific underlying indicators. However, it has been found that different values are considered more significant for different modes within E-Mobility. In the case of e-cars, the value expectation is for affordability and support. Affordability is about cost, maintenance, and access to government subsidies. At the same time, the value of support is about the expectation of robust charging infrastructure (which is considered as currently inadequate) and future upgrades of the vehicle. The values of safety, Hygiene, and comfort were found to be more significant for e-rikshaws. All these values are related to the physical design and operation of the e-rikshaws. For example, the safety from tripping from e-rikshaw or protection from Delhi’s harsh weather conditions can be addressed by changing the design of e-rikshaws. Further, respondents expressed the desire that some sort of sanitation mechanism must be installed in the e-rikshaws to provide for shared mobility. In the case of e-bikes (for rental), the respondents mainly emphasized the need for comfort in the design, including a second seat, a carriage basket, and some inbuilt balancing. One respondent observed that “*like most of my female friends, I grew up without any basic training in cycling. It's anyways difficult to ride a two-wheeler in the crowded streets of Delhi. I fear that I won’t be able to balance and fall down*”. Such a response indicates the cultural gender discrimination in mobility training. Therefore, innovating firms need to keep in mind such cultural nuances while ideating on future e-bikes. Another point in an e-bike is related to the aversion towards the app-based rental models. As many respondents pointed out that, there are multiple apps, and each one can’t be downloaded due to data limitations. Thus, there is a need to think the alternative models for making e-biking a success among women commuters.

3.3 Pathways for Faster Adoption of E-vehicles

This section is based on the outcomes of the FGD, which was conducted on the broader theme of identifying the strategy for government policy and innovating firms. Currently, the government in Delhi provides a substantial subsidy on the purchase of e-vehicles like two-wheelers and cars. Despite the subsidy, the sale of e-vehicles is still poor (“Growth of EV Sales in India Consistent Since Past Three Years; 1,67,041 Units Sold in 2019-20,” 2021), clearly indicating that this strategy is not working. Thus, there is a need for an alternative policy of incentivizing the innovation process in the E-Mobility sector. Experts were of the view that subsidies should be directed towards the responsible innovations in e-vehicles for achieving value-sensitive designs. Government schemes also support the social innovators and enhancing women's mobility is one such area of action. But at times, these schemes are reduced to tokenism. Therefore, there is a need to combine social innovations with responsible innovation processes (Bolz and de Bruin, 2019). It also came into the discussion that instead of pushing the sales of e-vehicles, making future e-vehicles appealing to

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people would automatically boost the faster adoption. It is crucial for the economic sustainability of innovative firms to adopt a value-sensitive approach for designing the future e-vehicles. Further, there is a need for the continuous operation of the feedback loop from stakeholders for a responsible innovation process so that reflexivity and responsiveness of the e-vehicle designs could be maintained. In short social sustainability of the e-vehicles is crucial for the economic survival of the innovating firms.

4 Conclusion

The most important finding of this research is the significant role of the 'design' in the adoption of e-vehicles by women users. The design includes physical aspects, technology, supporting infrastructure such as a charging network, and making the design of the future e-vehicle conducive to the needs and demands of the women-centric mobility will effectively enhance the chances of faster adoption of e-vehicles. In this direction, government policies directed towards encouraging responsible innovation processes can play a positive catalytic role. Gender equity is an essential part of social sustainability, which in turn is crucial for the economic sustainability of E-Mobility. Thus, there is a need to promote value-sensitive design in a responsible manner in the E-Mobility sector.

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Some Challenges of the New Open Science Policy for the R&D Evaluation System: The Case of Slovenia

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Abstract: The European Commission's Open Science Policy should become a new modus operandi in the context of evidence-based R&D policy and practice. Yet changes are essential in national R&D evaluation systems if this goal is to be accomplished. Most critics of the established and long-standing R&D evaluation systems believe the European Commission's call for changes is being interpreted in the wrong way. By referring to the Open Science Policy, such critics seem ready to deny all of the positive achievements of traditional R&D evaluation systems. The contribution critically confronts the arguments of those critics in Slovenia who reject the important role played by bibliometric in the assessment of scientific quality and excellence.

1 Introduction

Expectations that the new open science policy will become the new modus operandi of research activities within the European Union (EU) are growing. As already declared in various strategic documents of the European Commission (EC), the open science model is to replace the traditional (closed) model of science that dominated in the past (EC 2020; EC 2017; EC 2016). Yet, how are the announced changes expressed in the R&D policy and practice of small scientific communities? This question constitutes the focus of my contribution. I highlight certain implications held by the EU's new policy of open science for how the R&D evaluation system is perceived by scientists in Slovenia. Slovenia is an EU member state with a small scientific community. Although it also has a relatively short tradition in the implementation of more standardised R&D evaluation procedures, the well-developed system for assessing research plays an integral role in the national R&D decision-making processes regarding the appointment/promotion of academic positions as well as grant applications.

In the last few years, the academic community in Slovenia has levelled plenty of criticism of the R&D evaluation procedures used in the context of R&D policy. Such criticism builds on the assumption that quantitative indicators cannot play any role in the assessment of scientific performance and excellence. Moreover, among such criticism one can also hear claims that the use of metrics in R&D evaluation procedures runs counter to the basic principles of the open science model being promoted by the European Commission. The main sources of this public criticism are certain research professional societies and research trade unions, alongside some 'public opinion makers' among researchers in Slovenia who in various public media publish their views

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on the position held by science in society. Notwithstanding this, the relatively complex theme of R&D evaluation in science remains a relatively marginal topic for the broader Slovenia public, while attracting considerable attention in scientific circles.

Can we agree with this strong criticism and rejection of the R&D evaluation system being used in Slovenia as a country with a small scientific community? My contribution stresses that the new model of open science is extremely important for its introduction of new perspectives in traditional R&D evaluation procedures. Still, it cannot become an instrument to be opportunistically misused during national R&D policy debates. I believe the best and most promising way is to combine quantitative (metrics) and qualitative (peer review) measures in the country's R&D evaluation system and, whichever direction R&D policy in Slovenia is to take in the future, its first imperative must be to build a system of R&D evaluation that supports the excellence and international visibility of its scientific output.

In my conceptual and empirical investigation, I draw on content analysis of R&D policy documents and public opinions of scientists in Slovenia. By using the method of content analysis, I succeed at more general level to identify the main trends in public debates about R&D evaluation system in Slovenia.

My short essay is divided into three main sections. In section one, I present the basic characteristics of the model of open science. After briefly discussing why the open science platform is still sometimes extremely loosely defined, in the second section an overview is given of the R&D evaluation system in Slovenia. Slovenia is an EU member state with a small scientific community, which means the transparent and adequate use of quantitative measures that are treated as equal parts of qualitative R&D evaluation procedures is extremely important. In the third section, the 'populist' resistance among various groups of scientists in Slovenia against the use of metrics in the country's R&D evaluation system is described. It is concluded in this section that the more extreme criticism of bibliometric coming from part of the Slovenian academic community has no rational basis. The third section is followed by some short concluding remarks.

2 The New Open Science Policy in the Context of Responsible Research and Innovation

I start with a short overview of the new open science policy. The biggest challenge arising from the new open science strategy is how to review and produce research outputs to ensure they have a strong societal impact (Von Schonberg 2013). Another important aspect of the new open science policy is the sharing of knowledge and data

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among scientists as early as possible in open collaboration and to motivate them to use that in ground-breaking R&D activities. Accordingly, all scholarly publications on research results funded by public or private grants provided by national, regional and international research councils and funding bodies should be made immediately available through open-access repositories.

All basic EC documents concerned with the debate on the open science model mostly address these questions (e.g., EC 2020; EC 2017; EC 2016). They require the replacement of the traditional mechanisms supposedly based on the 'publish or perish' principle, then the promotion of scientific excellence as self-referential criteria etc. Unfortunately, these EC documents that talk about an open science policy platform sometimes use extremely loosely defined concepts of open science. They include many declarative statements about the need to introduce changes but lack more tangible recommendations on how to actually implement the changes. A good example is the genesis of the whole Open Science Policy Platform from 2016 onwards (EC 2020). In first 2 years, the Open Science Policy Platform strictly used the term altmetrics to describe alternative bibliometric approaches. In the next 2 years (2018–2020), the “altmetrics” concept was renamed—without it being highlighted—in “the next generation metrics” concept. This means that considerable inaccuracy is seen already at the level of semantics. Yet, to be fair, in the second period of the Open Science Policy Platform, more precise guidance is given to the various stakeholders on how to use “the next generation metrics”. For example, the project “Monitoring the evolution and benefits of Responsible Research and Innovation” has sought to develop indicators covering the six keys of responsible research and innovation (RRI) encompassed in the European Commission's R&D policy scheme (for more, see: Mejlgaard et al. 2019; Peter et al. 2018).

The idea of open science shares the destiny of the more general concept of RRI. Last but not least, the idea of open science forms part of RRI. Although the RRI concept is extremely widespread in theoretical and practical (policy) discussions in the EU, one can find many disagreements on the interpretation of its basic principles (Mejlgaard et al. 2019). The various groups of stakeholders in Europe to be included in these discussions are still far from reaching a consensus, which is the main point of RRI. It thus makes sense to distinguish at least two basic concepts in RRI. First, the administrative- and policy-oriented concept is mainly a concept of representatives of the EC and based on six distinct keys: engagement, gender equality, science education, ethics, open science and governance (EC 2014; EC 2012). Second, the (meta)theoretical concept draws much more from the general epistemological principles: anticipation, reflexivity, inclusion and responsiveness (for more, see: Yaghmaei and Van de Poel 2021; Arnaldi and Bianchi 2016; Owen et al. 2013; Stilgoe et al. 2013).

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In any case, the open science model is still in its early stages and if any real progress is to happen the stakeholders involved must invest greater efforts to operationalise it. On the contrary, the model will trigger considerable controversy on both the EU and national levels. Namely, as mentioned, even when all components of the open science model are relatively well elaborated on the theoretical and conceptual levels, there is no guarantee the model will not be misinterpreted by various groups of stakeholders on the national level.

3 The R&D Evaluation System in Slovenia as a Small EU Member State

Today, the model of open science raises the question of the practical implementation of R&D evaluation systems. History has seen all manner of R&D evaluation practices. The R&D evaluation landscape in European countries has varied in terms of context, history and traditions, the actors and interests involved, and the types of problems the countries were facing. If we restrict our view to the situation in Slovenia as a small Central and Eastern European country, which is still in some sort of transitional period concerning the implementation of a modern R&D policy, it is necessary to recognise that before the political turn in 1990 Slovenia (as part of former Yugoslavia) did not have a modern R&D evaluation system in place, at least not an R&D evaluation system comparable with the R&D evaluation systems seen in Western European countries. Despite differences in the functioning of the R&D policies of the former communist countries (the position of national sciences in the former communist countries was not totally monolithic, while certain crucial differences also existed between former Yugoslavia and the countries of the former Soviet bloc), their common denominator was parochialism and intellectual isolationism, the lack of international collaborations and the subordination of science to the one-party ideology. In the former communist era, especially the results of the social sciences and the humanities were mainly published by domestic journals and publishing houses featuring relatively low scientific quality and strong political control. In communist times, the ‘publish or perish’ principle based on an objective type of R&D evaluation was never implemented in practice.

The country’s political turn and attainment of independence at the beginning of the 1990s also included changes to R&D policy. Along with the radical political turn came requirements to establish a new relationship between science and politics. Through the processes of transition, R&D policy actors in Slovenia encountered new challenges, including how to ensure the objective assessment of scientific quality and excellence.

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During this period, the processes entailed in the transition of Slovenian R&D policy coincided with an interesting phenomenon: the old Western European democracies with long standing and well-established scientific systems were in the phase of ending the old social contracts for science where it was expected that the self-regulation of academic communities would assure the integrity and productivity of research. Yet, instead, the main R&D policy decision-makers in Western Europe began to impose stricter auditing of R&D output in academic science. “In West Europe, we witnessed at that time the triumph of science and technology (S&T) indicators—not only of bibliometric indicators—in the context of the encompassing need for assessments and the striving for evidence-based R&D policies” (Barre 2010: 229).

Evaluative metrics began to be used for research assessment purposes in most academic institutions and funding agencies on the assumption that more publications and higher citation counts mean increased productivity and better-quality research. Quantitative measures also started to be used by universities for the recruitment/promotion of staff and by funding agencies for evaluating grant applications. Moreover, evaluative metrics began to be used to rank universities around the world (for more, see: Ma and Ladisch 2019; Sørensen et al. 2016; Guston 2000).

In this situation, the recently started reform of R&D policy in Slovenia in many respects follows the new ideas regarding how R&D evaluation systems are organised in Western Europe. As concerns the introduction of new democratic mechanisms to allow more objective tools to be used to monitor the quality and excellence of scientific output, in Slovenia the establishment of the Slovenian Research Agency was extremely important. The Slovenian Research Agency—the only public funding institution in Slovenia—succeeded to organise new R&D evaluation procedures to assess the merits of research undertaken in the public sector. After the Slovenian Research Agency was set up, the expert system in Slovenian science began to more strictly apply a combination of quantitative (bibliometric) and qualitative (peer review) measures. Bibliometric (publications, citations etc.) became relevant in these new processes for evaluating science. For example, in the evaluation of R&D proposals for public funding submitted to the Slovenian Research Agency, the following criteria were applied:

1) The number of peer-reviewed publications of submitters of the proposal within the last 5 years, taking regard of differences in the publication ‘habitus’ of scientists working in different scientific fields (disciplines);
2) The number of citations within the Science Citation Index and the Social Science/Humanities Science Citation Index over the last 10 years; and
3) The funding received from non-Agency sources within the last 5 years.

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Each selected dimension of scientific performance (publication productivity, scientific impact, efficiency in obtaining funding) is given a number of points that are then used as a 'weight' while calculating the final score. According to information collected for the quantitative part of the R&D evaluation at the Slovenian Research Agency, the criterion of reliability is entirely fulfilled. Namely, the Agency has over a period of 20 years managed to create the national information system called "SICRIS", which permits access to the complete bibliography of every active researcher in Slovenia. There is also no problem with the collection of information concerning scientific citations because the Web of Science international information system is used. The data concerning any third-party funding of scientists' projects are directly obtained from scientific research organisations in Slovenia.

In my view, in a small scientific academic community like the community of scientists in Slovenia the use of bibliometrics in the R&D evaluation system brings more positive than negative effects, not only because bibliometrics can avoid the determination of quality and impact in science on the grounds of idiosyncratic and subjective opinions used by individual researchers who prefer to glorify their own achievements, but also because it can better help to avoid conflicts of interest. Namely, small countries are more vulnerable to conflicts of interest due to the reliance on qualitative peer reviews. The transparency of qualitative (peer-review) processes is not necessarily guaranteed. Such situations create various pressures that lead towards the informal and hidden penetration of the interests of different external lobby groups in the area of science. This means the transparent and adequate use of quantitative measures being treated as equal to the qualitative R&D evaluation procedures is extremely important. Although these R&D policy instruments can also be misused by a non-competent administration, they give great benefits to small scientific communities by increasing transparency in the allocation of state R&D funding.

4 Is the Criticism of the Use of Bibliometrics in Slovenia's R&D Evaluation System Always Justified?

Two types of dissatisfaction may be seen in the scientific community in Slovenia concerning the practical implementation of the R&D evaluation system as the basis for distributing funds for public science.

On one hand, the dissatisfaction based on requirements to make R&D policy decision-making less bureaucratic seems to be justified. As noted by some critical observers, continuous changes to R&D policy decisions without strong enough participation of scientists have been observed (Adam and Gorišek 2020; Majdič 2021).

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One weakness of Slovenia's R&D policy is the lack of cooperation between policy decision-makers and scientists. The entrenched bureaucratisation and rigidity of some institutions responsible for practical implementation of R&D policy mean there has been little propensity to lead communication with various groups of stakeholders. This is also often true of the Slovenian Research Agency, which does not always ensure that the interests of scientists are promoted in their expert bodies. In that sense, Slovenia is still at the beginning of forming a modern institutional R&D policy decision structure that would establish a balance between the autonomy and the heteronomy of the science system in the national framework (Mali and Pustovrh 2017).

On the other hand, part of the research community is constantly resistant to any kind of introduction of quantitative measures in science. In their extreme criticism of bibliometric, this group of scientists overlooks its inherent applied value for all stakeholders involved in R&D policy decision-making processes, especially if such R&D evaluation instruments are used in a small scientific community. Namely, as noted, a small scientific community notoriously lacks transparency. As a result, the traditional approaches to the complex processes of R&D evaluation are overestimated, sometimes based on the very loose argument that only qualitative types of evaluations guarantee the autonomy of academic science. In my view, the criticism based on the rejection of bibliometric is unjustified.

In the Slovenian context, two different groups of 'on-duty critics' of the use of bibliometric in the R&D evaluation process can be detected.

The first group of 'on-duty critics' includes researchers from various scientific fields and disciplines who frequently use social media to raise their voice among the wider expert or non-expert public. This group of scientists is making a shift towards a new pattern of hybrid science communication, which includes characteristics previously attributed to journalism. Although the vast majority of scientists today consider presenting their opinion on various matters of science to the broader public to be an important element of the social role of scientists (Horst et al. 2017), in all countries a narrow group of scientists has formed that is extremely involved in presenting their personal views on different aspects of science and science policy in social media. Their constant appearances on television, radio and in newspapers mean they often take on the role of 'public opinion makers' in the scientific community. It is also true that these scientists have often transformed into people who see it as their duty to commentate on everything and their use of social media is encouraging them to express their personal idiosyncratic views rather than pure facts. Here, the situation in Slovenia is not very different to that seen in other European countries.

Scientists who have held the role of the leading 'public opinion-makers' have in the last few years lamented that the use of bibliometric in R&D is creating the hyper-production of worthless publications, because "academic science in Slovenia is

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becoming exclusively the domain of fighting for a greater number of publications and citations" (Dolenc 2019). They, for example M. Klanjsek Gunde and U. Opara Krasovec, also complain that the "quantitative measures used at the Slovenian Research Agency are automatically leading to biases by distribution of financial resources for research projects and provide the basis for scientific fraud and scientific corruption" (Gunde and Opara 2016). Strong criticism of the use of quantitative evaluative measures according to policy decisions of the Slovenian Research Agency concerning the distribution of funding for public science has been triggered by the many other scientists who perform the role of 'critical voices' in science in front of the wider public.

The second group of 'on-duty critics' in Slovenia comprises particular scientific professional societies and trade unions that represent the interests of employees in the whole scientific community or its separate (disciplinary) branches. The priority of these organisations and their heads is to protect and defend the collective rights of employees in science (trade unions) or to ensure professional standards important for the progress of certain disciplines in science (professional scientific societies). In this sense, they raise their voice in the public with regard to a wide variety of R&D policy matters.

Since the main activities of trade union researchers in Slovenia in the last period have primarily been oriented to protecting and defending the rights of young researchers in the first few years of their professional career (including the loosening of the habilitation criteria for obtaining a permanent job position at academic institutions), the opportunity has not been missed to prepare an official statement on the deficiencies of the Slovenian Research Agency when distributing funding for public science (Skupna izjava Sindikata vzgoje, izobrazevanja in znanosti 2020). The leaders of the Slovenian trade union of researchers has constantly mentioned as a crucial deficiency of the Slovenian Research Agency the excessive use of bibliometric in the country's R&D evaluation processes.

Over the last 5 years, some scientific professional societies (also often known as "scholarly societies") have followed the same (critical) discourse as the trade union. In Slovenia, scholarly societies are associations which facilitate interactions of interested scholars on the national level to promote professional standards in their scientific disciplines. Although the primary goal of scientific professional societies is to improve the general image of the scientific discipline they represent through public advocacy, fostering networking, information sharing, professional development etc., they are often involved in very specific disputes. The controversies surrounding the role of bibliometric in R&D evaluation processes is one example of such a specific and hardly rational dispute. For example, the Slovenian Sociological Association which should develop and advance sociology as an area of professional expertise and as an

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academic discipline has in the last 5 years published a few official statements that constantly repeated that the “evaluation of research work based on bibliometric encourages the commercialisation or mainstreaming of science in Slovenia and supports the profit-oriented company Thomas Reuters, stifles critical scientific reflexivity and, last but not least, forces researchers into unpaid labour” (Stalisca Slovenskega socioloskega drustva do vrednotenja znanstvene uspesnosti 2018).

In any case, all types of criticism presented above coming from all groups of ‘on-duty’ critics extremely oversimplify the complex issues linked with the use of bibliometric in R&D evaluation processes. While they can be considered by some as a type of professional engagement of scientists and experts which contributes to the plurality of discussions, none of them make a significant contribution to making R&D policy decision-making processes more transparent. Namely, in their one-sided and populistic criticism they overlook that bibliometric approaches, especially when appropriately used in combination with qualitative peer-review assessments, hold the potential to expand the democratic participation of all stakeholders involved R&D policy decision-making. The attraction of bibliometric lies not only in its transparency and ease of understanding in the academic scientific community, but in its ability to translate information about research outcomes to non-academic stakeholders. That is, bibliometric helps non-academic stakeholders to deduce information regarding the perceived validity and quality of scientific results and producers of scientific results.

In the last part of the discussion, I present the main arguments against the scepticism emerging from certain scientists and their official representatives in Slovenia concerning the use of bibliometric in R&D evaluation processes.

1. The critics of bibliometric are unaware that, although the first forms of science evaluation were born in “Tormentin”, they have represented the crucial driving factor of scientific progress from the origin of modern science onwards. Also, that in the context of the complex socio-epistemic structure of R&D evaluation processes, which have advanced over the history of modern science, it has been difficult to strictly separate quantitative and qualitative dimensions (Arocena et al. 2019; Glaeser 2010). The relationship between quantity and quality in science is inherently interconnected. In that sense, bibliometric evaluations appear to be legitimated by scientific practices themselves. Their legitimacy stems from the fact that bibliometric evaluations rely on cumulated qualitative judgements. For example, if bibliometric is condemned for being based only on the quantitative counting of scientific publications, then it has been overlooked that every scientific publication already preliminarily passed the qualitative peer review. The same is true of the bibliometric measure of citations. Citations are not only quantitative numbers. They indicate peer judgements on scientific impact. Many critics of bibliometric refer to the

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deficiency of “metrics literacy” (Rafols 2018). They are unable to see the dual function of bibliometric as a form of scientific expertise, i.e., to help governmental administration as well members of the scientific community to improve the quality of R&D policy decision-making processes.

2. It would be good to shift away from the habitual discussions of the most fervent critics of bibliometric who claim that the end of bibliometric will re-establish equality in the Slovenian scientific community because the scientific ‘establishment’ that achieved (symbolic or material) privileges in the old times will lose them upon the introduction of exclusively qualitative evaluation criteria. Instead of this populistic discourse which lacks any kind of knowledge of Robert Merton’s theory of accumulative advantages in science (Merton 1968), it would be much more constructive to look at the positive effects of bibliometric. Namely, such simplified criticism overlooks that an R&D evaluation system based on a suitable balance between quality and quantity can help increase the visibility of Slovenian scientists in the international arena. Studies on the ‘publishing habitus’ of Slovenia’s researchers have pointed to the emergence of specific phenomena known in social network theory as “small worlds” (Cugmas et al. 2020; Mali et al. 2017; Ferligoj et al. 2015). Small worlds phenomena refer to the closed forms of scientific collaborations in local and parochial circumstances which do not contribute to the greater international visibility of scientists. In the context of scientific collaboration in the social sciences and humanities in Slovenia, many of these small worlds have been found, for example when all researchers in the same department or the same research institute have published a book of proceedings with a domestic publishing house. Although in these cases the scientists express a high level of commitment to mutual collaboration, their international visibility remains negligible.
3. The critics of bibliometric in Slovenia are insufficiently aware that different interpretative frameworks exist in theory and practice regarding what the idea of open science should be. With the open science model, contradictory interests can be detected among various groups of stakeholders, e.g., the primary interest of some of them is how to establish a balance between public and private interest, while others are interested in finding a balance between qualitative and quantitative R&D evaluation instruments etc. Although current criticism of bibliometric all around the world is often based on disreputable global initiatives and manifestos, such as the San Francisco Declaration of Research Assessment (DORA 2013) or the Leiden Manifesto (Hicks et al. 2015), the ideas contained in these declarations cannot find an easy way being realised in national contexts. In Finland, an analysis was undertaken among experts and scientists of the existing national R&D evaluation system. The study

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showed that they are aware quantitative data are still reliable for realistically interpreting quality and impact regardless of the problems that erode their credibility (Lauronen 2020). A study which investigated how Norwegian scientists perceive citations in terms of quality and visibility showed that their perceptions are 'ambivalent', yet mainly positive (Ma and Ladisch 2019).

4. Although altmetrics momentarily enjoys support among a wide group of scientists in Slovenia, all of the questions about this alternative approach to R&D evaluation procedures remain unanswered. Today, one encounters the lack of a common definition of what altmetrics in R&D evaluation should at all represent (Regan and Henchoin 2019; Robinson-Garcia et al. 2018). On one hand, altmetrics has been proposed by some experts as an attractive option to capture the societal impact of research and to draw attention to the scholarly communication taking place in the online environments of social media. For example, academic researchers working at universities are not only expected to be responsible for the creation of new knowledge and its transfer through teaching, but to engage by way of social outreach and public engagement. Therefore, all R&D evaluation procedures and indicators should also be adapted to these expectations. On the other hand, all debates around altmetrics are still imbued with inconclusive arguments, contradictory feelings on what is its novelty etc. For example, most altmetric analyses have extrapolated the bibliometric citation model to social media, and developed indicators based on the mentions (saying or citations) of scientific publications in social media platforms like Twitter, Mendeley, or blogs. Therefore, we might ask what is the novelty of altmetrics at all with regard to traditional bibliometric.

I have attempted to point to four cases where bibliometric will continue to play an important role in any model of science, including the open model of science. While the issues concerning bibliometric are an ongoing subject of controversy among scientists and R&D policy decision-makers, this does not mean that bibliometric must no longer be an element of R&D evaluation processes. In this sense, the extreme criticism of bibliometric levelled by part of the Slovenian academic community has no rational basis. It forms part of the recent 'populist' scientific trends which have also emerged in certain other scientific communities. They have little or nothing in common with the open science concept promoted by the European Commission.

5 Conclusion

In my brief contribution, I have tried to show that some kinds of 'populist' resistance among various groups of scientists in Slovenia against the use of quantitative measures in the context of the national R&D evaluation system are not justified. Their reference to the model of open science has no rational basis. In the open science model, the priority is to follow a responsible approach to R&D evaluation procedures. Here, the crucial question is not how to replace bibliometric with altmetrics, but how to responsibly develop R&D evaluations generally. A further improvement of R&D evaluation processes is certainly the most important step needed for improving the quality and excellence of scientific output in Slovenia. This improvement cannot be based on the opinion that we need to separate the qualitative and quantitative dimensions of science. As I have sought to explain, the quantity/quality relationship in science is inherently interconnected. Accordingly, bibliometric evaluations appear to be legitimated by scientific practices themselves.

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Borderland Encounters—Evolving Professional Identities Between Human and Machine Learning Processes

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Abstract. Nowadays, the ability to take initiative and to assert oneself, but also to care for others and show empathy, are considered as essential requirements in many professional settings. Those abilities have become part of the professional identity of many team leaders or department heads, as well as of collaborators in organizations with less hierarchical structures. Like other specialized skills, they are object of training and upskilling measures. As the approach to professional training has been changing significantly, more and more offers for experience-based, interactive and playful forms of training have been created. Recent years have seen an increase in the use of interactive training applications based on virtual reality (VR) and artificial intelligence (AI) technologies for developing social skills, such as public speaking, interpersonal communication abilities and so on. Considering that social and interactive skills are seen as distinctive human traits, the AI-powered digital space may constitute a borderland in which human and machine learning processes intertwine. Still, whereas machine learning processes function exclusively on the basis of pattern recognition, human learning and interaction is characterized by an openness that includes breaches, failures, external appraisal, critical reflection, and other forms of transformation. Using the case of an interactive VR environment for the training of social skills, we outline a new theoretical approach for mapping the borderland between human and machine learning processes in the field of social skills training. We discuss the case within the framework of Gabriel Tarde's concepts of invention, imitation and desire.

1 Introduction

In many professions, it has become crucial to develop a set of interpersonal skills, such as assertiveness or empathy. These skills are deemed important requirements in many occupational settings (Kanning 2009). In addition, interpersonal skills are considered as something one can train and develop with the appropriate learning and training measures. This has led to an increasing offer of courses, workshops and other forms of training dedicated to the development of interpersonal (also called soft or social) skills (Nangle et al. 2020).

While in the past, the formal activity of learning was confined to institutions of schools, universities or vocational training, over the past few decades it has been diffusing beyond these institutions and transformed into something that spans individuals' entire life. In other words, learning is no longer referred to primarily as the

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formal education one receives in childhood and early adulthood in a pedagogical form. Rather, it now refers to the knowledge acquired on an ongoing, self-directed and voluntary basis motivated by personal development, employability or social inclusion. Further education, formation, professional training, coaching and so on have been evolving constantly, not only within the public education system but also as an important branch of the service sector. Apart from this shift in how we perceive and approach learning, there has been also a shift in the learning and teaching techniques, with the emergence of a field of learning forms that are subsumed under the concepts of playful learning or edutainment. Nowadays, many organizations are engaged in offering their staff not just courses or seminars, but 'playful' forms of 'experiential learning'.

The paradigm shift is also reflected in the technologies used for learning. While in the past, learners were provided with course materials in form of books and followed the lessons in a standardized way, nowadays learning has become much more interactive, with didactical forms that invite learners to participate, but also with new technologies that allow to establish a constant exchange between teachers and learners. The technological advances in virtual reality (VR) and artificial intelligence (AI) have also permeated the field of learning and teaching. There are multiple applications based on these technologies meant to help individuals developing social skills, such as public speaking, interpersonal communication abilities and so on. However, social and interactive skills are fundamentally human traits. They help us make friends, create a network of people, work together towards a common goal and so on. So, in an activity that involves the teaching and learning of these skills, how do the technological, AI-based processes of machine learning and the human processes of socializing twine together?

The empirical background of this theoretical paper is the ongoing transdisciplinary research project Virtual Skills Lab.[1] Its aim is the development of a research prototype for a Virtual Reality (VR) based social skills training. The story line for the VR scene has been developed, on the basis of a participatory approach, in collaboration with mid-level managers in an international corporation based in Austria. In the scene, the player takes over the role of a team manager sitting in their office. A virtual agent named Mira Horvath (Fig. 1), who is introduced as a collaborator of the player's fictitious team, steps in, expecting her superior (the player) to start a scheduled meeting with her. She wants to present her team leader a template she has been working on. Suddenly, a message pops up, reminding the team leader to attend another meeting of higher priority. The task for the player is now to "say no in an appreciative way", i.e., to postpone the meeting with Mira again.

[1] https://projekte.ffg.at/projekt/3254984 (accessed 31st of May 2021)

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Fig. 1. Still of the interactive VR scene developed for the research project Virtual Skills Lab.

Against the background of this project that deals with the question how VR could be effectively used in the context of professional training, we aim to present a sociological account of 'learning' as a constitutive element of professional identity and its relation to technologies based on 'machine learning' (AI). We explore the space of encounter and interaction between humans and machines by drawing on Gabriel Tarde's concepts of invention, imitation, and desire. Although Tarde published most of his works at the end of the nineteenth century, scholars recently have referred to his theoretical concepts in order to analyze the innovation brought about by new technologies, scientific knowledge and sociocultural movements (Borch/Stäheli 2009, Candea 2010, Latour 2014, Latour/Lépinay 2009, Lazzarato 2002). Especially his theory on the "laws of imitation" (1890) contains concepts that are appropriate for analyzing characteristic phenomena of the digital societies, such as social media like Facebook or Twitter. The socio-technical dynamics constituting these communication spaces can be described by applying Tarde's concepts of invention, imitation, and desire. We first discuss Tarde's theory of invention and imitation and examine, within this framework and compared to other theoretical approaches, the concepts of learning, playful self, and professional identity. We follow with a discussion of these concepts as applied for leader social skills training and examine the role of VR/AI technologies in the diffusion of social skill knowledge. We then draw on Tarde's understanding of the notion of desire in order to grasp the conceptual difference between human and machine learning processes. In conclusion, we outline the

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implications of our study for future empirical research of technology-based leadership training.

2 The Social as Inter-Activity, Not Inter-Connectedness

Tarde analyzes the emergence of social facts out of actions (taken consciously or unconsciously), whereby these actions express ideas deriving from specific convictions or desires. He considers the innovativeness of ideas and their diffusion as a driving moment of social exchange and progress (Tarde 1893). Like waves of light in the physical space or the procreation of life in the evolution of nature, social facts emerge and expand via the repetition of original, inventive actions (Tarde 1890). The type of repetition that distinguishes social facts is termed by Tarde as imitation. Many of the sociocultural forms and practices characterizing modern societies function like that, for example the changing of clothing styles, or musical preferences, or ways of speaking in diverse sociocultural contexts. Their diffusion has accelerated enormously with mass production and especially commercial mass communication during the 20th century. Recently, the diffusion mode has shifted from serial to interactive, with the rise of social media, communication spaces where images and texts are posted and reposted millions of times. The 'seriality' (Sartre 1991) of classical mass communication via press or television is more and more replaced by the re-activity and inter-activity of communicating via social media.

This technologically-mediated interactive character can be well analyzed by applying the concept of imitation, as it was conceived of by Tarde, and later by philosophers like Deleuze (1994). In Tarde's view, an idea, conviction or desire emerges and diffuses by imitation, but it also changes in the process. In other words, a fact that has been diffused is never exactly the same as the original. In this sense, inter-activity describes a process of diffusion in which ideas are not merely reproduced, but also altered, combined and even get into conflict with each other. While the nature of imitation, its fundamental tendency, is infinite progression (Tarde 1890), the process of diffusion unfolds as a plurality of variations and conflicts between opposing ideas and desires, as well as of combinations. There are no preliminary social structures that bind these forces together. Rather, there are many modes of associating and dissociating, that is, of constituting emerging structures and of dissolving them. It is the inter-activity of these processes that forms the social (Latour 2005).

Hence, Tarde looks at the inventive character of imitation. He suggests that invention can be based on imitation, e.g., when an innovation emerges from the crossing of different imitative streams, or from a variation of an imitative practice. Thus, according to Tarde there is a basic inter-activity that forms society and that can be more or less

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dynamic according to how the processes and practices of invention and imitation are shaped and how they evolve. It is not a basic constraint that transforms a human expression into a social fact, but rather the (conscious or unconscious) desire to imitate and, by taking up an idea or a conviction, to vary, change or oppose this idea.

In the following sections, we show how Tarde's conception of a dynamic, inter-active emerging of social facts via invention and imitation applies to the realms of professional training in general (section 3), to professional identity conceived of as a continuously evolving and 'learning' self (sections 4-5), and to social skills training in particular (section 6). We then proceed to analyze how technologies like VR and AI can be used to create playful training experiences for an evolving professional self (sections 7–8).

In this context, i.e., social interaction in professional settings, besides the dialectic of invention and imitation, it is particularly Tarde's concept of desire that allows for comparing human interaction to human-machine interaction, as well as the respective learning processes. VR environments in which humans engage in interactions with AI-based virtual agents constitute a borderland in which these two learning processes encounter (Pan/Hamilton 2018, Asada 2015). The question is if these encounters are based on, or will lead to the constitution of, a common ground (section 9). In other words, are the patterns that emerge from human as well as from machine learning processes the same, or do they differ essentially?

This question regards human-machine interaction in many different aspects and realms, such as the possibility of designing services in a way that customers have the illusion to interact with a human while interacting with a computer. In this paper, we aim to address it from the specific angle of our research project, i.e., the training of social skills in VR environments by referring to Gabriel Tarde's concept of desire. When humans train their social skills, their desire to learn is not limited to their own behavior and to the question how to improve it. It is also directed towards an interaction partner to which they attribute the same desire, i.e., to understand the other and, according to the specific situation, to cooperate or to compete, as well as to establish a relationship characterized by sympathy, trust, appreciation or other socio-emotional qualities.

A peculiarity of simulations of social interaction in VR is that humans have the possibility to interact with computer-controlled agents as if they were real human persons. Apart from the technological preconditions that render the illusion of interacting with a real human more or less perfect, the question is if human users (players) of such VR environments can, or need to, attribute the desire of mutual understanding to their computer-controlled interaction partners. While we will not give a definitive answer to the question if machines will ever develop the desire of mutual understanding, we will use Tarde's perspective to show that even if we assume a fundamental difference between human and machine learning processes, there is an ever-growing intertwining between these processes.

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Learning as a *human activity* has become inter-active in terms of didactics, and this is due to specific socio-cultural processes as well as technological evolutions. Furthermore, the *subject of learning* (the learning self) has become inter-active in that it has to assume different roles, especially in professional settings. The latter are much less hierarchical and open to a certain variety of interpreting roles and tasks than in the past. Therefore, they are associated with processes of personal change and growth. Also in this area, the area of professional identity (as a fundamental component of personal identity), interactive technologies are of growing importance. Finally, *human-machine interaction* has an increasing impact in the shaping of organizational processes as well as professional relationships. Thus, social interaction should not be analyzed detached from the various forms of human-machine interaction that co-shape human communication. From a sociological point of view, our way of interacting with others cannot be fully understood if we are not able to account for the technologically-mediated character of this inter-activity (Latour 2005). This is the reason why, in our view, it is helpful to analyze how social interaction emerges by invention, imitation, and the desire to understand the other in reference to Gabriel Tarde's conception of those terms.

3 Learning: from Limited Activity to Pervasive Inter-Activity

How is Tarde's position linked to the field of education and professional training? We have previously discussed that 'learning' as an institutionalized activity had longtime been restricted to certain time (childhood) and space constraints (in schools, universities or vocational training institutes). It was institutionalized as a sequence of educational levels and passages, from early childhood to early adulthood. Learning was essentially designed as a preparatory (and in this sense a non-productive) activity: for professional life as well as for the diverse roles people had to take over in private and public life. The skills acquired in the context of professional life for a long time were associated with terms like 'practical experience' or 'tacit knowledge'. Conversely, learning is nowadays something that we are supposed to do on an explicit, ongoing, voluntary and self-directed basis. This has led to the development of an important segment of the services sector, focused on learning outside of the credit and degree attainment model (e. g. the emergence of MOOCs—open online course providers, or professional training services providers).

In Tarde's terms, by overcoming the limited forms and institutions of education, the desire to learn and train oneself has been obeying to the fundamental law of imitation, that of an infinite progression. Education, once confined to public institutions and

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professional associations, has been transformed into a globally available (and allegedly accessible) service, a commodity.

The extension of the activity of learning has been interpreted as an imperative that characterizes the societies of control as opposed to the disciplinary societies (Deleuze 1992). In the societies of control, ‘learning’ becomes an ongoing pursuit of knowledge, whereby individuals are not educated by an external authority through surveillance or sanctioning. In Deleuze’s terms, individuals in the societies of control ‘re-request apprenticeships and permanent training’ (Deleuze 1992). Consequently, ‘learning’ and ‘training’ have become techniques of an evolving self, based on intrinsic motivation. One sociological perspective on this transformation and the new forms of learning and training that have been emerging is to conceive of ‘learning’ as a form of subjectivation, a form of self-government, in line with a Foucauldian approach (Bröckling 2007). A central concept for the institutionalization of learning as an activity that pervades all periods and aspects of life is the notion of ‘competence’ (Gelhard 2011). All disciplines, curricula or subjects are centered on defining and operationalizing basic or advanced competences into small learning goals.

4 The Playful Self—Enacting and Interpreting Professional Roles

The fact that people claim to be continuously motivated to further training (Deleuze 1992) is reflected by the emergence and diffusion of a field of learning techniques that are subsumed under the concepts of ‘playful learning’ or ‘edutainment’. While in the past, the activity of playing was banned from formal education, it has first been adopted by alternative or reformatory pedagogy as a critical approach to traditional educational techniques. Subsequently, it became—in Tarde’s terms—a fashion, conquering many areas of education and training. These techniques have also been adopted by organizations, as a means to help employees in developing their creative skills.

Nevertheless, the more the ideas of ‘edutainment’ and ‘playfulness’ diffuse, the more technology takes over a crucial role in the design of learning activities. It is especially in the context of technology-based learning and training that these activities are denominated ‘experiences’. In terms of the development of new forms of training, the borders between the industry of gaming on the one side and education technology on the other become blurred. In the context of professional training, playful learning fulfils individuals’ desire to experience work not only as a useful, but as a satisfying and meaningful activity. This makes learning even more pervasive and even more apt for diffusion by imitation.

To summarize, activities identified and denominated as learning experiences have been diffusing enormously and span all realms of society as well as all periods of life.

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On the one hand they are designed as meaningful and playful activities. On the other hand, they become increasingly mediated by technological interfaces, devices and diverse forms of human-machine interaction. Because of the important role of technology in learning, a Foucauldian or Deleuzian perspective centered on subjectivation are not sufficient. Any analytical framework needs to account for the role the technology plays in learning. It has to account for the processes of diffusion of knowledge across the interfaces. We propose that a suitable framework for understanding the human and AI/VR-based processes in learning is the theory based on the notions of invention, imitation, and desire introduced by Gabriel Tarde. Tarde's theory enables us to account for the concrete actions taken in the process of professional training and learning. We do not limit our approach to the critical stance of analyzing subjectivation and control regimes made effective by the desire to undergo continuous training processes. We aim to describe the desires underlying training processes, how they are transformed into ideas and convictions and how the respective ideas compete, combine and diffuse (Tarde 1890). Since the diffusion process involves more and more learning technologies, we also have to consider how these two fundamentally different learning processes (human and machine learning) relate to each other. How are ideas translated into data?

5 The Learning Self and Professional Identity

We have stressed that learning has transformed from an activity that once was conceived as "education", as a prerequisite for professional upward mobility, to "continuous training" conceived as an interactive process that takes place throughout life. Learning becomes a fundamental characteristic of professional identity, so that identity itself is more and more seen as a process that has to be subject to continuous training. This resonates with theories of personal identity that stress the evolving character of the self (Mead 1934, Erikson 1968). Professional identity, seen as a central component of personal identity, is something one develops over time and involves learning processes. It is developed through regular interactions with the environment, or more specifically, in organizational settings that are based on social interaction.

As a reflection of these interactions and social encounters, the self-concept can be seen as an organized representation of beliefs about ourselves (McCormick/Pressley 1997). In this sense, identity is not a fixed attribute of a person, but a phenomenon embedded in relations and interactions (Gee 2001). In their extensive literature review, Pratt and colleagues (2006) propose a circular model of identity construction whereby individuals' learning about the work, receiving social validation for their performance

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and identity formation interact in a reinforcing loop meant to construct, shape and adapt one's professional identity. Professional identity is, thus, an ongoing process of becoming and interpreting oneself as a certain kind of person and having this self-concept validated by others.

In times of digitization, the process of developing one's professional identity has become even more interactive and technology-driven. Social interaction in organizations has shifted to virtual space, as we communicate via instant messaging platforms, emails and so on. Furthermore, the sources for constructing and reflecting professional identity nowadays include social media and platforms such as YouTube, Xing or LinkedIn, where continuously leadership styles are presented and reflected. These styles are invented and imitated, adopted to new contexts or contested. Social networks and media can be understood, in Tarde's terms, as communicative spaces where ideas and convictions on professional identities, especially the relational identity of 'leaders', emerge and diffuse.

6 Leadership Skills—Social Rather than Executive

How is a 'leader' expected to be like? What defines their identity? These questions are no longer restricted to certain private circles, nor are they implicit in the concept of leadership. They are discussed publicly and inter-actively on the social media platforms. The assumption that a leader's identity is fundamentally relational is not new. In a managerial context, the processes of professional identity formation and identity strengthening have longtime been characterized as relational (Mintzberg 1973). According to many scholars, managers and leaders need to be recognized formally and informally as the leader by their followers (Bass 1990). In the words of Pratt and colleagues (2006), they need to receive social validation in order to be able to exercise influence and provide direction (Wolff et al. 2002). Meindl et al. (1985) suggest that managers and leaders need to have certain social skills in order to be able to inspire followers to pursue a common vision. Mintzberg (1973) suggested that the ability to establish and maintain social networks, the ability to deal with subordinates or the ability to empathize with top-level leaders are some of the key interpersonal skills that are critical for managerial effectiveness (Riggio/Reichard 2008).

What new technologies add to these characterizations of a leader's social competences is the growing inter-activity of the emergence, construction and diffusion of ideas and convictions. Identity appears as a process of continuous being-in-touch, being accessible and accountable for one's own ideas and actions. With the rising openness and complexity of roles and functions in organizations, the development of

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professional identity turns into a never-ending story of personal challenges, ruptures, passages and reinventions of the self, that can be publicly reflected on and discussed, via social media and their opportunities to shape and design narratives. The ability to not only recognize complex frames in interactions (Goffman 1959, 1974), but also to explore the opportunities and restrictions connected to an organizational function is nowadays seen as a fundamental competence, especially of leaders. Yet, this competence, which is better characterized as a bundle of skills, is that of a self in interaction with others, hence, a social or interpersonal competence. In this sense, interpersonal skills are not only a prerequisite for a determined position or task within an organization, but also a narrative or an imperative, a responsibility to further evolve the relational self. It is the self that, in everyday interaction, becomes a crucial entity when it comes to keep up with the challenges of organizational and especially leadership tasks. To play a role in an organization is connected with multiple learning processes. From a sociological perspective, social competences are characterized as strategic action skills that allow to shape or change a specific field, such as an organization (Fligstein/McAdam 2012).

Originally, the terms ‘social skill’ or ‘social competence’ had been coined in the contexts of clinical psychology and of developmental psychology (Kanning 2009). In the realm of clinical psychology, social skills training measures were developed and applied especially for clients suffering from social phobia or autism, in order to strengthen their self-assertiveness and support them to face everyday situations, e.g., going to public places such as supermarkets. In the realm of developmental psychology, social skills are regarded as necessary for developing the ability to cooperate with others by taking their perspective, recognizing their needs and to connect one’s own goals and interests with those of other people.

Social skills as a topic of courses and seminars entered the stage of professional training in the 1990s. Skills such as self-assertiveness, the ability to deal with conflicts or decisiveness, but also perspective-taking, pro-sociality and the ability to listen, have been considered more and more as crucial in work contexts. The tendency, with respect to the reorganization of structures and processes, towards flat hierarchies, greater autonomy and higher responsibility has led to a rising focus on the communicative aspects of cooperation and, especially, of leading teams. Generally, communication is nowadays considered as an integral component that shapes organizational processes and structures (Taylor/Van Every 2000). While once leaders focused on establishing strategic aims and breaking them down to projects, in the last decades the job of leading, especially at the middle management level, has turned into a much more interactive task involving communication, motivation and negotiation that helps getting things done. Ideal leaders today are often depicted as not only assertive and strong, but also as appreciative and empathic towards their collaborators

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(Bröckling 2017). This has created a rising demand for training interventions that focus on strengthening the ability of team and department leaders to skillfully interact with collaborators, colleagues and cooperation partners. Leaders are trained to be more assertive and decisive in meetings as well as to be more empathic, to listen carefully and to be able to compromise.

7 How to Train Social Skills: Experiential, Playful, Inter-Active

Previously, we emphasized the central role of inter-activity in the process of invention and imitation in Tarde’s theoretical perspective. Using a symbolic interactionist approach, we also discussed how the professional identity of leaders is increasingly more akin to communication. This implies that leadership nowadays includes a variety of performative acts, or symbolic interactions with others. In the words of Goffman (1959, 1974), functions and roles undergo a perpetual process of (re)interpretation and change in private, public and organizational life. This implies that there is not a specific, well-defined professional leader identity. Instead, there are multiple styles, behaviors and ways of interacting.

That is the reason why social skills training has become an essential part in the formation of leaders, an activity which has changed substantially over the years. While there are diagnostic instruments like self-assessment surveys or 360°-feedback (Kanning 2009), social skills training can be delivered in the form of simulations, such as role plays. Experience-based types of learning have been characterized as particularly effective by neurobiological research (Ciompi 1997). These insights have been used to legitimate playful, experiential learning as a fully recognized didactical form also in professional training (Beard/Wilson 2002). For neurological processes of learning and memory to be triggered, individuals need to emotionally experience things. This can be achieved by letting participants assume a role and act out in simulated critical interactions. These simulations can be filmed and analyzed by the trainer together with the participants afterwards. The analysis and discussion on the simulation is meant to guarantee the transfer of knowledge to the trainees.

8 Interactive Technologies in Social Skill Training

Still, experience-based interactive learning is not limited to role plays and video but can also be realized by drawing on technologies such as virtual reality (Bombari et al. 2015, Gillies/Pan 2019, Schmid Mast et al. 2015). The degree of trainee emotional arousal triggered by simulated experiences is considered as a criterion for the design

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of effective VR/AI–based social skills training programs. While interactive forms of inventing, imitating and diffusing ideas on leadership via social media create a reflective or discursive space where the building blocks of professional identity are exchanged and negotiated, the VR/AI technologies promise to create an entire experiential environment in which interaction in the narrow sense of the term can be trained in a playful way.

There are already several solutions commercially available. Besides applications in which the avatars are controlled by human beings, there are also applications in which a human player interacts with a virtual agent controlled by a computer. Technically, the reactions of the virtual agent are generated by speech recognition and conversational AI as mediators of the human-computer interaction. If this type of training environment is combined with technologies like the tracking of eye movement, detection of facial landmark for emotional (micro-)expressions (Gebhard et al. 2018) or the measurement of physiological markers such as skin conductance, machines can appear as emotionally intelligent entities that aptly capture the cognitive and somatic state of the human trainee (Schoeller et al. 2019). From the perspective of the player, it is possible to develop feelings of ‘empathy’ or other socio-emotional attitudes towards their virtual interlocutors and perceive their reactions as ‘empathic’ towards them (Allen et al. 2020, Bailenson 2018, Bertrand et al. 2018, Loon et al. 2018, Louie et al. 2018, Troeger/Tümler 2020). With the evolving of the conversation, the player experiences not only cognitively, but also emotionally, an interaction that he or she symbolically frames as if it were an interaction with a human person. Furthermore, the VR technology triggers the feeling of being present in the computer-mediated environment, although the player is aware of the fact that he or she is wearing a headset (Waterworth and Riva 2014). Interacting in a VR environment is thus not only a cognitive and emotional, but a bodily experience.

9 Patterns: Human Versus Machine Learning

Socially skilled interaction includes many layers of human expression, from spoken and written language to gestures and facial expressions; it also includes psychological dimensions such as the cognitive and emotional experiencing of interactive situations. It includes symbolic forms and institutions like rituals, the expression and recognition of sociocultural differences (habitus), the formal and informal relationships between interaction partners. In this sense, even though ‘assertiveness’ or ‘empathy’ are generally considered as social competences, these competences can assume a variety of forms according to the context, the sociocultural setting and the individuals participating in a concrete interaction (Kanning 2009). If a certain behavior, and attitude

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or a verbal expression is perceived as assertive or empathic is, thus, always a question of interpretation and context.

Yet, the respective behaviors, perceived as more or less socially skilled in a concrete interaction or context, as subtle as they may be, more often than not evolve in a pattern-like manner. And this is the borderland where humans and machines seem to encounter in their learning efforts. The question we ask is thus, are we humans closer to machines than we would like, even when it comes to behaviors that are supposed to distinguish us more than anything from other forms of life? Should it not be possible to model any of our expressive forms in order to design algorithms and forms of machine learning that make machines capable of maintaining any spontaneous interaction with us (Pan/Hamilton 2018)? Can this borderland of human and machine learning be described by applying Tarde's concepts of invention, imitation and diffusion as social facts and practices? Can machines learn to behave like humans in terms of sociality? In the case of VR, the question is whether virtual characters can function as representing empathic machines.

The issue of empathy in machines has been raised in previous studies on the field of affective computing (Rust/Huang 2021) which stress the importance of realizing authentic communication and affectivity in human-robot interaction. This is all the more important and relevant in artificial intelligence tasks with applicability in healthcare and mental well-being (Inkster et al. 2018; Kerasidou 2020). While there is a consensus on the fact that the state of AI research and work in creating mathematical models that can help robots emulate the complex social dynamics in a believable manner is far from reality (Leite et al. 2013; Banerjee 2020), there have been notable advances in conversational AI and robotics fields that show promising results. Some examples are the affective developmental robotics models (Asada 2015) computational model of empathy (Yalcin/DiPaola, 2018) or empathy-driven Wysa conversational model (Inkster et al., 2018). Therefore, there is reason to be confident that modelling empathetic traits and emotional intelligence in robots may not be an impossible task as originally thought. By means of pattern recognition, machines could learn to integrate signals and expressive forms that are perceived by their human interaction partner as socially skilled. This would not be restricted to empathy. Machines might also learn to be assertive, decisive or know how to manage conflicts.

Taking up the considerations made at the end of section 2, we would like to return to the theoretical perspective we propose in this paper in order to stress its value for finding an answer to this question. Attributing to imitation the fundamental quality of social action, Tarde seems to lay the basis for a converging vision of human and machine learning processes. As actions emerge and diffuse, they assume the form of recognizable and reproducible patterns. This allows to transform those actions into data that serve as a starting point for machine learning. Still, Tarde's sociology is not

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only a sociology of imitation, but also a sociology of desire (Borch/Stäheli 2009). In order to learn, humans do not only invent and imitate ideas and convictions, they also respond to specific needs. Humans desire to learn for many different reasons. In the case of social skills training, these desires and ideas refer to a type of human cooperation that is based on processes of negotiation in which these skills are indispensable in order to attain pre-established aims. In other words, humans are driven by the desire to grasp the other's perspective and at the same time to impose their own view, and these two desires do not necessarily contradict or exclude each other. From a Tardian perspective, the ability to assert oneself is related to empathy in that assertiveness depends on the desire to understand, to take the other person's perspective. Vice versa, the ability to behave in an empathic way depends on the desire to reach one's goals in a given interaction. The strength of Tarde's position is that he is able to give a sociological account of psychic processes and properties such as desires, because via the concepts of invention and imitation he conceives of these processes not as intra- but as inter-psychological (Borch/Stäheli 2009).

The question of sociological relevance is thus how imitation is shaped and transformed by means of technology. Which ideas and desires diffuse and how is their diffusion amplified, curbed or altered by technology? In this sense, machine learning and human learning intertwine, not only in an intersubjective, but also in an inter-objective space, i. e., in a technologically designed space in which humans interact with each other and with machines, and in which machine learning gains more and more agency (Latour 2005).

10 Future Research Directions

In this sense, a sociology of transforming professional identities (learning self, playful self) can be enriched by drawing on Tarde's sociology and his concepts of invention and imitation. The concepts could be operationalized by a mixed methods approach. This could consist of a discourse analysis (Bröckling 2017) of ideas on leadership in a certain field that reconstructs the diffusion of determined leadership concepts and literature and the exchange on these concepts between leaders via social media, as well as qualitative interviews that allow to reconstruct the relation between leadership ideas and their manifestation in everyday interaction. Only by reconstructing how leadership concepts are applied on a micro level it is possible to show that diffusion by imitation unfolds as a process in which those ideas are varied and appropriated in very diverse ways. These analyses could be completed with the study and critical appraisal of algorithms and machine learning processes working and developing in the background of social media and communication tools (Mühlhoff 2019).

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Such an analysis could be combined with a critical appraisal of the possibilities of simulating diverse leadership styles in VR. As outlined, the crucial point is to make a clear distinction between behavioral patterns and the technical forms of pattern recognition and reproduction, and this points to the underlying desire, embedded in the activity of learning. If the purpose is to align human behavior to calculable, machine-like modes of dealing with each other, the outcome of such a training will constitute an expertise that is artificial, inflexible and which lacks spontaneity regarding human interaction in workplace environments. If the desire, on the contrary, is to playfully try out different styles of addressing a situation and to strengthen the reflexive capacity of leaders, such immersive training forms can be useful.

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Goodbye World. On the Incommensurability of Technical and Sensemaking Communication.

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Abstract. We have never communicated with machines, and we never will. All we have done so far to communicate with machines are detours to be able to communicate with each other via machines. The foundation for this statement is the differently designed logics of communication of machines and social systems. Social systems communicate by processing meaning. According to Luhmann, communication consists of the three parts of information-message-understanding. Connectivity and recursiveness are generated based on meaning. Machines, on the other hand, communicate causally and logically and therefore exclusively via information. Technical communication is therefore established causally and is only causally connectable and recursive. Following these assumptions, we notice, that social and machine communication are incommensurable. Nevertheless, social systems manage to bridge this hiatus and produce the illusion of communicating with machines. Social Interface, a concept and term coined by Bernd Miebach accomplishes this. We discuss this new approach based on communication theory using an example of organisation research: the AI assisted hiring process using Pymetrics. The example shows that the used technology fulfils its function reducing complexity in the decision-making of the hiring process by producing a communicationally connectible output in form of ratings. We conclude that this process is being made easier via AI on the surface, but the AI assistance also produces uncertainty itself, which cannot be presumed due to the incommensurable operation of communication.

1 Introduction

The relationship between humans and technology is a much discussed and an old one: people have been thinking about it since ancient times. At the latest since modern times and especially since industrialisation, the discussion about the relationship has become even more prominent. Nevertheless, it must be noted that the discussion is out of all proportion to the extent to which technology has permeated and continues to permeate the worlds of life for about 200 years (cf Heßler & Liggieri 2020). In the discussion about how the relationship between humans and technology can be described, a break has been apparent for some time: Before the invention and establishment of digital technology, the relationship can be best described as instrumental. By ascribing intelligence and agency to technology, the relationship can also be described as interactive (Rammert and Schulz-Schaeffer, 2002 after Weyer, 2018). In this essay, we would like to pursue a different view of the relationship between humans and technology, and decidedly not an interactionist one, but a

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communication-theoretical one. To clarify our approach, we argue (with three lines of argument) on three different levels.

On a theoretical level, we try to show why we have not chosen a theory for the connection to machine output that describes this relation as interactive. In doing so, we refer to the relevant overview by Muhle of some prominent lines of theory that attempt to describe this relation with reference to agency (Muhle, 2018). In a second step, we want to present the advantages of a communication-theoretical approach based on Luhmann, which mainly constitutes of an attribution of behavioral expectations when dealing with machine output. The background of this approach is the observation that machines and social systems cannot communicate with each other qua their communicative mode of operation, but that social reality shows otherwise. Therefore, with Miebach (2011), we introduce the term “social interface”, which means that sense-making systems can relate to machine output by addressing behavioural expectations to the machine. It is on the theoretical level that we will move the most. After all, the aim of this text is to introduce the communication theory approach to describe the relationship between humans and machines. The following two levels of the text arise from subsequent thoughts, some of which have been developed on the empirical example.

Following our communication-theoretical approach, we want to critically discuss Luhmann's concept of technology on a second, theoretical-empirical level. With our empirical example—the use of AI in the hiring process—we want to show that technology as a "functioning simplification" with the function of complexity reduction corresponds to its function in application, but it is problematic if the attributions that are addressed to technology in execution are evaluated as objective (Luhmann, 1997, p. 524). Through the discussion of the concept of technology in practice, we operationalise the communication theory approach.

Finally, on the third, empirical level, we want to illustrate the communication theory approach with an example from organizational practice and at the same time investigate what consequences the use of technology can have within an organisation. In our case, the technology used is the software solution of the company Pymetrics. It promises to make the recruitment process in companies efficient and objective. So, we discuss the use of this software solution for Human Resources Management (HRM) in companies. The starting point here is a functional analysis regarding HRM in organisations: HRM has the function of ensuring that the right people are permanently assigned to the right positions in the organisation. For HRM in large companies, a machine solution for this has become necessary due to the large number of applications. At first glance, Pymetrics’ AI solution also appears to functionally address the problem of job allocation: The AI solution used makes recommendations for action that make the decision-making process of HRM possible regarding the sheer mass of

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applications in the first place and then simplify it in a closer selection of applicants. However, our communication-theoretical representation shows that the functioning solution produces problems on several levels: Certainly, software solutions such as Pymetrics also serve as legitimisation within an organisation in the dispute about digital infrastructure. But if one addresses the behavioural expectations of the software solution as objective in the use of the technology, the question arises, for example, why HRM has not yet been automated during rationalisation logic. With our communication-theoretical approach, however, we can state that machine output of any kind, i.e., also recommendations for action from an AI, remains subject to meaningful connection if one wants to make use of it.

In our example, we will also see that the technical solution works for the process problem by reducing complexity and thus saving consensus, but in the long run it creates new organisational problems. The incommensurability of the communicative modes of operation of machine and social systems is the cause of this.

2 Sociality with Machines

The starting point of our work is the relationship between artificial intelligence and social systems. We metaphorize AI here to mean any form of machine, digital, algorithmic data processing. The focus here is not on the classification, assessment, or distinction between strong vs. weak AI or the differences between neural networks, machine learning and AI as a collective term, but fundamentally on how to “connect the technically binary world of the algorithm with the meaningfully structured world outside the algorithm”, as Armin Nassehi makes clear (Nassehi, 2019, p. 204). This quotation already conceals the core of the problem: digital machines are used at every level of society, and intelligent algorithms are increasingly providing the basis for this interaction. Objectified in a wide variety of devices (smartphones, personal computers) or larger socio-technical systems (traffic guidance systems, metrological forecast models), society interacts with the results of machine calculations. For this, it is necessary that these outputs are 'understood' and become effective in guiding action. But how does this special kind of understanding come about? Florian Muhle shows that the relationship between social systems and the outputs of AI can be roughly divided into three categories (Muhle, 2018). In the tradition of ANT or cyborg theory in the sense of Haraway, the relationship is not understood as dichotomous opposition, but network-like. Machines and socials form a hybrid collective that influences each other. In the sense of communicative constructivism, the relations between AI and human actors are understood as projection and specific form of cultural interpretation. Lindemann radicalises this perspective by assuming that there is an ‘existential’ actor status for machines when this is intersubjectively granted by genuinely social actors.

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The third perspective constructs a continuum along actor participations. Machines are granted more actor status as soon as they are responsively involved in actions. All three perspectives have in common that they are more concerned with a relationship between actors and the possibility or intensity of agency.

For the analysis of the social practice of connecting to machine outputs, an analytical perspective that—as reconstructed above—primarily captures the relationship between social systems and AI is rather unsuitable. It understands this relationship as interaction and for this it must first make conceptual and theoretical preliminary decisions about the way in which non-human entities can become social actors and thus capable of acting (Muhle, 2018, p. 155). It therefore seems useful to change the perspective of observation, to refrain from looking at actors and instead to focus on communication. A communication-theoretical perspective can do without this preliminary conceptual decision for the time being. This makes it possible to take the social practice of connecting to machine outputs as a given. The precondition for communication is the addressability and personification of entities, whereby communication with non-human entities (such as machine outputs) can also be grasped without presuppositional theory work. As will be shown below, such a perspective is also able to capture the practice of attributing meaning. We propose to switch to a communication-theoretical perspective to be able to ask in which medium communicative actions are processed in the interface.

Fundamental to our communication theory perspective is the assumption that communication functions as a functional and analytical final element of itself. A typical medium of communication is, for example, language or social action. Language as a medium enables communication processes in comparison to perception processes and with the help of symbolic generalisations in the form of signs to communicate about something a) that is not the case, b) that is possible but has not yet occurred or c) that is not present. In this respect, language as a medium sets communication processes apart from perceptual processes and thus creates a higher level of complexity processing (Baraldi et. al., 1997). Furthermore, within communicative processes, language also enables the communication of intentions to be distinguished to a more or less unambiguous degree and thus makes the success of communication more likely. In the form of language, linguistic signs, and their arbitrariness (Saussure, 2001), meaning as a medium acquires its centrality for communication. Communication therefore requires no agency to be accomplished or observed, but only a point of reference that is connectable in the medium of meaning. According to our theoretical view, meaning is to be understood as a current interpretation against the background of other, possible interpretations and orients experience, action and structure formation (Luhmann, 1997). In the context of this theory, meaning must not be understood as something that is fixed in the world, i.e., that a definitive meaning is already assigned

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to all things, which then only needs to be discovered. Meaning is not to be equated with identity. It does not emerge because an individual or groups profess certain identities.

In the context discussed here, meaning rather means being a form, a certain form of making distinctions and making observations of these distinctions. At the same time, sense appears as the product of a network of operations of distinctions. For social systems that operate in a sense-making way, distinction is reflected in the difference between self-reference and other-reference: “Every particular sense means itself and something else” (ibid. 48). In this way, meaning in the communication process enables understanding through differentiation on the one hand and ensures the success of communication through connection communication on the other. Meaning thus takes on the function of a mediating instance, a medium, in the communication process of social, sense-making systems. The basis for this remains that output for the medium of meaning is presented in a connectable form. This connectivity is (or can be?) established through behavioural expectations that are addressed to the counterpart. It is irrelevant whether the counterpart is in any way capable of subjectivity and more of the same. This theoretical debate does not arise in Luhmannian communication theory. Finally, the distinction between form and medium detaches meaning from the concept of subject in favour of the constructivist background of systems theory (Luhmann, 1995a). For sense as the difference between the potential and the actual cannot be transcended any further. At the same time, the medium of meaning is an almost universally necessary prerequisite for the operational capacity of social systems, because “meaning is co-present in everything that is actualised, as a reference to the world, and is actually present” (Luhmann 1997, p.49). In relation to the experience of reality, one can say that in every decision that makes sense, there are many other possibilities of decisions that can also make sense. This seemingly paradoxical formulation can be resolved by the fact that meaning is a concept without distinction. It includes its own negation (cf. Gripp-Hagelstange 1995, p.50). This also means that sense-using systems can only operate within the medium of sense. Nonsense can only be described as such if it operates within the medium of sense. From this it can be concluded that systems that operate in a meaningful way are dependent on this specific form of reduction of complexity. Sense as a medium thus provides the possibility for formation to take place through observational operations, the difference of actuality and possibility that consciousness and communication can use.

The output of meaningfully connectable output (in any form) remains important for successful communication. This becomes connectable by addressing behavioural expectations, i.e., it does not have a substantial, transcendental origin such as subjectivity, being human or similar.

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If one now looks for a way in which machines should be able to operate ‘meaningfully’, it seems that they fail because of the difference between actuality and potentiality. In the medium of sense, ‘something’ is actualised and then communicatively connected to it, but the potential is not excluded by this, but kept latent as a reference to the ‘horizon’.

The problem unfolding here reveals once again a question of interface, of how—to paraphrase Nassehi—the uniqueness of machine operations and the meaningfulness of its use in social contexts are coupled (Nassehi, 2019).

3 Social Interface

The starting point for further considerations of communication theory is a concept of communication based on the distinction between information and communication. Only by understanding the distinction between information and communication—which is not necessarily linked to the ‘correct’ grasp of a speaker's intention—can communication succeed in the medium of meaning (Luhmann 1995b). Successful communication becomes observable through subsequent communication. Therefore, for our example - practice of connecting to machine output - we start when a social system meets a machine or an AI. From this perspective, we must first consider the change in communication through its digital mediatisation. Based on an understanding of communication that is composed of understanding the difference between information and communication, it can generally be said for digitally mediated forms of communication that communication is decoupled. In terms of communication theory, this means that only information[1] is processed in digital (machine) communication (Halfmann, 1995).

The question now is how systems process information. Bernhard Miebach assumes that machine systems and social systems operate with different logics: On the one hand, we have social systems that operate in a sense-processing-recursive way in their communication (Karafillidis, 2013). On the other hand, machine systems operate based on binary distinctions and thus exclusively via data. Machine communication is thus produced in a causal-recursive way (Miebach, 2011). These operational logics are incommensurable with each other. After all, successful communication only takes place in the form of understanding the difference between information and communication. However, since machines operate exclusively via data in their

[1] From the communication-theoretical point, information would be the right term here. However, in a technical environment, it does not seem adequate to speak of information when it comes to the communication logic of digital machines. Strictly speaking, machines communicate via data and not via information from a technical point of view. Data are the raw numbers that consist of generalized symbols. Only with context of use data individually become information.

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operational logic, the understanding of difference cannot be accomplished. Nassehi discusses the loss of the signifier in a datafied world, and he shows quite clear that data just refers to itself, which is also the reason for their almost infinite combinability (see Nassehi 2019: 104-107). From this point of view, social systems should not be able to connect communicatively to machine output (see also Esposito, 2016).

In social reality, however, this takes place all the time, e.g., when applicants in the hiring process are invited to an interview based on a selection made by the AI. This contradictory context—that communication takes place despite different logics—is referred to by Miebach as the “social interface” (Miebach, 2011, p. 110). The term “social interface” refers to the interface between machine logic and that of social systems and functions for us as an analytical metaphor.

The bridging of the prevailing incommensurability between social and machine systems is initially to be understood analogously to the bridging between psychic and social systems. Access to the psychic system as well as to the machine system is not directly possible for any social system, as it represents a black box for the social system. The social system is therefore dependent on reconstructing it communicatively with its own system operations. This is possible by communicatively referring to the machine system and addressing behavioural expectations to it. In comparison to the psychic system, however, the machine system cannot be reconstructed by the social system as a person, but only as a “mirror projection of its own complexity” (Esposito, 2002, p. 302). Miebach uses the term “social interface” to describe this communicative reconstruction of machine outputs by social systems, i.e., systems that process meaning (Miebach, 2011, p. 108). Social interface is therefore not a bridge between the two systems but works rather as a bridge that only social systems (can) construct themselves. Social interface thus represents the one-sided reconstruction performance from the perspective of the social system in the medium of meaning. In the social interface, the social system is specifically tasked with dealing with the double decoupling that comes with digitised communication: it must reunite the information with the communication and at the same time deal with "the consequences of the computer's self-generated uncertainty" (ibid. 109).

Machines, on the other hand, communicate causally and thus exclusively via data. AI is also tied to machine communication. Moreover, AI is used for precisely this purpose: For data processing. It seems to need no explanation that AI can process much more data per unit of time than its user. For this reason, AI is mainly used in the service sector for reasons of efficiency. It is irrelevant whether the user knows the exact functionality of the AI. What is important is that the AI outputs data in some form so that the user can make a sense-processing connection to that output. The connection made in or through social interface is robust even in the case of irritation: as a study on phishing emails points out: even messages about threat on the social system side

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do not automatically trigger adequate actions (Benenson, Gassmann and Landwirth, 2017). More likely, it seems to be the case that communicative connection and success are to be established when the messages are reacted to but interpreted in terms of the operational execution of the social system. The fact that the messages are not related to the technical functioning of the machine system and corresponding steps are initiated follows from the fact that the incommensurability between social system and machine system remains if the machine system produces meaningfully connectable output, i.e., fulfils the addressed expectations and ergo functions (from the observation perspective of the social system). It is neither a property of the machine, nor its ‘correct’ functioning, that (co-)constitutes the relationship, but only the meaningfully connectable output that the machine delivers, to which the behavioural expectations on the part of the social system can link.

4 AI-assisted Recruitment Processes: Pymetrics[2]

The explanations given so far paint a complex and thus also interference-prone relationship between machines, such as AI systems, and social systems. Now we want to illustrate our communication theory approach with an empirical example. The communication theory approach remains central to this text. Nevertheless, we want to think one step further and ask the question whether technology in this context can continue to be understood as a “successful simplification” (Luhmann, 1997, p. 524) or whether its inherent logic makes the objects to which it is applied more complex? The question thus helps us to operationalise the social practice of connecting to machine output more or less unambiguously: If, after our reformulation of practice in terms of communication theory, technology continues to confirm without doubt the simplification dimension, our approach would only have theoretically postponed the problem.

To deal with this question in an exemplary way, we look at the interface between the labour market and organisations, i.e., the problem of how jobs in organisations can be adequately filled. The digital transformation and the informatisation of work that preceded it have increased the requirements for jobs overall and especially those in knowledge work. In addition to purely technical competences, social competences also play an increasingly important role in project-based organisations, which makes the selection process itself more demanding. In addition, the possibilities of generating attention for a position are increasing and, in turn, the communicative possibilities of reacting to published positions have also grown. This also leads to a quantitative increase in application interactions. Large numbers of people apply for specific

[2] https://www.pymetrics.ai/ We base the following representations of Pymetrics' services on information that the company itself disseminates on its website and affiliated channels.

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vacancies in large organisations that are perceived as attractive. Organisations see themselves forced to make automated pre-selections, otherwise the departments concerned would be incapable of acting in the long run. It is precisely this process that we want to address on the software side with the example of the company Pymetrics.

The company Pymetrics is an example of a company whose service is to deal with the phenomenon of the oversupply of applicants on the labour market with the aid of software. Pymetrics promises to have developed a selection programme that can determine the suitability of applicants on a scientific basis. First, a basic data set is created in the form of typed personas that ideally represent the group into which applicants are to be recruited. In a second step, applicant data is collected in the form of games. These games should provide information about personality traits of the applicants. In the last step, the basic data of the personas are then related to the data of the applicants, and it is calculated which applicants fit best into the existing team. Translated into our theoretical language, the Pymetrics programme means making the density of information and complexity in the application process manageable for organisations, including the delivery of a recommendation for action and in this sense: successful simplification in decision-making in the process of filling a vacant position. So, in the recruitment process for a job that has thousands of applicants, it is now common for resource-rich companies to pre-select via AI. The applicants' data is filtered by an AI regarding various parameters. Applicants whose data does not exceed a certain threshold are excluded from the process. And finally, suitable applicants are ranked and given a score to quantify their suitability. Finally, the software presents these scores as output to support HRM in decision-making. So, on a theoretical and empirical level, all the requirements we formulated in advance seem to be fulfilled: The software is used for a specific problem and the expectation of the software is successful simplification in the recruitment process. The software also provides meaningful output in the form of scores and rankings. This output can be addressed in a process-oriented way as a basis for decisions.

However, if it were agreed that the AI score is in the last instance the most meaningful criterion for hiring, HRM would consequently make itself obsolete using such technology. However, social reality shows that hiring processes are not (yet) fully automated.

The information output needs to be reconstructed and contextualized—in the spirit of the social interface. This is the basis for the use of AI. It is noted that AI like every other IT system which produces data is not a value-free technology either, but usually carries a bias qua training data due to assumptions about the world, which the system is used to describe (cf. Stachowiak, 1980; critical: Janich, 2001). The reduction of complexity in the first step - from all applicants to a selection of applicants—is therefore already biased when using an AI. This makes the data provided in the form of scores

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and rankings much more complex than it first appears, because the selection is associated with contingency and the technology's promise of objectivity seems untenable. Furthermore, the question can be asked to what extent a one-point difference in scores constitutes a relevant difference. This also needs to be discussed—meaningfully, socially—because it is the task of human resource management to put the right people in the right positions in the long run.

Furthermore, the consequence of a machine hiring process is the schematisation and computerisation of personalities and social, interactive, changeable dispositions with the promise of a perfect and objective outcome. HR managers can select the most suitable individuals from a continuum of maximum fit by reconstructively linking to the machine output. However, reconstructive here does not mean that one can reconstruct exactly how the scores are calculated on the technical side. Rather, reconstructive here means reading the output of the machine—in this case the scores—as a call to action and, for example, selecting and hiring one of the three best-placed applicants. A certain degree of objectivity is attributed to the technology used, but—following our theoretical representations—this expectation of objectivity must be relativized through meaningful connection, since otherwise HRM would theoretically make itself obsolete and, on the other hand, the output cannot be transferred to the organisation. Finally, the obsolescence debate regarding HRM is also about organisational responsibility regarding the final decision of hiring, which, like every (organisational) decision, is fraught with risk.

Moreover, in the long run, the way Pymetrics works means that the teams for which applicants are recruited are homogenised. Because in the case of Pymetrics, it is the personality traits of the existing team with which the personality traits of the applicants are matched. Based on this informational comparison, the applicants are then listed and hierarchized, resulting in a recommendation for HRM to hire one of the highest-ranked applicants. HRM cannot yet foresee that this procedure will contribute to the homogenisation of teams in the long term, because the machine will recommend the best applicant, suitable for a team in a certain defined situation. The illusion of communication with the machine in the form of the instructions for action works in the way that the expectation of facilitation associated with the technology takes place for the process used. Only later, e.g., when the team no longer must deal with constructive and productive conflicts through homogenisation and all personal diversity has been unified, does it become clear that the AI solution has simplified the hiring process as expected, but has induced further problems through its mode of operation. So, for the process for which the AI solution was used, the AI solution has been able to fulfil its expectations, but for the function of HRM within the organisation, its use may result in productivity issues in a team modelled this way due to its streamlining. For the informational accounting of personality traits, the functioning of the software solution,

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does not seem to become visible through the meaningfully connectable output. In this respect, it must be stated that the technology used and examined—measured against the ascribed expectations—did work here in terms of reducing complexity, but its functioning causes problems in the long term. The use of technology, for example, to support decision-making in the hiring process can be legitimised in terms of the process and at the same time legitimises the decision, but both the addressed expectations and the consequences of the use of technology must be observed and interpreted. Consequently, our theoretical preliminary considerations coincide with the predicted, empirical observations. The communication theory approach to reformulating the practice of connecting to machine output seems to be an explanatory gain on a theoretical and empirical level.

5 Conclusion

Finally, we return to the three levels of analysis we identified at the beginning: On a theoretical level, we can state that the practice of connecting to machine output can be modelled with communication-theoretical means. In contrast to interactionist theories that attempt to describe the relationship with machines through gradual agency, the communication-theoretical approach to the practice of connecting to machine output that we have outlined does not require a discussion about whether or to what degree subject status and the same can be attributed to machines. The basis for the communication theory approach is communication in the medium of meaning, which is conceived as an analytical triangle: It differentiates between information the act of communication and the process of understanding the difference between communication and information (Luhmann 1995b). Although the theoretical situation characterises communication between machines and social systems as incommensurable, communicative connection is nevertheless possible. Miebach’s concept of social interface serves this purpose. With this, a relationship is established that unilaterally bridges the incommensurability and makes the machine output connectable for the social system through addressed behavioural expectations. This is accompanied by a series of necessities that the social system must fulfil during communication: Reconstruction and contextualisation of the data offered in the output, dealing with “the consequences of the self-generated uncertainty of the computer” so that communicative success can be established by means of follow-up communication (Miebach 2011, 109).

On a theoretical-empirical level, we have tried to depict its Janus-facedness via Luhmann’s concept of technology and thus operationalise our theoretical approach. Faced with the sheer mass of applicants and due to efficiency reasons in the inner and outer company competition, organisations are forced to use software solutions to make

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a pre-selection. On this side, the function of technology stands up to expectations: it is a “successful simplification” of an organisational process (Luhmann, 1997, p. 524). Nevertheless, problems can also occur if objectivity is attributed to the machine output in the form of recommendations for action; and decisions on recruiting are made according to these recommendations, unquestioned. Finally, recruiting agents make themselves obsolete if the machine output is taken for granted. Finally, the usage of an AI-based software solution like Pymetrics can be described as ambiguous: Certainly, the software simplifies, rationalises, and legitimises decision-making in the recruiting process. However, while using the application (in a performative sense), the consequences of the AI's functionality cannot be foreseen: We have predicted that Pymetrics will produce connectable, quantifiable, and thus simplifying output, but in the long run it may lead to a certain kind of homogenisation of the teams into which people are assigned to. This long-term problem is inherent in the functionality of the software solution and cannot be observed in the process of using the technology, but only through permanent sense-making on the output. To put it briefly: a human manager must control, to what consequences the machine-made choices will lead.

An outlook for further action based on the communication-theoretical approach we have outlined could look as follows: On a theoretical level, the communicative process of connection should be examined in more detail. Through the communication-theoretical basis, the aforementioned process can possibly be reformulated as a phenomenon of different languages, stemming from different spheres to which the theory of translational relations then applies (Renn, 2006). Putting the analytical assumption into work, more areas of application must be identified, empirically. Then one must ask, if a communication -theoretical approach can help to shed some light on the deepening relationship of social systems with technology. Currently, research is undertaken to reflect on status of digital communications as evidence in court cases (Peetz et. al).

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Why Ethics Norms are Not Enough, or: How Current Critique of Digital Data Technologies Preserves Power

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Abstract. This paper contributes to the long-standing tradition within STS to analyze the intertwining of technoscientific discourses, practices and artefacts with power asymmetries and social inequalities. It does so by scrutinizing AI ethics guidelines and standards as the currently dominant form in which society articulates critique of digital data technologies and seeks to cope with this critique. Based on a discourse-analytical reflection of selected AI ethics norms, it is argued that the key premises underpinning this form of dealing with the challenges and risks accompanying the digital transformations of society come with some severe limitations, especially when it comes to understanding and questioning social relations of power and the role that digital data technologies play in upholding and/or producing them. Against this backdrop, the turn to ethical responses as a ‘panacea’ is described as conserving rather than reducing existing power relations. Therefore, the article pleads for strengthening critical/feminist STS-perspectives within the ongoing negotiations of how to understand and handle the risks and challenges that accompany the digital transformations of society.

1 *AI ethics* and the Manifold Contradictions of Digitalization, Datafication and AI

In recent years, a rising number of research has problematized the social, political, and economic contradictions of digitalization, datafication and AI, thus, challenging the promises made in the name of digital data technologies [1], namely: to foster emancipation, decentralization, democratization and objectivity. Racist risk assessment tools employed in the US criminal justice system, sexist recruiting tools deployed by private companies or highly classist algorithmic decision-making systems used in credit granting procedures – to name just a few – testify to the fact that digital data technologies are neither neutral nor objective, but prone to bias and discriminatory results (O’Neil 2016; Noble 2018; Prietl 2019a; Gebru 2020). Public uproar due to privacy breaches, filter bubbles and social bots influencing democratic processes (Pariser 2011; Wooley 2016; Pörsksen 2018; Dutton et al. 2019) have further fueled debates on how to regulate private as well as state organizations involved in the development and use of digital data technologies, especially as monopolization tendencies increase (Lyon 2004; Leighton et al. 2017; Srnicek 2018; Véliz 2021).

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Whereas computer science researchers pursue technology-focused ways of addressing the aforementioned problems such as discrimination aware data mining (DADM) or fairness, accountability and transparency in machine learning (FAccT), the prime (public) reaction to be observed is a 'call for ethics' resounding within politics, academia as well as industry. Around the globe, responses to the challenges and risks posed by digital data technologies either take the form of ethics boards, audits, frameworks and guidelines, or of efforts to educate AI developers and data scientists in ethical awareness (McKay/Yallaly 2017): In 2016 the IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems was launched as an industry connection program of the IEEE Standards Association, aspiring for "ethics to become the new green." In 2019 the US National Science Foundation (NSF) has partnered with Amazon to jointly support computational research focused on fairness in AI, while the European Commission presented its *Ethics Guidelines for Trustworthy Artificial Intelligence.* In academia, research centers and chairs for AI ethics are being institutionalized such as the heavily disputed *Institute for Ethics in Artificial Intelligence* at Technical University of Munich that was founded with the financial support of Facebook. Additionally, the big global tech companies, such as Google or Microsoft, have released ethical principles as a sign of self-regulation.

As these examples show, industry is heavily involved in discussing and shaping the science, morality and laws of AI and digital data technologies more in general. Critics, thus, called the hype around AI ethics a smokescreen for carrying on with business as usual. Instead of initiating a genuine push towards social justice and equality, ethics were largely employed to convince politicians as well as the general public that ethics guidelines were enough or even better than regulations when it comes to handling the manifold contradictions accompanying the digital transformations of society. Considering furthermore that most of these self-imposed standards are hardly binding, even less enforceable by law, they might remain a mere gesture of goodwill (Sloane 2019; Benkler 2019; Daly et al. 2019; Nosthoff/Maschewski 2019). [2]

While I am sharing the skepticism vis à vis a so-called 'ethics washing', this paper wants to take the critique of an 'ethical' approach towards solving the challenges related to digital data technologies a step further: By taking a closer look at the key premises of what becomes currently implemented as AI ethics, it sets out to scrutinize this dominant form of criticizing digital data technologies and coping with this critique. Though critical towards the all-encompassing recourse to ethics, it also distances itself from what has been called 'ethics bashing', namely the over-simplified consideration of ethics as shallow communication strategy and instrumentalized cover-up, with (moral) philosophy being reduced to a mere academic endeavor that stands in opposition to political discussion and social organizing (Bietti 2020). However, this

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paper contents that the sole focus on ethical norms has its limitations when it comes to understanding, reflecting and challenging power asymmetries and social inequalities and the role that digital data technologies play in upholding them.

2 Approaching Ethics Norms as an Object of Study

The argument presented in this paper is informed by critical and feminist perspectives in STS. Digital data technologies are understood as sociotechnical phenomena that are the result of an inextricably interweaving of technology and society, of the material and the semiotic (e.g., Haraway 1985). As such they are considered to have politics (Winner 1980), materializing and at the same time (re)producing social structures (of power and inequality) as well as cultural orders (and symbolic hierarchies). Therefore, digital data technologies are neither neutral artefacts, nor are they isolated from society, its structures, institutions and norms. From this point of view, ethics guidelines and standards are an interesting object of study as they make the values and norms materialized in digital data technologies explicit—at least partly [3].

Although the question of how effective ethical guidelines are in changing the thinking and practices of technology designers is heavily disputed (Hagendorff 2020), ethics statements can be considered “powerful instruments for constructing and imposing a shared ethical frame on a contentious conversation” (Greene/Hoffmann/Stark 2019: 2129), thus, setting the table for further discussions on ‘good’ digital data technologies. They are constituted by and constituting the historical, local, political, economic, and cultural conditions of the society they shape and are shaped by. Conceptualized as *discursive elements*, I understand ethics guidelines and standards as taking part in (pre)structuring our perceptions of digital data technologies, the ways we think about their design, implementation and use. As such they are productive in the sense that they take part in enabling specific sociotechnical paths of developing and using digital data technologies, while impeding others. Put differently, ethical statements are powerful as well as political, being a means of power as well as instrumental to power relations (Paulitz 2005; Prietl 2019b).

Following this line of thinking, the core argument of this paper is that addressing the challenges and risks of digitalization, datafication and AI solely in terms of ethics is not well suited for challenging the existing power asymmetries and social structures of inequality in our society. Drawing on a discourse-analytical reflection of 16 ethics guidelines and standards that have been theoretically sampled using the *AI Ethics Guidelines Global Inventory* provided by the German watchdog-organization Algorithm Watch [4] as well as literature on AI ethics, I will sketch three limitations of this currently dominant form of criticizing digital data technologies and coping with this critique: (1)

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an a-social understanding of action, (2) an individualistic conceptualization of problems as ‘errors to be fixed’ and (3) a focus on fairness of distribution as proposed solution.

3 State of the Debate on AI ethics Guidelines

The last few years have seen an explosion of literature on AI ethics, sometimes also called digital ethics, computer ethics, or information ethics. Following Dignum’s (2018: 2) differentiation of three levels on which AI and ethics can be related, this vast and heterogenous field of research can be divided into three strands: first, *ethics by design* that is concerned with how to include non-human actors in moral thinking (e.g. Adam 2008) and how to program ethical reasoning capabilities within artificially intelligent artefacts allowing them to act ‘as if’ they were moral agents (Allen et al. 2006; Etzioni/Etzioni 2017; Cervantes et al. 2019); second, *ethics for design* that is concerned with developing specific rules and criteria for how to design ‘good’ AI, e.g. guidelines, frameworks and standards, including codes of conduct for designer and/or users of AI (Bostrom/Yudkowsky 2014; Filipovic et al. 2018); and third*, ethics in design* that is concerned with the regulatory and engineering methods that allow for analyzing the ethical implications of AI as they become implemented within society (e.g. Cath et al. 2018; Floridi et al. 2018). Additionally, there is a growing interest in how AI ethics are being developed and implemented across the globe and by different organizations (see below). The paper in hand contributes to the latter strand of research, thereby taking AI ethics as an object of STS-analysis.

Several comparative analyses of AI ethics guidelines and frameworks help to map the debate on how to design and implement ‘good’ AI, which to date centers around almost two hundred documents, of which the huge majority has been issued since 2018. While acknowledging that the design of AI is a legitimate site for ethical debate rather than a neutral domain, there are huge differences in relation to how the proposed principles are interpreted, how they are legitimized, whom they address and how they should be implemented and enforced (Jobin et al. 2019; Daly et al. 2019; Greene/Hoffmann/Stark 2019; Hagendorff 2020).

Looking at who issued these documents, it can be noted that private companies, amongst which are some of the global tech giants that lead research and development in AI, and governmental agencies play a major role in developing AI ethics, with actors from the so-called Global North being overrepresented (Jobin et al. 2019: 3-5; Schiff et al. 2000: 154). Whereas the UK and the USA together account for more than a third of all ethical AI-documents, followed by Japan, Germany, France, and Finland, voices from Africa, South and Central America, and Central Asia are underrepresented. The addressees of these guidelines and frameworks are for the most part either multiple

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stakeholder groups and/or AI practitioners, with a significant portion being self-directed (Jobin et al. 2019: 6). Albeit there existing no agreed upon set of ethical standards to govern the design, development and deployment of 'good' AI (Yeung/Howes/Pogrebna 2020), the documents seem to converge around a handful of ethical principles, namely: transparency and accountability, justice and fairness, non-maleficence, responsibility, and privacy.

Hagendorff (2020, 103) argues that all of the recurring elements of 'good' AI are requirements which are rather easily operationalizable mathematically and for which technical solutions are being developed, with some companies already offering specific technological fixes such as tools for bias mitigation or fairness in machine learning. On the other hand, there are a number of issues that are only rarely mentioned within the majority of these guidelines and frameworks. These blind spots contain questions of (ecological) sustainability and hidden costs of AI development, malevolent (mis)use of AI, democratic control and governance of AI, questions of human dignity as well as solidarity and social responsibility (Jobin et al. 2019, 7; Hagendorff 2020, 104-105). When it comes to how AI are understood in these documents, it can be noted that a rather deterministic vision of AI is dominant with AI artefacts being mostly understood as isolated entities that can be optimized by experts so as to find technical solutions for what are perceived of as social problems. Consequently, there seems to be little to no discussion on how AI could be constrained or limited. Instead, 'better building' is presented as the only ethical path forward (Greene/Hoffmann/Stark 2019, 2122-2128). As Greene, Hoffmann and Stark (2019) point out, ethical design is considered to be a project of expert oversight, whereas the experts in question are supposed to be primarily technical, and secondarily legal experts (2126). What is however lacking is a consideration of the wider social contexts and relationships within which AI is embedded (Hagendorf 2020, 104).

4 Limitations of the Currently Dominant Form of Criticizing Digital Data Technologies and Coping with this Critique

Taking the above literature review as a starting point and drawing on my own analysis of selected AI ethics guidelines and statements, I will now elaborate on how the key premises underpinning these discursive elements are related to questions of power and social inequality.

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4.1 Understanding Action

In accordance with Western-Eurocentric philosophy, AI ethics guidelines and standards largely—and: unquestioningly—assume the existence of a rational and autonomous (human) being as the subject of any—be it ethical or unethical—action. Consequently, the diverse ethics norms continuously—albeit often implicitly—address the figure of the autonomous subject of action—be it designers, practitioners or users of AI and other digital data technologies—appealing to their understanding to modify their behavior and actions. At the same time, discussions about the sociocultural, political, economic or organizational context within which these actions take place are largely missing. Thus, the social embeddedness of all action that not only explains certain actions, but also pre-structures them and limits any 'simple' and willful alteration of so-far established modes of acting and behaving in certain circumstances, are neglected within the majority of documents analyzed. Neither is there a systematic mentioning, let alone discussion, of the fact the digital data technologies are developed by private companies whose main objective is economic profit, and not the dismantling of social inequalities; nor are software developers or AI practitioners addressed as employees, which they mostly are, and, thus, first and foremost obliged to comply with their employers' demands.

As a consequence, the social structures and symbolic hierarchies that are influential for how people—and machines—can act in certain situations and that—even more importantly—are out of their immediate reach, are hardly taken into account. Thus, one important factor for not only understanding, but also for changing existing sociotechnical relations and their consequences is consistently ignored in this currently dominant form of criticizing digital data technologies and their social effects.

What is needed instead, is a decidedly *social* understanding of action that allows for challenging the power asymmetries and social structures of inequality within which digital data technologies and the people developing and using them operate (see e.g.: Weber 1920; Bourdieu 1987; Emirbayer/Mische 1998). Acknowledging the social embeddedness of all action, namely: of embeddedness within hierarchical structures and symbolic orders, makes visible the limits of individual willful actions and the capability of changing them. It also draws our attention to these historically established, social phenomena that are in need of change, if existing power asymmetries shall not be reproduced.

Apart from the economic and organizational structuring of digital data technologies mentioned above, there are also symbolic asymmetries to be considered that manifest themselves in available data (sets). Take for example the case of automatic skin cancer identification (Zou/Schiebinger 2018). The fact that such technologies are much less effective in identifying skin cancer in people of color than in 'white' or lighter pigmented people is not so much the result of 'bad' actors—be it the developers of the

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respective technology or the medical applicants; instead, it is the historically established asymmetries of technoscientific in/visibilities that build the foundation for the overrepresentation of 'white people' within machine learning-training data sets that then results in the tool's increased ability to identify deviations in their skins. Only, if we keep these structural components of sociotechnical action in mind, can we effectively address the problems laying at the heart of the manifold contradictions accompanying the spread of digital data technologies.

4.2 Conceptualizing the Problem

Related to the aforementioned asocial understanding of action is a rather narrow causal thinking that focuses on—human or technical—'errors to be fixed' when conceptualizing the problems of AI and other digital data technologies. Consequently, the diverse ethics norms depict the risks and challenges related to digital data technologies largely as *individualistic* problems or errors that call for a singular solution. Initiatives such as discrimination aware data mining (DADM) or fairness, accountability and transparency in machine learning (FAccT) strive to rectifying bias in AI by developing better algorithms. Ethics by design initiatives on the other hand focus on human actors, such as AI researchers and developers, and propose codes of conduct that shall guarantee the development of 'good' digital data technologies.

Thus, it is a technosolutionist stance that underpins the majority of AI ethics guidelines and standards, according to which all problems—also genuinely social ones—can be solved by technical means. Again, neglecting the social structuring of technology, 'better building' is presented as the only way forward (Greene et al. 2019, 2122-2128). Alternative paths such as a fundamental socio-political debate about which technologies would be desirable for which situations, however, do not even seem to be an option in the respective documents.

Critical and feminist STS-perspectives instead remind us that "artefacts have politics" (Winner 1980). Acknowledging the political dimensions of AI and other digital data technologies raises questions about who is (not) involved in creating these technologies, whose wishes and needs are (not) accounted for and who profits from their implementation and use—and who does not (Weber/Prietl 2021). Additionally, such a sensitivity towards questions of power also draws attention to the inextricable interweaving of technology and society, the material and the symbolic, thus, drawing our attention to how these diverse human and non-human actants evolve together and produce certain effects in their intra-acting (Barad 2003).

Take for instance the AMAS-algorithm of the Austrian Public Employment Service, AMS, as an example. The tool has become heavily criticized for assessing the chances of women, migrant and elderly employment seekers for finding new employment systematically lower than those of younger, Austrian-born men, which has

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consequences for the job seekers' entitlement to receive specific benefits and services by the AMS. In order to understand and, thus, be in the position to criticize the introduction of this digital data technology it is not enough to point out these biases or—even worse—single out the *one* cause of the problem to be corrected. But, we need to account for the technology's connectedness to certain political aims (optimizing resource allocation within neoliberal welfare state reforms), a specific statistical model (having been set in a way to optimize its overall accuracy, i.e. its 'correct' prediction of future employment chances derived from patterns found in past employment chances), a labor market that is highly discriminatory (especially against women with children and people with a migration background), and a strong belief in technical efficiency and objectivity (Lopez 2019, Allhutter et al. 2020). Keeping all of these intra-acting elements in mind, of course, does not make it any easier to describe, understand and eventually solve the problem at hand, but it increases the chances of not remaining a mere gesture of goodwill.

4.3 Proposing a Solution

In the light of biases against minorities and vulnerable groups of people, it is of little surprise that fairness features prominently in many AI ethics guidelines and standards. However, in the documents analyzed fairness is—if at all—mostly defined as equal-treatment, with questions of power and social structures of inequality again being left out of the picture. Instead, transparency, accountability and trustworthiness are promoted as pathing the way to fair digital data technologies (see also: Daly et al. 2019; Greene et al. 2019; Hagendorff 2020). With equal treatment as core solution and normative goal, non-discrimination is declared to guarantee justice.

As Hoffmann (2019, 905ff.) has problematized with regards to US anti-discrimination politics, such a focus on equal treatment is not well suited to address the intersecting effects of different categories of discrimination and inequalities, such as face recognition software being least efficient in recognizing the faces of black women [5]. What is even more worrisome, is that equating fairness with equal treatment and the latter with non-discrimination does not account for the fact that people are positioned in a highly unequal and hierarchical way in our society, thus, essentially ignoring that there is no level playing field.

Consider for example the infamous COMPAS-algorithm employed in the US criminal justice system to assess the recidivism rates of defendants. Although the tool does not explicitly take into account the 'race' of the accused, African Americans are much more likely to be assigned a higher risk score than 'white' Americans (Angwin et al. 2016). Some computer scientist work on improving the algorithm's accuracy, hoping that the same accuracy for 'white' as well as African Americans will solve the problem of unequal treatment (Corbett-Davies/Goel 2018). What such an approach, however,

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does not account for is that people of color are much more likely to be targeted as high risk because of structural racism that makes it much more likely for them to have no higher education, to be unemployed or to be related to someone who has been charged with a criminal offense – all of which are factors accounted for in the risk model implemented in the COMPAS-algorithm. Ignoring these fundamentally unequal pre-conditions not only does not solve the problem at hand but threatens to mask the problem in a veil of equal treatment. Considering EU anti-discrimination law that aims for substantial, not only formal, equality, Wachter et al. (2021) therefore argue for fair machine learning techniques that 'transform bias'. Instead of 'preserving bias', such techniques explicitly account for historically established social inequalities and try to actively counteract them.

5 It's About Power, Stupid!

Based on a discourse-analytical reflection of AI ethics guidelines and standards, this article has outlined how this currently dominant form of criticizing digital data technologies and coping with this critique is strongly influenced by traditional Western-Eurocentric moral philosophy that is highly individualistic in its approach (also: Jaume-Palasi 2019: 483). Such an epistem-ontological underpinning entails considerable limitations when it comes to addressing the role that digital data technologies play for maintaining power asymmetries and social inequalities. Whereas the very social structures and symbolic orders within which digital data technologies are developed, produced and used are largely out of sight, attention is directed first and foremost to singular 'black sheep'—be they human or technical artefacts. Framing these 'bad' actors as responsible for the problems and challenges of digital data technologies, it is in their 'correction' that a 'solution' is sought for.

Following this line of reasoning, the recent turn to ethics norms seems to be neither a 'panacea' against the manifold contradictions accompanying digitalization processes, nor a neutral undertaking. On the contrary, AI ethics guidelines and standards can be described as preserving existing power relations and social inequalities as they leave the social relations within which digital data technologies and their developers, designers and users operate largely untouched. The monopoly-like structure established by a few, primarily private-sector but also state organizations, due to the extreme resource intensity and high economies of scale of data-based AI (Srnicek 2018), is not systematically addressed in these documents, let alone problematized. Thus, the few dominant actors can continue to develop and deploy digital data technologies primarily to pursue their own interests, specifically: "profit (for a few), surveillance (of the minoritized), and efficiency (amidst scarcity)" (D'Iganzio/Klein

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2020, 41). Nor are the 'conservative' logics of algorithmic knowledge-production and decision-making considered as crucial to understanding—and, consequently, addressing—the challenges of digitalization processes, most importantly the idea that patterns found in data of the past, allow for predicting the future (Lopez 2019; Prietl 2019a, b).

Therefore, a strengthening of critical/feminist STS-perspectives is needed within the social negotiations of digitalization and AI. These perspectives would—amongst others—direct our attention to the following questions, and call for their public debate: Who is in charge of developing digital data technologies? Who benefits from their use? Which purposes are served by digital data technologies? Who and/or what aspects of (social) life are considered, in- and excluded? For which purposes do we want to use digital data technologies? What technologies do we want as a society? Starting from a debate on these and many more questions, a critical/feminist approach to challenging digital data technologies would also entail to give up on hopes of neutrality and objectivity but strive for digital data technologies that—albeit no longer being able to claim neutrality—are explicitly dedicated to reduce power asymmetries and social inequalities instead of upholding the status quo.

Endnotes

[1] Digital data technologies designate technical artifacts that operate with digital data, e.g. AI-technologies, mail programs or tracking-apps. It is digital data technologies that are at the heart of current sociotechnical transformation processes that are often discussed as ‚digitalization' (Houben/Prietl 2018).

[2] Metcal and colleagues (2019) draw a more nuanced picture in their study of people responsible for ethics in big tech companies, detailing the heterogeneous constraints within which their work is situated and that force them to fit ethical concerns within the organizational logics dominating the Silicon Valley, namely: meritocracy, technological solutionism and market fundamentalism.

[3] As has been pointed out in organization studies there might be a considerable mismatch between talk, action and decision (Brunsson 1993) as corporate actors may state things they don't actually act upon, in order to manage conflicting expectations, such as profit maximization and social responsibility.

[4] See: https://inventory.algorithmwatch.org/ [4th of June 2021]. The selected AI ethics-statements allow for theoretically sampling (Strauss/Corbin 1990) with respect to (a) authors/issuing organization (private sector, governmental actors, academia, civil society), (b) geopolitical reach (national, international, global) and (c) degree of compliance (binding agreement, voluntary commitment, recommendation).

[5] See the work of Joy Buolamwini online under: https://www.media.mit.edu/people/joyab/updates/ [6th of Juni 2021].

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A Cross-Border Railway Bridge Non-Reconstruction: Actor-Network Analysis of its Design, Non-Development, and Non-Action

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Abstract. We describe the story of the railway missing links, particularly of the cross-border railway bridge in the Mura-Drava-Rails network. Eight railway lines formed this railway network from 1857 to 1924. We introduce our research with the historical case of design and innovation development of the semi-parabolic railway bridges. The central time frame of this paper is delimited to the post-second world war years to the present. With actor-network analysis, we describe the non-development and non-action in the two cross-border railway regional lines, each with its missing link. These two missing links in an estimated length of twelve railway kilometres prevent the network from being reformed. Additionally, we draw insights from urban studies, development studies, and machine theory. We followed the logic of the non-reconstruction of the railway bridge on the border of the former Yugoslavia with the Republic of Austria and the rationalisation of the passenger railway transport in the former country in 1968 on the one side. That is how we tried to understand also the commissioning of the cross-border road bridge between the two countries over the Mura river only a year later, in 1969, on the other side. We had to broaden our research perspective to all the railway border crossing od today's Slovenia with Austria, Hungary, and Italy. By mapping these railway border crossings, we were able to describe the strategic intent of the former country, which was to close the majority of the railway borders crossing—seven out of ten railway border crossings existing before the second world war—on its northern borders.

1 Introduction

We wish to describe the story of the railway bridges' design, non-development, and sustainability across the Mura and Drava river regions in four countries: Austria, Slovenia, Croatia, and Hungary. While we will describe key developments of the railway lines along the Mura and Drava from its construction and openings on, the central time frame of this paper is the post-second world war years to the present.

Along the Mura and Drava regions, eight railway lines form a railway network that we will call Mura-Drava-Rails (hereafter MDR) network. The first railway line in Mura and Drava regions opened in 1857 (Verginella, 1997). By 1924, when the last railway line from Ormož to Ljutomer and Murska Sobota opened (Smodiš, 2004), the MDR network had been completed.

Table 1: Railway lines that form the Mura-Drava-Rails network

Railway line	Estimated length [km]
[—Wien—]Graz—Leibnitz—Maribor—Pragersko[—Ljubljana—Trieste]	84
—Maribor—Ruše—[Klagenfurt—]	13
—Pragersko—Čakovec—Kotoriba—Nagykanizsa—	147
[—Zaprešič—]Varaždin—Čakovec—	13
—Spielfeld-Straß—Bad Radkersburg—Gornja Radgona—Ljutomer—	60
—Čakovec—Lendava—Rédics—Lenti—	34
—Zalalövö—Hodoš—Murska Sobota—	50
—Ormož—Ljutomer—Murska Sobota—	39
	440

In the estimation and calculation of the length of the MDR network, we took Graz as the starting point of the railway line that otherwise spans from Vienna to Trieste and Pragersko as its end station. In the length estimation of the Maribor—Klagenfurt railway line, we took into our account only the part from Maribor to Ruše. Ruše was namely the end station of this line in the 1960s after the former Yugoslavia rationalized the passenger railway traffic. In the railway line Zaprešič —Varaždin—Čakovec, we considered in our calculation of MDR network length the part from Varaždin to Čakovec, because this is the part connected with the Mura and Drava rivers.

Our research interest is focused on two of these eight railway lines of the MDR network. Each of these two lines has a missing link that prevents the MDR network from fully functioning again. One is the Radgona railway line from Spielfeld-Straß to Bad Radkersburg, Gornja Radgona, and its final destination Ljutomer. The other one is the railway line from Čakovec to Lendava. The missing link in the former line is the railway bridge over the Mura river that the German Army mined in April 1945 (Steindy et al. 2020; Balažic Peček, 2016) and the missing link on the later railway line is the dismantled border railway track between Lendava and Rédics. Presumably, authorities in former Yugoslavia had dismantled that railway track on today's border between Slovenia and Hungary. These two missing links in an estimated length of twelve railway kilometres prevent the MDR network from being formed, reformed, and performing in its entirety again. Our research aims to understand the non-development and non-actions of actors involved in (non)operating the MDR network.

2 Literature Survey

In architecture, the classic parable of "architecture's power to control and generate the order" was discussed around the bridges that Robert Moses built in the United States of America (USA) in the 1920s (Yaneva, 2018, p. 1). The Moses' approach to building bridges was criticized by Caro (1974 p 318 in Matthewman, 2011, p. 74) and Winner,

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who argued that technology is supposed to be to be means to end, but it becomes the ends of means (1980, p. 229 in Matthewman, 2011, p. 74). Both Moses and Winner agree on the idea that problems or political issues could be solved by constructing or settling the concrete and steel (Matthewman, 2011, p. 75). Joerges argued that Caro and Winner are just plain wrong (1999 in Matthewman, 2011, p. 78). Matthewman concludes the heated debate that "Moses' bridges facilitated the rapid movement of one social class but led to immobility of another" (2011, p. 82). Focus of our paper is though specifically connected to the railway bridges. Historically, innovation, development and design of railway bridges took place predominantly in the 19th century. That is why we need to say something more about this as well.

Material innovation of the railway bridges in the 19th century—from cast iron to wrought iron—enabled different types of systems to be put in place, some of which were repeated several times and some of which were single layout. The further development of the shapes of iron lattice girders showed the endeavour to move away from the rigid structure of the parallel girder and instead to produce outlines of more aesthetic effect through the parabolic or circular curvature of the top chord (Pottgießer, 1985). In the last decade of the 19th century, the era of railway bridges built completely out of steel began. First such railway bridge was constructed in Scotland—built from patented innovation called Siemens-Martin steel—for the Forth Bridge, which is still in use (Blanc, Mcevoy and Plank, 1993). Mild steel was used in many other semi-parabolic railway bridges, including the railway bridge over the Mura river on which we focus in our paper.

Although the before-mentioned series of material innovation is by itself worth scripting with the lense of Actor-Network Theory (ANT), we will now shift our attention to the theoretical basis of this research. We will try to draw together insights from science and technology studies, particularly through the development of ANT, which is responsible "for opening anthropology up to large technical ensembles" (Fisch, 2018, p. 14). Additionally, we will draw insights from urban studies, development studies, and machine theory.

It is obvious that war as a catastrophe brings with it its consequences—in our case mined and dismantled bridge. Like Bender, we will ask ourselves how much of our bridge case resulted from human inaction in "a variety of relevant networks" (2011, p. 305)? Bender sees the promise of ANT in "many points of intervention of various sorts" and additionally supports an inclusive, practical, and incremental approach to ANT scholarship. Not least, Benders sees the role of ANT in "politics that brings together act, causation, and responsibility" (2011, p. 319). In Bender's reading of ANT, it seems possible—through his analysis of Cronon's Nature's Metropolis: Chicago and the Great West—to fully acknowledge hierarchies of power and authority (2011, p. 307). That is

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how Bender is challenging Latour's insistence on keeping the social flat. Latour namely insists on the principle of democracy between actants (Harman, 2009, p. 17).

Science and Technology Studies (STS) in general draws on the non-dualist, non-substantialism approach to the interaction of things as co-constitutive processes, similarly as machine thinkers do (Fish, 2018, p. 8). Fish argues that in many respects and in many fundamental concepts STS cannot be separated from machine thinking. Following Fish's argument, machine theory insists on a fundamental incommensurability between human and machine (2018, p. 8). With machine theory, Fish derives the conclusion that railway was not just a machine, but "it was the first iteration of the emergent machinic ecology" (2018, p. 10).

3 Approach

We will use ANT to form an actor-network of the analysed cross-border railway bridge and the missing cross-border track of the border railway line. We will apply a weak ANT approach in our analysis, following Bender's questioning of the value of using weak ANT in urban studies (2010, p. 317).

While we will follow the process of design, daily use, and maintenance, as Yanevya (2017, p. 2-3) suggested, our main focus is to describe the non-development and non-action, represented in the non-reconstruction of the railway cross-border Mura river bridge in question. It is what Bender sees as one of the virtues of ANT "that a non-action requires as much explanation as an action" (2010, p. 316). With our approach, we will also try to answer the dilemma if the causal logic of ANT evacuates responsibility, as Bender has asked himself (2011, p. 305).

Additionally, in our actor-network analysis, we will *think the train*. It is an approach originally developed by LaMarre, who encourages us to "approach the evolution of a technological ensemble such as the railroad from the perspective of its generative relations", but it was Fish who has developed the phrase "thinking the train" (2018, p. 14). We will describe human and machine *non-interaction* because our important focus is on the non-action of the actants involved in the MDR network. Our description will come out of reading Fish who has focused on "human and machine interaction" (2018, p. 9–10) in his perspective of Tokyo's commuter train network.

4 Implications

In the following sections, we will describe the formed actor-network. It was obvious in the past as it is obvious in the present that politics is commissioning the bridges.

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Structure, design, material, and its innovation must follow the economic capabilities and even more importantly gain the trust of commissioners. Only few of the authors have described the non-reconstruction of the mined infrastructure, in our case railway bridge.

In solving the puzzle of the non-reconstruction of this cross-border railway bridge one fact is immensely interesting. Former Yugoslavia and Republic of Austria *did* commission and solemnly opened the cross-border *road* bridge over the Mura river in 1969 (www kultprotur.si, 2019), only several dozen meters away from the location of the railway bridge. All this happened a year after former Yugoslavia in 1968 rationalised the passenger railway transport. During this infamous rationalisation, authorities in former Yugoslavia abandoned the passenger railway transport on the railway line from Ljutomer to Gornja Radgona (Gimnazija Franca Miklošiča Ljutomer, 2013). What were the reasons for such a strategic decision by authorities and other actors in former Yugoslavia? On the one hand, they stopped the railway passenger transport to the city on the border with Austria, while on the other side, they knew they would open the road bridge next year. Did authorities see the *car* as advanced technology in 1968, that is worth the effort and investment into the new bridge? Was the road bridge economically more viable? Or is there another logic to follow?

4.1 Actor-Network: Former Yugoslavia-the Republic of Austria Regional Border Transport after World War II until the Cold War

In following the logic of non-reconstruction of the railway bridge and abandoning the cross-border regional railway passenger transport, Fish is offering us one possible explanation. First, large-scale infrastructure—as is any railway infrastructure, including the MDR network— "can be mediums of time and space that traverse borders, cities, and culturally distinct regions to allow for the movement of people and things; at the same time, they can be a form of a place (or "non-place") with its own spatiotemporal character" (2018, p. 15–16). This is where one possible explanation for the non-reconstruction of the railway bridge over the Mura river could lie.

Mura and Drava rivers—*as* is any other river—are connecting people and objects through borders, cities, and regions with bridges as their critical links. The Republic of Austria dismantled its half of the railway bridge in 1947. Former Yugoslavia followed only in 1955 (www.styria-mobile.at, 2014). Additionally—at the height of the Cold War and the beginning of the economic crisis due to new custom provisions with Western-European countries in 1968 (Klasić, 2015, p. 46)—former Yugoslavia even abandoned the railway passenger traffic to the border with Austria. But both countries did build a cross-border street bridge on the other hand. It seems that security reasons prevailed for the former Yugoslavia, as illegal crossing the border over the Mura river between both countries immediately after the second world war was well documented and rather

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mass activity (Rihtarič, 2016). And leaving the country officially by car was a well-controlled and complicated process, as we know that even getting a passport in former Yugoslavia was far from being granted to everyone. This could be—although rather unusual—a possible way to address the problem of people—and with them the workforce—leaving the country. Stopping people from getting by train near the border, with the excuse of going on holidays to the well-known spa in Radenci and from there illegally over the border.

So, there is no action by both countries to rebuild what would be a cross border railway bridge, connecting again two cities divided after the second world war. Furthermore, former Yugoslavia restricted the passenger railway transport to the border. Additionally, former Yugoslavia knew it would have to face a rapid export decline to Western Europe in 1968 (Klasić, 2015, p. 46), but it still kept the railway border crossings to the East—in our case to Hungary—*closed.* Not only did they dismantle the railway line with the border to Hungary in Lendava after the second world war. They abolished and dismantled the other railway crossing with Hungary in 1968, from Puconci to Hodoš (but not from Murska Sobota to Puconci because they did transport freight from Puconci to Ruše by railway). In today's view, it is a challenge to even describe—what else to find reasonable arguments—of all these decisions, abandonment, dismantlement and non-action regarding the railway lines and cross-border railway bridge in MDR network.

Let's take the argument further. It is Fish who argues that large-scale, technical transport infrastructure discourages dwelling and enables mobility while it tends to be inhabited by indeterminate publics that are temporally manifest in various forms of communication and technologies (2018, p. 16). We know from our own experience that car use was rather rare until the end of the 1970s, what else in the 1960s in the former Yugoslavia. In this case of the MDR network, authorities did allow freight railway transport, but only inside the borders, closing the railway crossing and even dismantling the railway tracks to the East with Hungary and not re-forming the railway connections with Austria by re-building the railway bridge over the Mura river. Which had a logic to the degree that freight railway transport is more economically viable than regional passenger railway transport. But why not completely re-enable *cross-border* railway transport, at least for economic reasons to the East. Obviously, political and security reasons prevailed. What we wish to say, it seems that former Yugoslavia with its non-decision to reconstruct the railway bridge over the Mura river encouraged dwelling and disabled mobility of all. And the Republic of Austria could not rebuild the railway bridge alone—because the Mura river that this railway bridge was crossing was now the border, marking not only the border of two countries, but also dividing once a city into two new cities—so it had to be satisfied with the new road bridge.

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Finally, Fish sees large-scale technical infrastructure as “systems of systems, formed in a fusion of mechanical, electrical, and informational technologies that ground our daily lives but often remain unseen and unacknowledged” (2018, p. 16). In our case it really seems that the railway bridge was unseen and unacknowledged, as obviously, no one saw it as the critical, missing link to reconstruct not only one railway line in its whole but the whole MDR network in today’s four neighbouring European Union countries.

5 Conclusions and Recommendations

We will conclude our actor-network analysis in a rather Foucaultian manner, with the issue of control of the cross-border movement at the border of today's Slovenia with its three neighbouring countries—Austria, Hungary, and Italy. These countries formed the northern border of the former Yugoslavia. Before the second world war started, that border had ten railway border crossings. Four on the border of today’s Slovenia with Italy: Trieste/Hrpelje-Kozina, Sežana/Villa Opicina, Nova Gorica/Gorizia and Rateče/Tarvisio, four on the border with Austria: Jesenice/Villach, Prevalje/Bleiburg, Šentilj/Spielfed-Strass, and Gornja Radgona/Bad Radkersburg and two on the border with Hungary: Hodoš/Zalalövő and Lendava/Rédics.

We have mapped all these ten railway crossings, of which the Trieste/Hrpelje-Kozina and Rateče/Tarvisio borders railway tracks and crossings were completely dismantled in former Yugoslavia and don’t exist anymore. According to available sources, former Yugoslavia kept only three railway border crossings by the end of the 1960s. One on the border with Italy: Sežana/Villa Opicina, and two on the border with Austria: Jesenice/Villach and Šentilj/Spielfed-Strass. Former Yugoslavia closed both railway border crossings on today’s border of Slovenia and Hungary.

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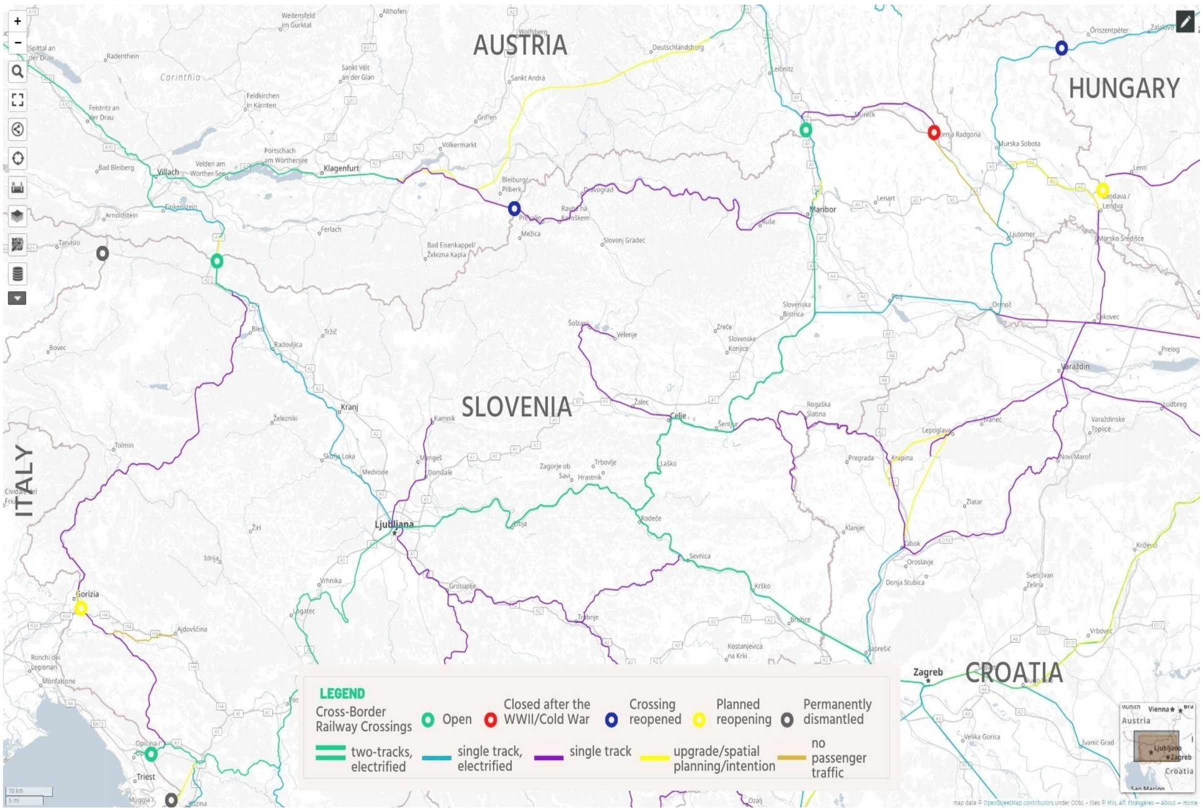
Fig. 1: Mapped railway network of Slovenia, with marked railway border crossings in Hungary, Austria, and Italy.



We took a broader perspective of the non-development and non-action of reconstructing the cross-border railway bridge over the Mura river. It seems that non-development and non-action in former Yugoslavia was part of a planned dismantlement or strategic intent. The intent was obviously to keep only a few exits and entrances—be that for railway passengers or freight—, in or out of the former country. The situation for cross-border railway passenger transport has even rapidly decreased in Slovenia and other countries in Western Balkans (Brezina et al., 2018). Both countries, former Yugoslavia and the Republic of Austria did agree on building a new cross-border road bridge, in 1969. In recent years in Slovenia some of the cross-border railway crossings did re-open. On the border with Austria: Prevalje/Bleiburg, marked on the map with dark blue colour. Additionally, Slovenia plans two more railway border crossing re-openings. On the western Slovenian border with Italy: Nova Gorica/Gorizia and on the eastern Slovenian border with Hungary: Lendava/Rédics, both marked yellow on the map.

Former Yugoslavia stopped the cross-border passenger railway transport with its infamous rationalisation of railway transport. It seems that authorities were able to implement this rationalisation—not only abandoning the passenger's railway transport but also dismantling some regional railway border tracks—by the end of 1968. For the

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purpose of our research, we were not able (yet) to obtain official documents confirming and detailing this rationalisation of railway transport. Its side effects were definitely rather unusual, and we know about them from the personal experience of one of the authors of this paper, who spent his youth in the city of Ljutomer, near the border of former Yugoslavia and today's Slovenia with Austria.

In the former socialist country, citizens near the border had special local border passes. Supply of some groceries—such as coffee and chocolate—was rather scarce or expensive or both. That is why the cross-border smuggling of coffee and chocolate was part of monthly or even weekly family trips by car—in order not to raise suspicion as adults-only trips—from Ljutomer to Bad Radkersburg. It would require another analysis of shopping tourism if reconstruction of the railway bridge would enable regular shopping trips *en masse* to this part of Austria—as it was practiced on the only railway border crossing of the former Yugoslavia with Italy, to Trieste (Mikula, 2010, p. 218). Nevertheless, with actor-network analysis, we were able to trace some logic behind it. We cannot confirm that causal logic of ANT evacuates responsibility, but actor-network analysis proved useful in describing the non-development and non-action of the infrastructure non-reconstruction.

In explaining the metaphysics of Latour, Harman sees the logic as "a logistics in which some translations are better supplied with food and ammunition than others, and thereby prevail for a time." (Harman, 2009, p. 26). Car and the street bridge prevail over a train and a railway bridge for the last few decades, not only for a time. From today's perspective non-decision to reconstruct a railway bridge definitely had its social, economic, and possibly other consequences and possible side effects. It also seems evident from today's perspective that car transport was strongly favoured if we analyse the closings of the railway border crossings in the Mura and Drava river regions. But we realised, we had to take into account the bigger picture, including other railway borders crossing in the whole of Slovenia in times of the former country.

Further research in this direction would be possible by obtaining access to the mentioned infamous railway transport rationalisation documentation.

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The Hidden Potential: Gender in Research Funding of Three Strong Innovators

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Abstract. In academic, non-profit and business research, project funding and grants are important elements to promote science, boost innovation and support researchers on their career paths. However, they are also powerful instruments to materialize and prioritize major principles of science policy and social values such as gender equality and equity. An analysis of research funding processes and organisations in the scope of the EU project CHANGE[1] could illuminate gender policies and practices, aiming at a more diverse and gender equitable research and innovation landscape, but could also reveal inherent gender biases. This paper particularly focuses on the results of 41 expert interviews on research budgets, gender policies and practices in research funding in the three “strong innovator”-countries Austria, Germany and Israel, and explores the hidden potential of gender in science and research funding in all sectors.

1 Introduction

Gender equality (GE) and mainstreaming in research has been defined as priority number four by the European Research Area and Innovation Committee (ERAC), a policy advisory body assisting the European Commission and the Council of the European Union on research and innovation (R&I) issues that are relevant to the development of the European Research Area (ERA). In negotiations and policy briefs

[1] The project CHANGE has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 787177 and is carried out between 2018 and 2022. The overall aim of the project is an institutional cultural change towards gender equal work environments in research performing organisations (RPOs) by implementing gender equality plans (GEPs) and fostering the importance of gender inclusive R&I programmes in research funding organisations (RFOs). CHANGE works with a responsible research and innovation approach, by involving key actors (for instance Transfer Agents in all partner organisations) and relevant stakeholders from the beginning, establishing regional communities of practice (CoPs) and co-producing gender equality knowledge for and with science and research (see: https://www.change-h2020.eu/).

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it had been discussed how to tackle gender bias in research evaluation and maintain GE as a priority in the new funding programme Horizon Europe (ERAC 2018[2], p. 16).

But how are these priorities and recommendations incorporated in national science policies and research funding programmes? Several EU GE related projects[3] discuss good practices and policies to mitigate gender gaps in research funding processes, from individual support instruments to organisational approaches such as gender mainstreaming (GM) to regional and national regulation. All practices seem relevant, and it has been suggested that a combination of several good practices addressed both to the individual and the structural levels might be effective (Benschop & Verloo, 2011), and that GE policies and legislation in government institutions are not enough—there is a need to allocate resources for GM at both local and regional level (the Knesset, 2013).

However, little is the empirical evidence on how GE policymaking and strategies implementation actually works in practice of research funding. Of special interest are countries, which dedicate a relatively high budget to science and research: How well do they integrate gender equality and mainstreaming in their science policies and research funding practices? Are their good practices proved to be effective in terms of gender balance in research and innovation?

1.1 High Innovator Countries of CHANGE

According to the Frascati Manual research and experimental development (R&D or R&I[4]) comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge. Research activities are implemented and funded[5] in: business enterprise (BE), higher education (HE), governmental (GOV) or private non-profit (PNP; OECD, 2015). While industrial research (BE) is considered almost exclusively applied, academia (HE) is also involved with basic research (Almog & Almog, 2020).

As Austria, Germany and Israel[6] have higher research intensities than the EU average of 2.419% gross domestic expenditures on research and development as percentage of their nominal gross domestic product (GDP): Austria – 3.142%,

[2] All included European policy documents and reports stem from 2018 4in order to have comparable data for the latest available “She Figures 2018”, published by the European Commission in 2019.
[3] See an elaborated list of GE related projects: https://www.change-h2020.eu/sister_projects.php
[4] R&D and R&I are often used interchangeably – see the Forward chapter in the Frascati Manual (OECD 2015).
[5] Note that a certain sector can finance research implementation in another sector; For example, the BE or GOV sectors can fund research implementation in the HE sector.
[6] Six countries are in the project CHANGE: Austria, Germany, Israel, Portugal, Slovakia and Slovenia (see all involved partners here: https://www.change-h2020.eu/team.php).

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Germany – 3.118%, and Israel – 4.846%, they are marked as 'high innovator countries' in the European innovation scoreboard (OECD 2018).

Austria declared in 2011 the aim of becoming 'innovation leader' within the European research landscape by 2020 (Republik Österreich, 2011). According to Statistics Austria, the Austrian national statistics office, in 2019, 12.8 billion Euro had been spent on R&I in Austria. The research intensity has increased from 3.05% in 2015 to 3.19% in 2019. This is the second highest share spent on R&I (behind Sweden) in the EU (Federal Ministry of Education, Science and Research; Federal Ministry for Transport, Innovation, and Technology & Federal Ministry for Digital and Economic Affairs, 2019).

In Austria, the total budget for research and development comprises 12.69 billion Euro, 3.66 billion Euro from that total budget stem from public funding and 6.04 billion Euro from Austrian companies. As a logical consequence the largest proportion of research expenditure is with 69.9% in the BE sector and the HE sector is far behind with 22.4% the GOV sector accounted for 7.1% and the PNP sector 0.5% (Federal Ministry of Education, Science and Research et al. 2020; see figure 1).

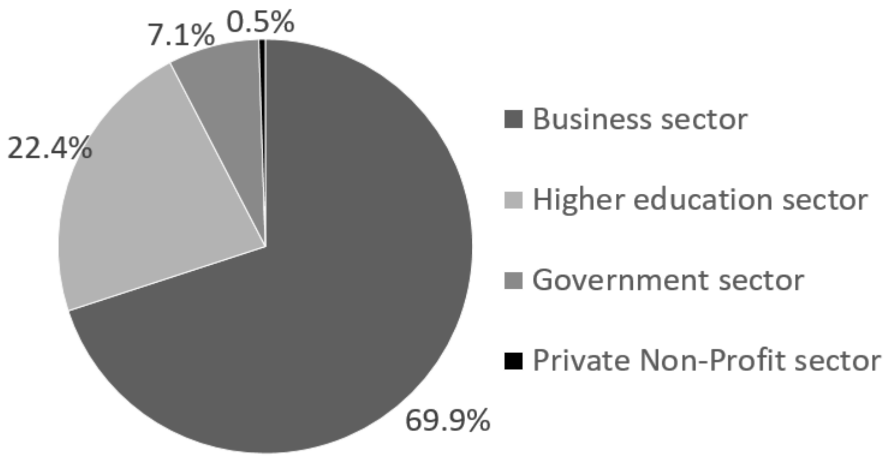

Fig. 1: Proportion of research expenditure in Austria by sector (Source: Federal Ministry of Education, Science and Research et al. 2020)

Promoting gender equality in research has been explicitly mentioned in the Austrian Research and Technology Report:

> "*Women have represented over 50% of university graduates in Austria since 2000, but they are still under-represented in many areas of research, especially at higher hierarchical levels, in industrial research, in many natural sciences, and in most engineering sciences. The RTI strategy therefore included the goal of gender balance amongst those involved in research work.*" (ibid. p. 111)

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This is defined by the three actions: gender budgeting in all research funding measures, individual support measures for early-stage female researchers, and measures to improve compatibility between career and family (ibid. p. 112). However, although this strategic aim and its actions have been declared in 2011 already, gender balance (let alone gender equity) is still not reached: Austria’s share of women researchers is with 29.5% below the EU average (33.4%; European Commission 2018b).

In Germany, governmental research funding is organized on a division between the Federal Government and the States due to the federal structure. At the federal level, the three ministries Federal Ministry of Education and Research, Federal Ministry of Economics and Technology and Federal Ministry of Defense finance the majority of the federal funds for research and development by providing long-term institutional funding and temporary direct project funding. The States provide the majority for the universities.

The German government has set a target of spending 3.5% of GDP on research and development in 2025. The share of expenditure has already risen from 2.9% in 2016 to 3.13% in 2019. In total, 109.5 billion euro were spent on research and development in Germany in 2019. Looking at the financing of the budget for research and development, the Federal Statistical Office of Germany states for 2018 that 66% of the budget comes from the private sector, 28% from the public sector and 6% from abroad (Federal Statistical Office, 2021a). Therefore, as logical consequence the largest amount goes back into the BE sector (as in Austria). In 2019, 75.6 billion euro (69 %) of the research and development expenditure was spent in the BE sector, 19.0 billion euro (17.3 %) in HE institutions (HEI) and 15.0 billion euro (13.7 %) in PNP (non-university research institutions) and the GOV sector (Federal Statistical Office, 2021a; see figure 2).

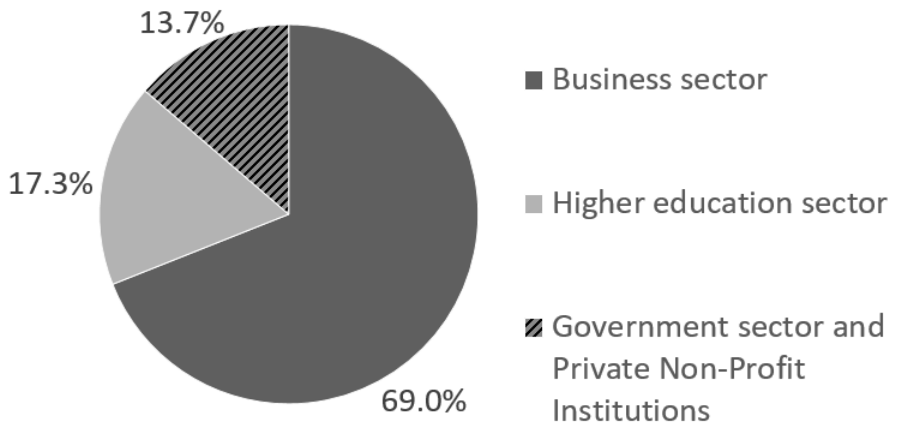

Fig. 2: Proportion of research expenditure in Germany by sector (Source: Statistisches Bundesamt, 2020)

Gender equality is a declared goal of the German Federal Government. In 2020, the national GE strategy "Towards a stronger future" was agreed. In the strategy, the Federal Government specifies how equality between women and men is to be implemented in legislation and in its funding programmes. The GE strategy sets out nine goals for GE and corresponding measures to achieve these goals. One goal is equal presence and participation of women and men in culture and science (Federal Ministry of Family Affairs, Senior Citizens, Women and Youth, 2020). However, the share of female researchers is with 28% lower than in Austria. In the higher education sector, although 38.7 % of researchers are female, the business sector has only a 14.7% share of women researchers, which is below the EU-28 average of 20.2% (SHE Figures 2018).

In sum, similar to the Austrian situation, it seems that the gender gap in research in Germany is bigger in industry/businesses[7] compared to academia. The reason for that gap is that governmental policies and budget regulates German academia more, to promote or encourage certain participation of women, while industry research is driven by industrial money and is not regulated by gender-inclusive governmental policies.

[7] In Germany, the main BE are automotive industry with a total turnover of EUR 439 billion in 2019, mechanical engineering with a total turnover of EUR 257 billion in 2019 and chemical and pharmaceutical industry with a total turnover of EUR 198 billion in 2019 (Statista, 2020). However, employees in the metal, automotive and mechanical engineering sectors are only between 12 and 13% female. In the chemical sector, women have a share of 21%. The pharmaceutical industry has the highest share of women among the most important industrial sectors in Germany with 41% (Pharma Fakten e.V., 2019).

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However, gender gaps exist in academia as well. In fact, both in academia and in BE, the higher the position, the bigger the gap, regardless of sector or discipline.

In Israel, the highest percentage of R&I expenditure is also in the BE sector (88.9%), and the rest is in HE (8.6%), GOV (1.5%) and PNP (1%) institutions (CBS, 2019 – see figure 3). Within the BE sector, the highest expenditure on R&D in 2017 was 26.5 billion ILS in computer programming, consultancy, and related activities (considered the main source of R&D growth in this sector), followed by 19.7 billion ILS in scientific research and development and 12.8 billion ILS in manufacturing, mining and quarrying (CBS, 2020a).

In terms of financing, the R&D resources stem both from local and foreign funding: more than half of the civilian R&D expenditure (52.5%) is financed by funds from abroad, about one third (35.7%) is financed by the business sector, 10.7% by the government, 0.3% by higher education and 0.8% by the private non-profit sector. The BE R&D is mainly financed by funds from abroad (57.4%) and the BE sector itself (39.4%), whereas HE R&D is mainly financed by the government (67.2%) and funds from abroad (20%) (CBS, 2020b – table 14, p. 83).

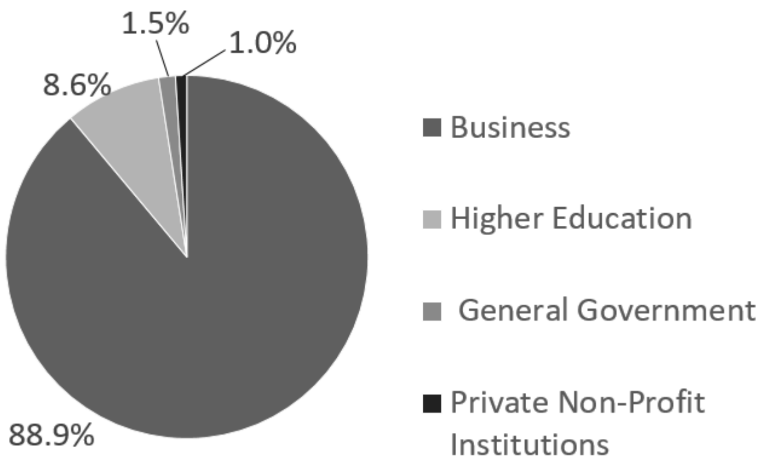

Fig. 3: Proportion of research expenditure in Israel by sector (Source: State of Israel, Central Bureau of Statistics, 2019)

Despite its relatively modest share of R&D expenditure, most, if not all, of Israel's basic scientific research[8] takes place in the HE sector, meaning research universities and some academic colleges[9] (The Israel Academy of Sciences and Humanities, 2013 and 2019). The HE research is mainly funded by the government (GOV) through the

[8] It is mentioned, however, that in recent years the distinction between basic and applied research is sometimes "blurry" (The Israel Academy of Sciences and Humanities, 2013).

[9] Although research infrastructure in colleges is 'modest' and college researchers are less supported in their research work (ibid, 2013).

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Council for Higher Education (CHE) and its Planning and Budgeting Committee (PBC) and through public research funds (partly financed by the government). Other sources for research in HE are private donations from abroad, the business sector (whether local or from abroad), foreign funds or internal budget (ibid).

Regarding gender equality, all public institutions in Israel are subordinate to state laws and government resolutions regarding GE in the work force and the civil service. In addition, there are governmental bodies or policymaking committees that constantly examine gender issues and promote gender equality national policies and regulations in certain sectors[10].

In recent years there has been a growing concern regarding gender gaps in Israeli R&D. However, regulatory efforts to mitigate these gaps have been especially evident in the Israeli academia, as for instance, by means of all public HEIs are obliged to nominate Gender Equality Officers (GEO)[11], or by financial incentives given to HEIs based on their GE outputs,[12] while no such regulations exist for RF in the BE or PNP sectors.

In sum, in all three countries gender equality is well embedded in regulations and policies to promote GE in the HE sector. However, the implementation of gender mainstreaming on a broader scale in all (especially BE) R&I sectors is lagging behind.

1.2 Gender imbalances in science and research

In terms of women's presence in research and research funding all three countries manifest gender imbalances (see graphs 4 and 5):

Austria's share of women researchers is 29.5% (EU average: 33.4%), of which the share of women researchers in HE is 39.9%, and only 17.1% in BE (European Commission, 2018 – graph 4).

In Germany, the share of female researchers is 28% to 38.7% in HE, but only 14.7% in BE (EU-28 average: 20.2%; European Commission, 2018 – see figure 4).

In Israel, although the percentage of female doctoral graduates is higher than the EU average and is almost 50% (IL 49.7%; EU: 47.9%[13]), their share in R&I positions is lower than the men's in all sectors (see figure 5): BE – 29.7% (CBS, 2011a), HE:

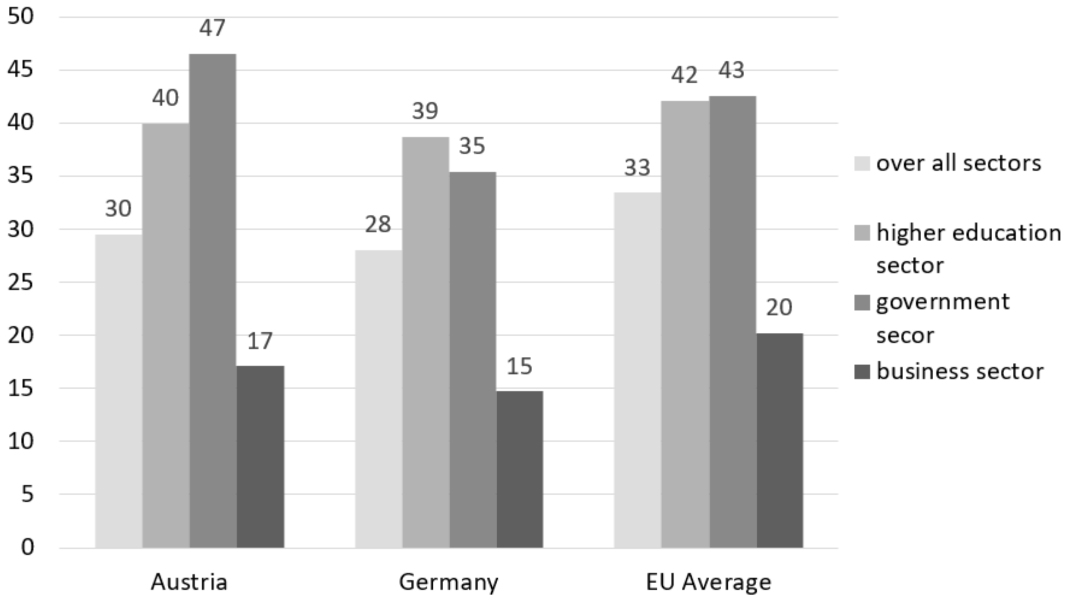
[10] Such as: The Authority for the Advancement of the Status of Women in the Prime Minister's Office; the Ministry for Social Equality; the Committee on the Status of Women and Gender Equality in the Israeli Parliament; the Steering and Judgment Committee for the Promotion of Gender Equality in the CHE/PBC; and the Council for the Advancement of Women in Science and Technology in the Ministry of Science and Technology (consisting of three sub-committees: Academia, Industry and Education).

[11] According to CHE resolution 3/4/2012 regarding the promotion of women in academia. Link (in Hebrew)

[12] CHE/PBC newsletter 28/8/2020. Link (in English).

[13] SHE Figures, 2018, Figure 2.1, p. 19.

universities – 32%, colleges – 43% (the Knesset, 2018), GOV – 30.9% and PNP – 24.9% (CBS, 2011b).



Fg. 4: Share of women researchers in different sectors in Austria, Germany and EU average (own graph, data from: European Commission, 2018, figure 4.1, 4.5, 4.6, 4.7)

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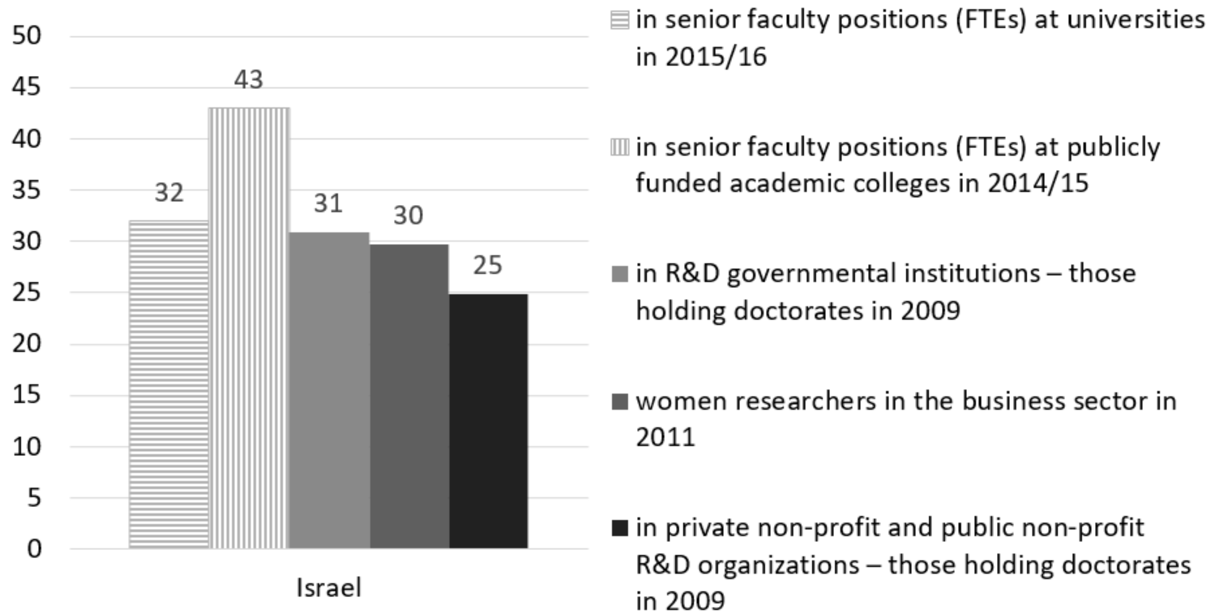

Fig. 5: Share of women researchers in different sectors in Israel (own graph, data from The Knesset, 2018 – higher education sector; CBS, 2011b – governmental and non-profit sector; CBS, 2011a – business sector)

Moreover, under representation of women is more prominent in senior positions, which are usually more accessible to research funding, as for example in academia (SHE Figures 2018)[14] or in high-tech technology management positions or entrepreneurship (Israel Innovation Authority, 2020).

2. Gender in research funding in Austria, Germany and Israel

Could RFOs be seen as potential enablers of gender equality, by incorporating budgets to respective research programmes and corresponding objectives to their evaluation, and thus putting GE science policies into practice?

2.1 Methodology

After a stakeholder mapping and exhaustive desk research, 41 experts in Austria, Germany and Israel were interviewed, between November 2019 and March 2020, in order to explore gender in science policies as well as research programmes and funding. An in-depth preparation of the interviewers has been proven a crucial factor for successful and rich interviews on eye-level with policy and experts from research

[14] Cf. SHE Figures, 2018, Figure 6.6 Glass Ceiling Index, 2013-2016.

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funding organisations (RFO). In Austria, the majority of interviews have been conducted face-to-face with a team of two interviewers, only two have been conducted via phone and video-call. In Germany, the participating RFOs are spread all over the country. Therefore, most of the interviews have been conducted by phone and three in person. All interviews have been transcribed in full length; their summaries translated in English. The interviewed experts are all stakeholders from RFOs[15] and policy makers from governments and ministries, which are significantly involved in science and research. All interviewed experts are either in charge of science and/or research in general, research funding in particular (e.g., heads of specific funding programmes), and/or gender in science and research (see details about the sample in figure 6).

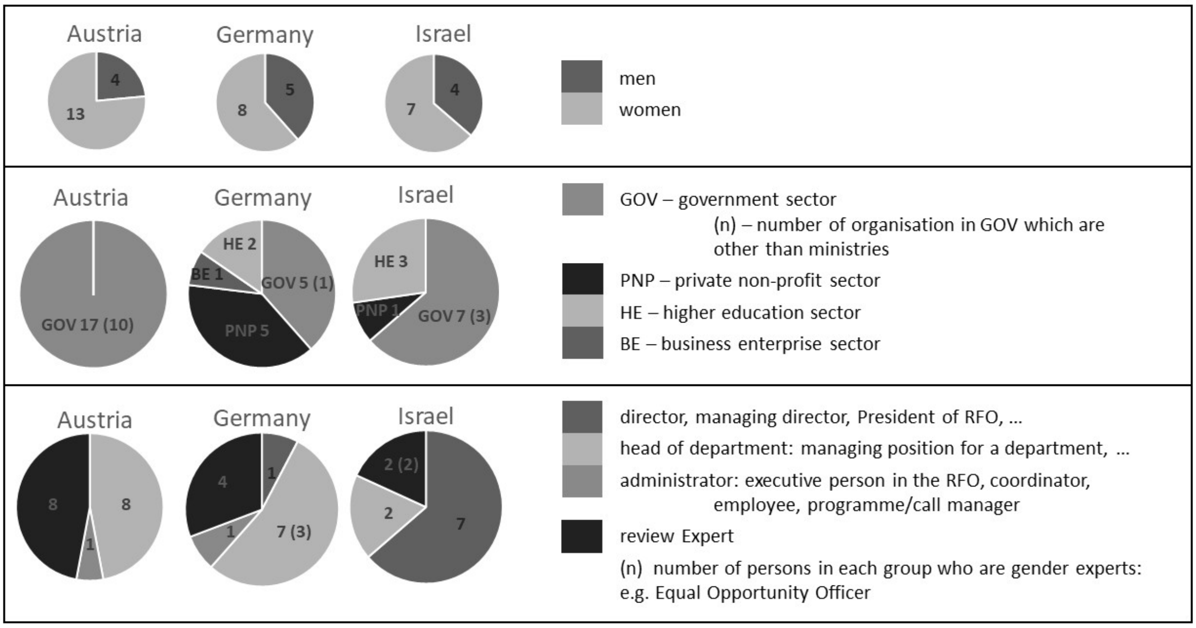

Fig. 6: The composition of the expert interview sample

2.2 Results

2.2.1 Policies, practices and gender gaps in Austria

As pointed out, Austria's share of women researchers lies below the European average, however, many of the interviewed experts agreed that especially the gender imbalance in industrial research (BE) is a huge issue, which cannot be governed as

[15] In this context RFOs (research funding organisations) are organisations, which operationally organise research fundings, they can also be RPOs (research performing organisations) or other organisations with implemented research funding programmes.

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easily as gender mainstreaming in universities. This has to do with several Austrian regulations and laws.

Since 1995 Austria is member of the European Union, and several interview partners see this very fact as a catalyst for gender equality efforts. In 2000, the Austrian government committed to gender mainstreaming, which goes back to Austria signing the Treaty of Amsterdam in 1998. Since 2002 gender equality is a leading principle for all universities, regulated by a university law ("Universitätsgesetz 2002"), and since then gender equality offices and gender equality plans are obligatory at all Austrian universities.

Additionally, policy makers from ministries pointed out that several judicial changes and budget reforms helped tremendously in governing changes towards more gender equality. For instance, in the budgeting reform of 2009/2013 gender has been included as one of five impact goals, which should also lead to more gender equality in Austria. Although the consequent implementation of gender budgeting is seen as international good practice example, the data to assess the gender impact and the assignment of resources to the gender impact goals could be improved (Saliterer & Korac 2018).

However, the private business sector cannot be governed like the public sector. Therefore, R&I funding has been recognised as important steering tool and leverage point. One interviewee explains the motivation for implementing gender mainstreaming and diversity issues in businesses and industrial research:

"*There are three motives: One motive is justice. But, the second motive is that innovation comes from diversity and because there are verifiably product developments, which stumbled, because mono-cultural teams worked on them. And the third is that there is a skilled labour shortage and with the leaky pipeline there is an underused potential of labour there. I think, we already stated that in 2005 and I believe it is still true.*" (AT_RFO07_F_EI09)

The three interviewed federal ministries and the national funding agency FFG (managing research programmes for two ministries[16]) are operating based on the mentioned Austrian gender mainstreaming policy from 2000, and the Gender budgeting law, where gender mainstreaming is a goal within the so called 'impact orientation' since 2013. One interviewee explains the importance of this law and its concrete consequences on implementing gender as evaluation criterion in research funding etc.:

"*And I believe remembering, the actual impulse happened at an event in the ‚Haus der Forschung[17]' about gender budgeting and a head of department of the finance*

[16] The Federal Ministry for Digital and Economic Affairs and the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology are owners of FFG.

[17] The 'Haus der Forschung' translates to 'house of research', and it accommodates several RFOs and RPOs and hosts several networking activities and other research events.

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ministry gave the talk, and he was very euphoric, because he received the news immediately before or during the event that gender budgeting has been accepted. ... And as far as I can remember, I was not in our organisation back then, but the anecdotal evidence is that the head of our basic research programme said ‚No, we have to do something!', and so they started with the gender criteria in the basic research programmes. And based on that we developed that further. Yes." (AT_RFO02_F_EI02)

These three federal ministries, the FFG plus the Vienna Business agency, which operates on a regional level, promote gender mainstreaming in their organisations, have several gender experts additionally to GEOs, so the gender expertise is broadly distributed in these organisations, and they all offer at least gender trainings for management. Moreover, all of these five organisations have a strong evidence based and impact-oriented evaluation culture, which is why they are all members of the Austrian platform for research and technology evaluation[18]. This evaluation platform has been established in 1996 and set the gender dimension as standard criterion for evaluations.

However, the interviewed provincial government, and two other RFOs of the Austrian sample have less commitment to GM in their organisations and in their research funding activities, although single good practices were identified, which are rather efforts of individuals committed to gender equality than broadly implemented governance instruments and good practices for GM in science policy and research funding. But this very fact has been identified as success factor, to implement governance structures based on GM policies and legal requirements instead:

"*Yes, this would be an effect of improvement. When the topic is stabilized and you do not have to run after people with your vendor's tray ... I for instance gave up to run after people and look where else can I add the gender dimension? This was so incredibly cumbersome and everybody was reluctant and it was so tiring. And with those governance instruments and because it became a legal requirement, ... this has changed something*." (AT_RFO01_F_EI01)

One interviewee points out the diplomatic skills involved in setting a focus on gender equality in a research funding call in an organisation, where gender mainstreaming is not a guiding principle:

"*... it was a challenge to construct this research fund in this way, to explicitly realise the call in the area of equality, and it is still a challenge to bring equality-focused projects forward, because it exists an institutional bias towards equality oriented, feminist research projects. The reason therefor lies in the committees, ... This is a structurally conservative organisation although it is progressive in its whole spectrum,*

[18] Plattform Forschungs- und Technologiepolitikevaluierung: https://www.fteval.at/

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however as an institution it works conservatively and this indicates the mentality of this house." (AT_RFO08_M_EI08)

Room for improvement has been identified in those cases where research funding procedures are less formalised, less transparent and evaluated internally or decided by a political board (after an external evaluation with mostly Austrian evaluators). One interviewee says about not using standardised evaluation criteria:

"*Well, we do not have such a formalism, we submit the proposal to the evaluator and he evaluates that then. So we do not have any criteria, but rely on the expertise.*" (AT_RFO05_F_EI17)

In total, several good practices could be identified in our interviews. For instance, the Vienna Business Agency is funding in the "FemPower-calls" only research and development projects, whose project leaders are women and/or main executors in the project and if the core focus of the project is an issue of gender mainstreaming. Additionally, they award all projects with a "Women Bonus" of 10,000 euro on top, if the project leaders are women. These measures proved to support women researchers' careers (Thaler & Hofstätter 2014). The Vienna Business Agency has now been a cooperation partner in the EU project GEECCO and learned there about the influence of unconscious bias. Our interview partners reported about their on-going efforts to improve their research funding procedures and their current plans to integrate obligatory unconscious bias e-learning training in their review process:

"*Businesses submit, projects are evaluated, projects are accompanied and operated by us. This means it is a whole process of things which take place, and accordingly you can turn several screws und one screw is 'how do we get women in the pipeline'. And another screw, which we will turn this year is to change the process of evaluation a little bit, because we say all who evaluate projects - internal and external people - must get a certificate, participating an online-tool on unconscious bias.*" (AT_RFO07_F_EI10)

The FFG, as the main national funding agency for applied research (focus on industrial research) and innovation in Austria, provides the funding services for the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Federal Ministry for Digital and Economic Affairs (BMDW). Occasionally funding programmes from other Ministries are managed as well. Beside national funding programme management, the FFG also manages cooperative European (e.g., ERANETs, National contact point for EU Framework Programmes) and international programmes (e.g. Beyond Europe Programme). In sum the FFG currently manages 45 programmes and funding instruments, which cover various types, ranging from a basic programme (thematically open) to thematic calls (energy, cities and the environment, mobility, materials and production, ICT, safety and security, and space), training programmes, career development, to infrastructure funding.

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For funding instruments specifically directed towards supporting women in R&I (Talente programme: FEMtech research projects, FEMtech career, FEMtech internships; w-fFORTE; Laura Bassi) approximately 2% of the total funding budget of the FFG are allocated. Besides that, gender issues represent an integral part of the standard criteria for funding, which are applied for any type of programme managed by the FFG. This means that gender issues are considered in the project evaluation as part of the assessment of 'social aspects' of R&I projects, which embrace criteria such as the value of society, the level of qualifications, labour and social law norms, etc. This was initiated in 2010 for funding within the basic programme and was then stepwise expanded to all other programmes in order to foster equal opportunities for women and men (so not particularly focussed on 'women'). The evaluation criteria include I) gender aspects in the project content and potential impacts, II) gender-balance in the project team, and III) gender-balanced working conditions. The quantitative weighing of gender related evaluation criteria vary between different programmes, in average it counts for 10% of the overall evaluation. However, in case shortcomings are detected, adequate measures are required to be implemented by the projects, which are in consequence also monitored in the scope of project progress evaluations. For instance, in the 'Comet' programme (Competence centres for Excellent Technologies), five goals are evaluated, one of them is focused on human resources, which comprises career models in the respective competence centre and gender equality, which needs to be tackled with a gender equality plan. One interviewee explains how RFOs can increase gender equality in research with such an instrument:

"*However, we do have indicators for human resources as well. Generally, about the structure of the centre, how many persons are there, but we also take a look at how many female researchers are there. And if we see that these are not very ambitious goals, then we … with our jury … set the goals higher, … each RFO has this leverage. When we do not get what we want then there is no money flow. … And yes we are connecting such requirements with paying the instalments. And our competence centres must be a limited liability company. And this means this is connected to liquidity, … so this is really critical, if the money would not come, and we handle this with care, because we do not want to – and we never had a case – that a centre gets problems with their liquidity, but we can make pressure. Yes, and then we receive the gender concept and we let them evaluate internally.*" (AT_RFO02_M_EI06)

So, if gender mainstreaming is not already part of the initial Comet centre concept, this has to be considered at the midterm review, and FFG evaluates this with concrete indicators, which are dependent on women's share in respective disciplines etc. only then the next part of the budget is paid. To support the research centres in developing

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a gender mainstreaming concept they can additionally apply in the FEMtech career programme to pay for external gender expertise and implement a gender equality plan.

The FFG funding programmes undergo regular impact assessments as well, which includes a gender monitoring that is not only based on counting heads, but also refers to gender balance in lead positions. Based on the programmes' impact assessment, the evaluation criteria are revised accordingly.

Some funding programmes are evaluated in house, which means that FFG experts do the review; either the thematic expert holds gender expertise her/himself, or in case not, one of the FFG gender experts is consulted on that matter. For the bigger funding programmes, external experts are contracted, which are chosen according to their specific expertise on the research topic, and at least one of them needs to hold gender expertise. Moreover, the aim is to set up a gender balanced evaluation panel according to FFG rules (which in reality does not always work out).

Through the manifestation of gender issues as basic criteria for all FFG funding activities, it was institutionalised in a sustainable way, and within a very broad spectrum of R&I activities, essentially all funding programmes of two Austrian Ministries and even beyond.

2.2.2 Policies, practices and gender gaps in Germany

In Germany, the share of female researchers is below the European average as well. The political equality goals are not as closely intertwined with the academic assessment system as in Austria. Therefore, there is not such a strong incentive for gender equality in science. Furthermore, there is a big and extensive research landscape with many different kinds of funding organisations, which makes a uniform approach more complicated.

Nevertheless, since November 2001, the 'Law on Equality of Women and Men in the Federal Administration and in the Courts of the Federation' (Bundesgleichstellungsgesetz, BGleiG) has been in effect in Germany, which regulates equality at the federal level.

Under the umbrella of the Joint Science Conference (GWK), science ministers and federal and state finance ministers coordinate federal and state science funding in Germany. Details of the joint funding are regulated in so-called implementation agreements (Ausführungsvereinbarungen, AV). The 'Implementation Agreement to the GWK Agreement on Equality between Women and Men in Joint Research Funding' (AV-Glei) of 2008, regulates that the principles of the BGleiG also apply to the research institutions jointly funded by the Federal Government and the States. In addition, the implementation of the legal mandate for the advancement of women and gender

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equality for university research institutions is regulated in the higher education laws of the respective federal states.

However, all legal requirements provide a good basis for achieving gender equality within research funding organisations.

Most of the interviewed experts see positive effects caused by it in the past years:

"… More than 10 years ago, the funding discrepancy [between male and female participants] was noticeably different, but in recent times this is hardly noticeable." (DE_RFO1_F_EI01)

Almost all interviewees describe GE-oriented policies and legal instruments (like monitoring the distribution of sexes) as the most powerful and effective tools to assimilate gender equality in their funding processes:

"That is because we are responsible for implementing the law ... we are required to fill the positions with women on a regular basis. And this is also evaluated quite well ... how many women we have ... this is published. So, there is also a sensitisation." (DE_RFO3_F_EI03)

"The chair remains empty, if no woman is found, it is not filled by a man, but the chair remains empty. This is due to the changes in the last amendment of the Federal Equality Law and it is bearing fruit." (DE_RFO3_F_EI03)

However, dealing with and implementing GE in an organisation always depends on how important this issue is to the top management of an organisation. As a logical consequence, it is important to convince the leaders and get support for changing the system towards more GE:

"... The fact that we try to give the director the topic in order to have the support, or at the level of the heads of department, is very important to push the topic forward." (DE_RFO3_F_EI03)

A point worth highlighting is, as soon as the BE is involved, the funding organisation considers mainly technological factors and social factors are less important. For example, one industry-driven RFO stated that the research institutions funded by the RFO are already committed to equal opportunities and the RFO therefore would not need to take any additional measures:

"Of course, we are ... motivated to promote women in research as well. But we do this in agreement with our cooperation partners in science: as all research organisations which apply for our grants, anyway committed themselves in order that women will be employed and supported in the projects ..." (DE_RFO02_M_EI02)

"We have stated in the Articles of Association that the institution must become younger and more feminine. However, this is not pushed by regulations – this is good in our opinion, because the focus is on promoting technology." (DE_RFO02_M_EI02)

Some RFOs do not employ gender experts or gender sensitisation tools. Either they do not seem to perceive them as necessary, or they are confident that they are

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educated enough to overcome any possible biases as described above, the issue of women's empowerment is written into law especially for academia:

“In this sense I see myself as a gender expert. This has to do with my biography: I was in various positions. ... There is no organisation in which promoting of women is not an important issue." (DE_RFO02_M_EI02)

Another reason given by smaller RFOs (e.g., foundations) for not having gender experts is that they have few employees and could not afford an additional expert. Actually, each consultant has to have gender knowledge (beside other expert knowledge). As most of the employees have a PhD the RFOs expect their employees to instruct themselves into several themes:

“… so of course, it stands and falls partly with the people [involved in the funding process]. And there have been and are changes over the years, which certainly has an influence on how the topic gender is positioned.” (DE_RFO6_M_EI07)

Similar to lower percentage of women in evaluation committees, certain domains of science and technology are known to have lower percentage of women researchers, which (along with other biases) is followed by a low percentage of women’s submissions or applications in those domains:

“Justice can only be achieved on the funding side if justice is obtained on the applicant side. This will not be the case if not more women do come to positions of responsibility and submit more applications.” (DE_RFO10_M_EI11)

All funding organisations (beside the industrial driven RFOs) monitor the numbers regarding the distribution of women and men. Mainly RFOs in the higher education sector are implementing unconscious bias trainings for evaluators. Furthermore, it is important that the large funding organisations (e.g., European Commission) in particular act as role models, as the smaller RFOs usually take up on their processes. So, European research funding guidelines provide German RFOs with a procedure for how funding can be structured on an equal basis. Processes such as the accurate and detailed evaluation of applications have been adopted by some RFOs.

In the German research funding landscape, there are promising approaches, such as the ‘Offensive for Equal Opportunities for Women and Men Scientists’ (German Council of Science and Humanities, 2006), in which the major German science organisations have jointly committed themselves to implementing concrete measures and deploying resources to significantly increase the participation of women scientists in research. However, there is still a lack of strict and legal obligations, which slows down the implementation of equality.

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2.2.3 Policies, practices and gender gaps in Israel

As mentioned above, basic research in Israel is mostly implemented in HEIs financed by GOV and funds from abroad[19],. Consequently, almost the only way for researchers in HE to apply for funds is by being affiliated and in senior or tenured positions in Israeli academia. Therefore, the first gender gap lies in the fact that the percentage of women among 'eligible researchers' to apply for funds are initially low (see figure 5), especially in certain domains as STEM. Similarly, the major gender gap in BE research funding is probably the under-representation of women in senior positions:

"...There are not so many women entrepreneurs."(IL_RFO5_M_EI05)

The second, and probably most significant, gender gap in the funding process is in the submission phase, as indicated by a report by the Israeli Ministry of Science (MOS, 2019) on four of the leading public research funds in the country[20]. Women apply less to funds (23% of all applications), which is less than their respective share in senior academic staff members (34%)[21]. In average 68% of grants are given to men, 24% to women and 8% to combined teams of women and men:

*"The bottom line is that men get more [*research funds] than women [...] the problem is [...] the proposals submission phase. Therefore, the [*intervention] work should focus on the [*submitting] institutions. Are women in those institutions networked and know exactly what to do? Do they need assistance with managing the submission, maybe a research assistant etc." (IL_RFO8_F_EI11)*

Meaning, less women tend to apply for research grants relatively to their percentage in academic staff members. Once they do apply, their chances to be granted are rather proportionate to their percentage in total submissions. This finding suggests that the main barrier or bias in the process is related to women's feasibility to apply, resulting from prerequisites or other factors such as promotion criteria in academia and (lack) of supportive instruments given to them by their home-base institutions. This issue should be further investigated and analysed, for better understanding of the roots of the bias.

Another observation based on the expert interviews is, that unlike HEIs, where a gender equality officer (GEO) is mandatory, in most (if not all) public funds in Israel GE is neither included as a crosscutting issue in the policy nor in the routine procedures

[19] Consequently, most RFO expert interviews in the BBC framework were conducted either in GOV or HE organisations.

[20] Major governmental academic funds, Ministry of Science and Technology, Israel Scientific Foundation (ISF), The U.S.-Israel Binational Science Foundation (BSF) and The German-Israeli Foundation for Scientific Research and Development (GIF) in 2017-2018.

[21] Senior academic staff members in universities and grant applications(ibid).

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of the funding process. Moreover, gender equality is sometimes perceived as a challenge to excellence or meritocracy:

“The focus is on our work ethics. Gender is not an issue. What is important is the quality of the researchers. I can’t tell about men and women figures. It’s not a criterion we focus on.” (IL_RFO2_F_EI02)

Finally, a gender gap which is more focused on is the post-doctorate phase. As being the entry point to senior academic positions in universities, and as required to be held abroad, this phase was recognized as a major barrier for young female researchers in Israel (MOS, 2015). In an attempt to mitigate this barrier, a few postdoc programmes for young excellent female researchers in the field of life sciences are implemented in the country. The aim of these programmes is to assist young women by allocating extra funding for their families, thus supporting their relocation abroad:

*“We have learned that the source of the problem is the spouse’s position. There is no difference in the abilities of men and women. […] We have realized that when a man has to go [*abroad] to his postdoc, […] A male scientist’s mobility with his family is much more common and accepted than a female scientist’s […]Women don’t even get to the point where they raise and discuss the question of mobility.[…] We decided to add a scholarship of 25 thousand $ to make it easy on the family to economically adjust to this change. We have found out that this tool encourages women to go to postdoc. This programme has been operating for the last 12 years and has impressive achievements so far.” (IL_RFO6_M_EI06)*

In sum, the gender gap in Israeli research funding stems from the low percentage of women in senior academic ranks. Specific postdoc programmes for young female researchers in life sciences and training and incentive programmes female entrepreneurs (IIA, 2020) are good-practice examples on an individual level, however their impact on the systemic or national levels is unclear. Regulatory strategies to promote GE in science and research on the national level are still needed to have more gender-balanced research funding processes in the country.

3. Conclusions

The following conclusions are based on exhaustive desk research and 41 interviews with RFO experts and policy makers in the three high innovator countries Austria, Germany and Israel.

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3.1 Research budgets and gender imbalances

Findings from the expert interviews on research budgets, gender policies and practices confirm on the one hand general gender imbalances in funding processes regardless of place, policy, regulation or budget. This means that despite the efforts put into research in the examined strong-innovator countries, their high scientific potential might not be fully materialised due to unconscious biases along the ‘leaky pipeline’ of grant application and evaluation. On the other hand, the specific imbalances differ across the three countries:

Although the allocated budget for R&I in HE in Israel, Austria and Germany is different (9%, 17% and 22% respectively), the share of women researchers in the academic staff is still less than half in all three countries.

The disparity between budgets and women’s participation in research is especially apparent in BE sector in Austria and Germany, where almost 70% of the total research budget is allocated, but only 15% respectively 17% are women researchers.

3.2 The hidden potential lies in gender policies for all research sectors

Despite significant regulative measures taken in HE, academia is still gender biased or gender imbalanced. This fact has an impact on women’s career progression, including their chance to be funded and supported for their research.

Nevertheless, HE and research funding on a national level manifest more GE policies and GM practices than BE and research funding on regional levels. Therefore, one of the main challenges is to transfer gender-inclusive policies and practices from the national to the regional level, and from academic to industrial research.

Based on the expert interviews, it can be recommended to combine different policies and practices at all systemic levels (not only individual measures), in order to achieve effective and sustainable change:

1. Gender national policy and legislation in research funds, similarly to those implemented in HEIs.
2. Sharing of knowledge between research performing organisations and RFOs, in order to identify gender gaps and biases in their organisational processes, as well as intersections or matching points, where women might face more challenges, and thus procedures could be adapted or gender sensitisised.
3. Further investigations on the roots of gender gaps in funding processes and the development of tailor-made solutions (e.g. biased prerequisites).
4. Gender as cross-cutting issue in research funding programmes, with detailed explanations and examples in the guidelines for applicants.
5. Support of the management of the organisation to improve the implementation of gender equality in the individual divisions.

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6. Gender as a general evaluation criterion for grant reviews, carefully explained in reviewer briefing material.
7. Compulsory gender and/or unconscious bias training for staff of RFOs and reviewers to raise awareness and to foster a sense of commitment of RFO practitioners to promote GE within their organisations.
8. Constant monitoring and impact evaluation of research funding programmes, incl. gender dimensions in the whole research funding cycle.

Finally, there exists a window of opportunity in the ERA right now, as with the European Commission's 'Horizon Europe' research funding programme, the inclusion of gender equality plans (GEPs) is communicated as an eligibility criterion for proposal applications[22]. However, this momentum of connecting research budgets to gender policies has only the full possible impact, if this eligibility criterion will in future be applied to all sectors including BE, and if the request for GEPs will be regularly and qualitatively monitored, e.g., in the scope of the mandatory project reviews.

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Challenges and Synergies for the Local Energy Transition in Local Case Studies in the Netherlands and Hawai‘i

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Abstract. The energy transition is already underway across the globe. This paper examines two very different approaches in the implementation of renewable energy projects—the Netherlands and Hawai‘i. In the Netherlands, 27 suburbs are acting as pilot areas for the goals to transition from gas to alternative energy sources by 2050, and initiatives are implemented that allow for novel techniques and methods of cooperation and governance. Meanwhile, the U.S. state of Hawai‘i is ambitiously attempting to reach its 100% renewable portfolio standards (RPS) goal by 2045 through the implementation of solar and wind projects across its islands.

The main questions to be answered by looking at these two cases are how the current transition approach can enable reaching the sustainable development goals locally along with other policy targets, and which synergies and challenges arise during this process. The results are grouped around four themes: (1) technologies; (2) data management; (3) government/policies; and (4) society. This study examines these themes and proposes potential solutions to each of the challenges where possible, as supported by relevant literature. Special attention is paid to the educational and human resources required for the energy transition, as the initiatives in the case studies are intended to be scaled and sped up in order to fulfil the national transition targets.

By showcasing these two diverse examples of local implementation of the energy transition, this analysis assists in providing insight on the challenges for diverse communities around the world, as well as informing and inspiring communities in transition.

1 Introduction

Despite the global COVID-19 pandemic, global CO_2 emissions are still rising to levels incompatible with the goals of the Paris agreement (NOAA, 2021). Our planet is not merely overpopulated with humans, our consumption patterns and resource use are unsustainable, which is why a global energy transition towards less consumption and more renewable energy sources is necessary. Simultaneously we face continuous marginalization and inequality. The current progress on Sustainable Development Goal (SDG) #7, “Ensure access to affordable, reliable, sustainable and modern energy for all”, shows there were still 759 million people in 2019 without access to electricity (United Nations Department of Economic and Social Affairs, 2020). Therefore, an energy transition in line with the SDGs is needed to maintain and reach a decent

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human life for all humans. (See also (WMO, 2019), “Limiting temperature to 1.5°C above pre-industrial levels would go hand-in-hand with reaching other world goals such as achieving sustainable development and eradicating poverty”).

Our research question focuses on determining what challenges and synergies exist when implementing the SDGs, whilst also attempting to achieve the energy transition on a local scale. To reach the SDGs and transform existing energy systems, we require a fundamental rethinking and integration of urban infrastructure design. This is an urban transformation, a systemic change of the urban system encompassing more than just technologies and buildings. It is a process of fundamental irreversible changes in infrastructures, ecosystems, agency configurations, lifestyles, systems of service provision, urban innovation, institutions and governance (Elmqvist et al., 2019). As there is little experience with implementing such a transition, let alone on this massive scale, there is a lot of uncertainty, which hampers decision-making. The involved costs are high, which further delays committing to technological choices where no flexibility for future change is possible. There is a clear need for gathering, sharing, and analysing technical and financial knowledge, knowledge about methods of consensus forming and governance, and innovative educational programs that anticipate the new professions and people who will make the transition happen.

Across these contexts, overlapping factors exist which can affect each other: temporal/spatial scale, resource access, understanding/taking on responsibilities, ownership, chance/fear of lock-in. Mapping the challenges of implementing the urban energy transition with other SDGs simultaneously helps develop planning perspectives that measure synergies and trade-offs between these goals. This can aid the many cities who face policy deadlines but still await a magic wand to help create integrated and sustainable plans.

As a reading guide, in section 2 we present the framework applied to gather and analyse data, as well as background of the case study areas. Section 3 groups the results into four energy transition related thematical challenges: technological, data management, governmental/policy, and societal challenges. In section 4 we reflect on how these results impact the ability to reach the related SDG targets, and which similarities and differences we find between the case study areas and implementation strategies. Section 5 summarizes the conclusions and prioritized actions.

2 Framework

In this section we lay out the framework motivating our choices for organizing the results related to the SDGs, the four different themes for challenges, and for looking at these two case studies in the Netherlands and Hawai‘i.

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2.1 Links Between the Energy Transition and the SDGs

In this study we link the discovered challenges and synergies to relevant SDGs, as the ultimate goal is not only to create a clean and affordable energy system, but a truly sustainable living environment for all. We find that many policies affect the same environment and these policies are all interconnected, so it is prudent to understand how impacting one goal can affect another and identify possible synergies and challenges.

According to the International Council for Science (2017), the most important links of SDG 7 are with SDGS 1, 2, 3, 6, 8, and 13 (see figure 1). Each of these links are briefly explored below. In our comparison we identify the most important links to other SDGs per case study to discover the reasons behind the similarities and differences.

SDG 1: Affordable energy for all can only be achieved if poverty is eradicated. The minimum amount of energy and related services for a decent life are still under debate.

SDG 2: There is a direct trade-off between land-use for agriculture or for energy. Largescale bioenergy utilization impacts food prices, access, and incomes.

SDG 3: Renewable energy directly impacts air quality, and less energy intensive forms of travel such as walking or cycling positively boost health and well-being.

SDG 6: The body of literature on the water-energy nexus is large, but many studies still focus on optimizing either water or energy goals rather than reaching these simultaneously.

SDG 8: While the need for increased human capital is clear, a current research gap exists on who stands to benefit more and who less when the transition is implemented. How can we ensure workers in the current technologies and resources are not left behind?

SDG 13: The need for the energy transition is directly linked to anthropogenic climate change and what we can do to decrease our impact on heating the Earth.

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Fig. 1. SDGs most related to SDG 7 (International Council for Science, 2017; Image adapted from: Group on Earth Observations, 2021)

2.2 Systematic Exploration of Case Studies Focusing on Four Themes of Challenges

Data gathering for the Netherlands was accomplished by a combined literature search and the project results of FiDETT (FiDETT 2021), where local stakeholders (municipalities, housing associations, construction companies, installation companies, contractors, grid operators, and educational organizers) were questioned about the issues they anticipate for implementing the local energy transition, and which phases and tasks they distinguish in the process. Data gathering for Hawai‘i was accomplished through a literature review of Hawaii's sustainability goals and investigating publicly available government documents and data related to energy.

Combining our results, four separate though related themes emerged: technological, data management, governmental/policy, and societal challenges. Within each of these themes further links to the SDGs are possible, which we analyse after presenting our results. The reasoning behind grouping the information into each of these themes is as follows:

- Technological: Energy cannot be consumed without accompanying generation, transformation, and transportation systems and infrastructure. Existing and future mass applied technologies differ greatly and each face distinct as well as overlapping challenges to consider when deciding upon how to transition.
- Data management: The scale of the energy transition requires data beyond what is currently known. Especially intermittent energy sources of wind, water, and solar powered technologies lead to optimalization needs for energy storage. Existing

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aboveground and underground infrastructure (power cables, fuse boxes, etc.) need to be charted in order to plan changes efficiently.

- Governmental/policy: Traditionally governments have managed or regulated how energy is generated and distributed. Many current renewable technologies allow for more local generation and different forms of ownership than the existing infrastructure is based upon. Regardless of the scale of the transition, there are many new stakeholders involved and policies that could help smoothen or hamper the transition.
- Societal: Energy is required especially in densely populated areas, where there is less space available for energy generation and storage, leading to a spatial trade-off. The human capital required to implement the energy transition cannot be underestimated, in terms of how to educate and re-educate workers, but also how to harness enthusiasm for this sector which already faces employee shortages.

2.3 Case Study Descriptions

We explore in depth the local energy transition in the cases of Hawai‘i, USA, and the Netherlands, with a focus on the region Twente. These cases differ widely in terms of geography, government, culture, and existing energy systems. There are also similarities between these two areas. Both have ambitious goals and clearly defined targets, both in terms of energy transition goals as in deadlines.

Further, both are within developed countries with a high amount of resources and knowledge required for the proposed transitions. The goal of this comparison is to explore how these cases differ in their local challenges, the consequent local choices to reach the energy transition goals, and the resulting consequences for the related SDG targets.

2.3.1 The Netherlands

The Netherlands lies in Europe on the North Sea, with 2/3 of the country below mean sea level. There are nearly 17.5 million people on 42,000 km2 leading to a high population density of 423 people/km2 (CBS, 2021), and an energy consumption of 6,713 kWh/capita (World Population Review, 2021). The primary energy demand is 3100 PJ of which 42% is from natural gas, a large part of which comes from underground resources in the northernmost province and the North Sea. 8% is generated by renewable sources (Energy in the Netherlands, 2020). Since 1960 the energy infrastructure has been expanded based on the available natural gas, and 95% of all houses are connected to gas for cooking. The resources are now close to depleted (The Oxford Institute for Energy Studies, 2019), and extraction has led to a large number of induced earthquakes while the building infrastructure has not been made resilient against this hazard (Van der Voort & Vanclay, 2015).

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From 2015-2019 the climate organization Urgenda has successfully sued the Dutch government to do more to implement the Paris agreement and to implement policy goals to reduce emissions with 25% by the end of 2020 (Urgenda 2021). This helped lead to the Dutch Climate Act of 2019, which has concrete goals to reduce emissions in 2030 and 2050 (Directorate-General for Climate and Energy, Climate Department, 2019; Energie van Noord-Oost Twente, 2020):

Cut CO_2 emissions in half by 2030 (compared to 1990) by 5 goals:

1. Built environment: by 2050 7 million houses and 1 million buildings should be disconnected from gas
2. Mobility (traffic and transport): by 2050 there are no emissions
3. Industry: circular by 2050 and close to no GHG
4. Agriculture and land use: climate neutral by 2050
5. Electricity: by 2030 all electricity comes from renewable sources

In concrete numbers, the expected emission and uncertainty per sector are shown in figure 2.

For the built environment and electricity sectors, the energy transition means that eight million buildings currently connected to the natural gas network need to have a different energy source, preferably renewable. To enable this, the Netherlands has been divided into 30 regions that each make their own energy strategy, and each municipality in these regions has to draft implementation plans and gather stakeholder feedback (including from citizens) in 2021. The smallest scale is the suburb or neighbourhood, which is the scale of implementation plans with a joint choice for energy alternatives for natural gas. 27 neighbourhoods have been selected for piloting projects to implement ‘gas-free’ living, subsidized by 120 million euros (National Government (2018). Other related spatial policies for implementing the Climate Act are the Delta Program for Spatial Adaptation (2017) and the National Adaptation Strategy - Implementation Program (2018).

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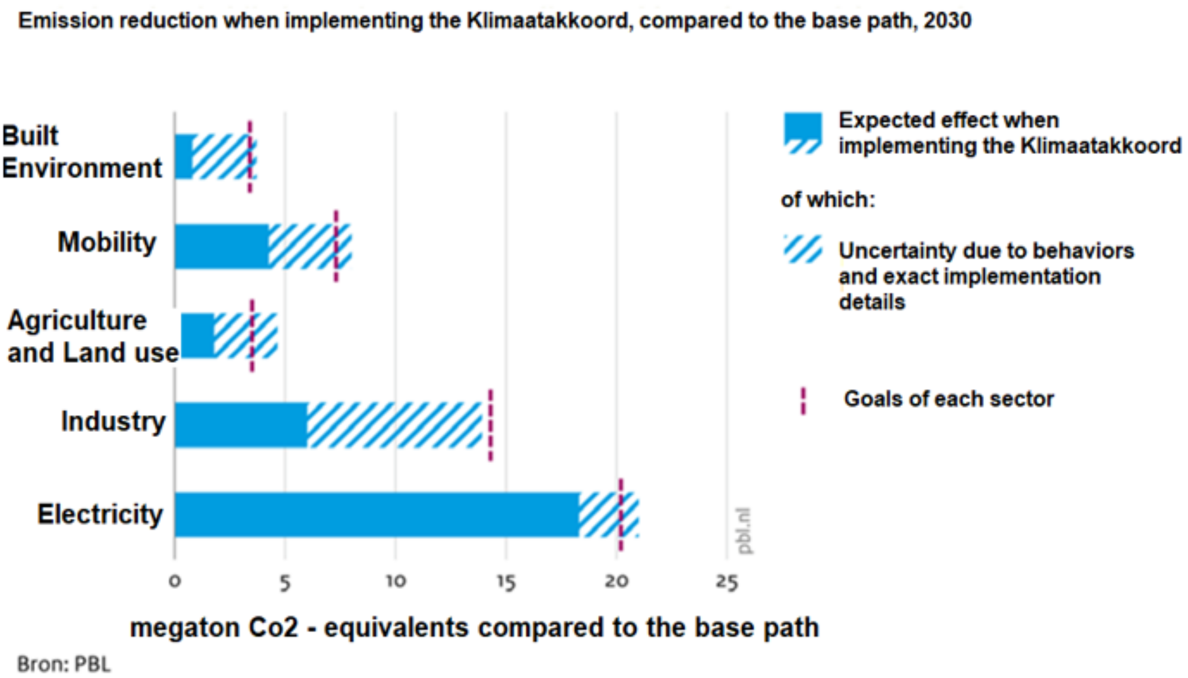

Fig. 2. Emission reduction when implementing the Climate Act (translated from Planbureau voor de Leefomgeving, 2019)

2.3.2 Hawai'i

Hawai'i is an archipelago consisting of eight major islands in the middle of the Pacific Ocean, with approximately 1.4 million inhabitants. By the year 2045, the State of Hawai'i aims to have all electricity and transportation fuelled by renewable energy sources, while also aiming to become carbon neutral by that same year (Act 97 and Act 15). In the year 2017, following President Trump's announcement that the U.S. would be withdrawing from the Paris Climate Agreement, Governor Ige and Hawai'i's four county mayors came together to sign two state bills and a mayor's agreement committing that Hawai'i would meet the goals set forth in the ambitious global climate accord, becoming the first U.S. state to do so. Other energy-related targets include a state-wide ban of coal power for electricity generation by the year 2022, a goal for the state's light-duty vehicle fleet transition to zero emission vehicles by the year 2035, and for the state's public schools to become net-zero in energy use by the year 2035. For a chain of islands isolated by almost 4,000 kilometres to the closest landmass (California), these ambitious clean energy goals are no easy feat. Hawai'i has traditionally relied upon a system of importing coal and petroleum products from different countries to produce electricity. In 2019, 75 percent of Hawai'i's electricity was produced using fossil fuels, while approximately 25 percent was produced using renewable energy sources (State of Hawaii Energy Office, 2020).

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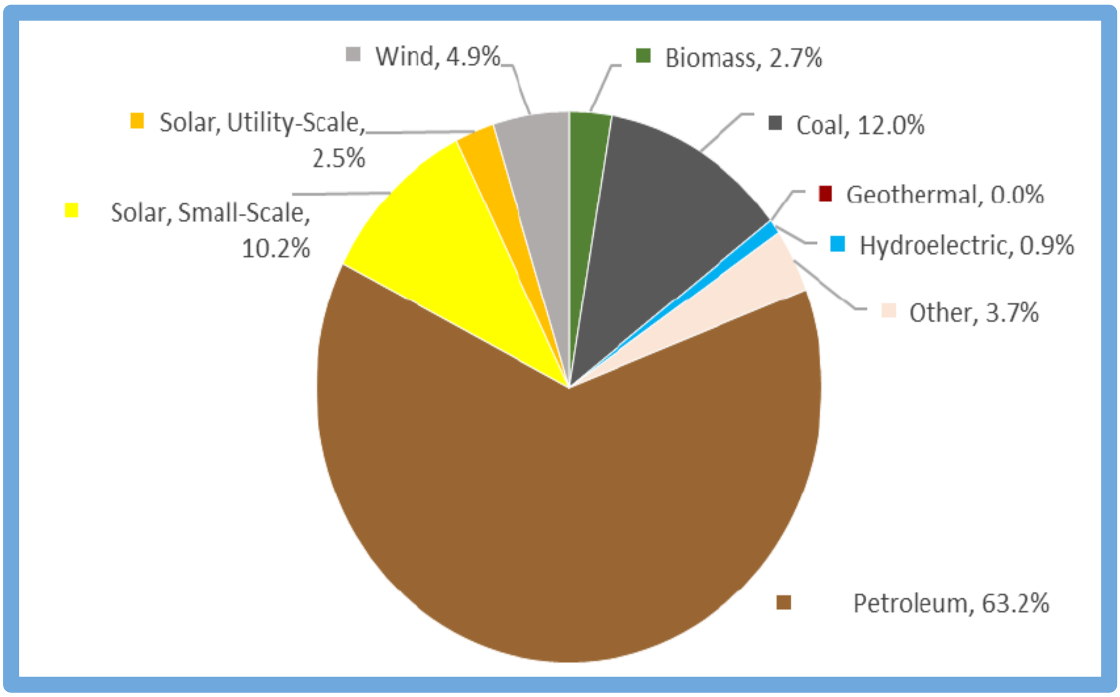

Fig. 3. How Electricity is Produced in Hawai‘i (Source: State of Hawai‘i Energy Office, 2020)

The reason for using fossil fuels for electricity is predominantly due to the economic cost—it is much cheaper to produce electricity with imported coal and petroleum products than it is to produce electricity from entirely new (or yet to be built) renewable energy systems. However, while Hawai‘i is importing these cheaper fossil fuel products, Hawai‘i still boasts the highest electricity costs in the U.S., with the average utility bill at $162.00 compared to $115.00 in the continental U.S (State of Hawaii Energy Office, 2020).

Nevertheless, Hawai‘i is taking great strides to implement a variety of renewable energy projects across its six main islands to meet its ambitious clean energy goals, which is hoped to eventually decrease energy costs in the long-term. Due in part to Hawai‘i’s isolated geography, construction costs are very high, as products, materials, and labour must also be shipped from other places. Hawaiian Electric, the major private electric utility company serving most of the islands, selects renewable energy developers through a competitive bidding process, which the State of Hawai‘i’s Public Utilities Commission (PUC) oversees and ultimately approves. Several renewable projects have been deployed and many more are in different stages in the approval process. The hope for these renewable energy projects is that they will produce clean and eventually, cheap energy to the Hawai‘i population.

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3 Results: Challenges in Local Contexts

The following section covers the main challenges per case study area and grouped around four themes: (1) technologies; (2) data management; (3) government/policies; and (4) society.

3.1 Technological challenges

3.1.1 The Netherlands

Currently major investments are being made in solar and wind power. The Netherlands has no economically viable hydropower system possible, with the highest elevation being around 330m. Geothermal systems are not efficient in all parts of the country, and where they might be, areas are often already densely built or protected nature areas. Solar and wind power are intermittent, and the amount of critical infrastructure dependent on electricity requires a large amount of, and space for, backup storage. While initially these renewable technologies were subsidized, the existing electricity networks are being overloaded and several areas are now facing prohibitions for renewable energy sources being connected to the main network.

The main technological challenges when looking at the energy transition goals lie in implementation. In the Netherlands there are approximately 13,000 neighbourhoods, and if we look at just one of the 30 regions, Twente, there are 450-500 neighbourhoods to transition. Estimating 4-5 years to fully transition, this means around 80 neighbourhoods are in various phases of transition at any one point in Twente. Coordinating companies, available equipment, and required parts are becoming pressing. The pilot areas show that a single residence requires 50 hours to become gas free (Dubbeld, 2021). So far, in the first two years of starting and for all 27 pilot areas combined, only 206 houses are now finished (Van den Berg, 2021), proving that the scale of implementation requires increased management and coordination.

3.1.2 Hawai‘i

One of the major technological challenges that Hawai‘i faces in renewable energy deployment are interconnection issues with linking renewable energy infrastructure with the utility grid. The reason for delays for several renewable energy projects in progress are cited by the utility to be due in part to interconnection issues (Public Utilities Commission, Docket No. 2020-0136).

In 2014, the PUC released a document titled, “Commission’s Inclinations on the Future of Hawai‘i’s Electric Utilities” (2014). In this document, the Commission acknowledges that Hawaiian Electric appears to “lack movement to a sustainable business model to address technological advancements and increasing customer

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expectations.” This statement was based on the Commission’s belief that Hawaiian Electric’s integrated resource plan (IRP) appeared to be a series of unrelated capital projects without a strategic focus and of questionable long-term customer value. Interconnection challenges also relate to connecting infrastructure being built in remote areas, potential inter-island connections (via undersea cables), and microgrids, which are relatively new technologies that are still in development. Hawaiʻi’s utility company will need to adequately address the challenges surrounding its interconnection issues to alleviate the concerns of the PUC, or risk more regulatory scrutiny. Further, as Hawaiʻi is ahead of the curve in renewable energy deployment compared to other U.S. states, it is difficult to comprehensively assess the viability, benefits, and challenges of these new technologies.

3.2 Data Management Challenges

3.2.1 The Netherlands

Data supporting decision-making is a crucial part of the energy transition. A digital twin of our entire planet is already being made to support policy-makers to make steps to become climate neutral in 2050 (Ulmer, 2021). Creating a more localized digital twin of each neighbourhood has several challenges.

Aside from data gaps, existing data is not always ideal. The required data metrics of recentness, update frequency, history of data set, accessibility, reliability of methods, scale/resolution, geographical coverage are difficult to find in even a single dataset (Vink et al., 2017; Voskamp et al., 2018). For energy management, the data interval frequency could be minutes, yet there is no adequate system available to collect, manage, and store such data on multiple urban scales.

Coordinating data or data gathering also brings challenges. For ideal management, data need to be generated and exchanged between departments, devices, and regions (Li et al., 2018). This requires governance practices to settle ownership, management, and updating data. A proper impact assessment of climate change requires big datasets, which makes the calculations expensive (Mauree et al., 2019). Who pays for each step from data gathering to analysis and storage needs to be settled as well. The energy costs of data management are often not taken into account and are contradictory to the goals of reducing energy consumption.

Finally, there are privacy and safety issues concerning private citizens and organizations providing vital services. Digital twins would make data available to all users. Installation companies may need data of the inside of buildings to know how to connect cables and pipes, but other stakeholders do not. Therefore, “a new style of energy transition data management is required” (Willemsen, 2021), in which sharing enables implementation without breaching trust.

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3.2.2 Hawaiʻi

When it comes to data management, Hawaiʻi's challenges include the lack of meaningful data transparency and the need for useful indicators and metrics for decision making. Transparency of information is crucial for sound decision-making (Bertot, et al 2010). The PUC, the regulatory agency tasked with overseeing Hawaiʻi's electric utilities, must review hundreds, if not thousands, of pages of information submitted by the utility in any given proceeding. However, the data submitted has at times deemed incomplete, or unnecessarily redacted, which has made the PUC's role in decision making more time consuming (Public Utilities Commission, 2021). Transparency in information sharing is crucial to a smoother decision-making process, as well as in building trust between the utility and government agencies.

Useful indicators and metrics are also in great need in order to justify the project costs to ratepayers. For example, an energy storage project that was recently reviewed for approval is said to provide the following grid service benefits: "...fast frequency response, load shifting capacity, primary frequency response, frequency regulation, real-time near instantaneous dispatchability, automatic voltage regulation, reactive power support, grid forming system stabilizing functionality, and blackstart capability," but when the PUC inquired if the electric had considered methods to quantify or otherwise valuate the aforementioned grid service benefits, the utility did not provide a clear answer. The lack of a clear way to quantify the value of certain projects makes decision-making also difficult, as these infrastructure projects will be in use for at least twenty years, and the costs will ultimately be shouldered by the ratepayers.

3.3 Governmental/policy Challenges

3.3.1 The Netherlands

Two large and related challenges are uncertainty and costs. No one wants to invest in something only to find out it is not as effective, requires more costs, or alternatives would have been better (lock-in effect). But no one knows yet what the best possible solution(s) might be. This leads to municipalities each waiting for others to take the initiative. Further putting pressure on the time factor is the lengthy change process in policies and building codes.

Despite the millions of euros available for the 27 pilot areas and while municipalities are positive about results so far, it is clear there are insufficient funds and authority to reach the goals. There is not an affordable solution for everyone (Dubbeld, 2021), which goes directly against the SDG principles of no one left behind. The fragmentation of ownership means that citizen organizations don't speak for all the inhabitants. Private homeowners aren't required by law to make changes and investments to their house, though a more sustainable energy rating of a house makes it more valuable

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when selling it. Nationally, the annual costs to implement the Climate Act for municipalities are estimated to be around €500 million in 2022, increasing to €770-950 million in 2030. Provinces and water boards are also expected to have increased costs (Andersson Elffers Felix, 2020). There is of yet no plan on how to finance these extra costs.

Merging policy implementation between impacted domains is still a slow process. Traditionally adaptation and mitigation have been treated as two different policy fields. This means that synergies between planned and ongoing measures are not exploited due to limited information sharing and poor coordination, and strategies that could potentially deliver co-benefits are not even examined (Frantzeskaki & Tilie, 2014).

3.3.2 Hawaiʻi

There are two major challenges related to governance in Hawaiʻi's renewable energy policy. One challenge is the strained relationship that can occur between agencies, such as that of the electric utility and government agencies. Legislators and other political leaders may also fully support or vehemently oppose renewable energy projects, making deployment a challenge. Another major challenge is that of the permitting process. Usually, a developer must obtain a series of environmental, land use, and building permits, which sometimes can take years to be approved. The high cost of doing business in Hawaiʻi is also a concern for attracting developers to pursue renewable energy projects. The procurement process involves the developer to conduct some of the project work even before the application is approved by the PUC. This means that the developer might have already begun the process of securing permits, conducting community outreach, and designing the project, while the application may be ultimately denied. More inter-agency coordination is needed to address these challenges and improve efficiency in this process. As a recent example, the governor of Hawaiʻi has put together a "Powering Past Coal" task force to bring together the different agencies (i.e., the utility, government agencies, developers, and environmental agencies) to collaborate on planning as the closure of the island's coal plant is set for September 2022. The goal of the task force is to, "convene stakeholders to increase transparency, coordination, collaboration, and urgency to timely facilitate, coordinate, and align project development and reviews by Hawaiian Electric, state, and county agencies for those measures anticipated to provide electricity for Oʻahu to replace the coal plant's electricity…" (2021). In doing so, more efficient processes, such as speedier permitting and regulatory processes, are anticipated.

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3.4 Societal challenges

3.4.1 The Netherlands

What is often forgotten in communicating the energy transition plans is that it is not just a transition from one type of technology to more renewable energy technologies. The transition is not just technical; a focus on emission reduction is required with the same tenacity. The issue here is that what is considered a decent standard of living that should be protected or that sustainably (including economically) could be guaranteed or strived for may lie below the current high standard in many developed countries, including the Netherlands. People may not accept a less comfortable life with alternative modes of transportation, smaller living spaces, or exposure to heat and possible floods (ScienceDaily, 2019). The division of responsibilities to act and pay may not be accepted. People may adhere to the thought that since governmental regulations allowed for negative environmental consequences to come into being, the government should solve it.

People may also simply not have resources to implement measures on their private properties, or have different priorities. Residents often prefer to have other problems solved first before a new project like the energy transition is started (Programma Aardgasvrije Wijken, 2021).

Another large issue which ultimately becomes a societal challenge is the required human capital. It is estimates around 35,000-70,000 new fulltime-equivalent jobs are needed to implement the current plans (EIB, 2020; NVDE – Ecorys, 2021; PBL, 2018; PBL, 2020; ROA & PBL, 2019; Van Dril, 2019). In the Twente region this is around 2,500 FTE. These professions and related competences need to be newly developed, including their training capacity. If the sector does manage to attract the required human capital, other sectors like education, health, and agriculture lose people.

3.4.2 Hawai‘i

While climate change and renewable energy initiatives appear to be supported by the general public, there are numerous societal considerations as the state moves towards its ambitious renewable energy goals. First and foremost, the literature shows that climate change impacts will pose the greatest threats to communities that typically have the fewest resources to respond or are socially and politically marginalized (World Resources Institute, 2014). As previously mentioned, energy costs are not insignificant for Hawai‘i residents. While Hawai‘i has a relatively high household median income when compared to the U.S. ($85,000 versus $68,000), Hawai‘i is considered to be one of the highest costs of living in the U.S. (US Bureau of Economic Analysis, 2019). Meanwhile, the official U.S. poverty rate reflects a relatively low poverty rate (13%),

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but other reports demonstrate a starker picture—that up to 42 percent of Hawai‘i's population is actually struggling to make ends meet (ALICE Report, 2020).

Further, approximately 17,000 households on the island of Oahu alone have an energy burden that is higher than 6 percent, while the national average is approximately 3.6 percent (City and County of Honolulu, 2021). A high energy burden means that households, particularly low-income households, are paying significantly more for their energy needs. Therefore, finding ways to reduce this energy burden and improve community benefits through deploying renewable energy would be most advantageous, particularly focusing on households that are already struggling to make ends meet.

Another major societal issue in Hawai‘i is that indigenous Pacific Island communities are disproportionately impacted by climate change due to historical governance structures (Honolulu Climate Change Commission, 2020). Hawai‘i's colonial history created institutions and structures that have marginalized and disenfranchised Native Hawaiian communities, evident in sociodemographic data and indicators. Meanwhile, a strong sovereignty movement among Hawaiian communities exist and are manifesting themselves through opposition of state-led initiatives such as the Mauna Kea telescope project (TMT) and renewable energy projects such as the wind farms in the rural town of Kahuku. There are cultural impacts to development projects that need to be addressed.

More models of collaboration and partnership with local communities are needed for projects to be accepted by communities. Without community support, developers will have increasing difficulty in securing projects in Hawai‘i, which could disincentivize other developers from attempting to do business in Hawai‘i.

4 Analysis: Combining SDGs and Comparing Locations

Ideally the world is transformed in such a way that all SDGs are achieved. However, addressing all aspects is a challenge in itself which requires integrating policies, technologies, stakeholder perspectives, as well as resources. In this section we first look at how addressing these challenges can lead to reaching several SDG targets. Secondly, we look at the similarities and differences between the two case study areas to discover potential synergies in each other's approaches.

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4.1 SDGs Related to Reaching SDG#7

4.1.1 The Netherlands

For the Netherlands (figure 4), no poverty (SDG#1), zero hunger (SDG#2), and clean water and sanitation (SDG#6) are of less importance in relation to affordable and clean energy, as these are for the most part addressed in full by other policies and services.

Fig. 4. SDGs related to achieving SDG#7 for the Netherlands

We do see a link to good health and well-being (SDG#3) and climate action (SDG#13) through the climate act goals and policy links to the delta plan for spatial adaptation. We also see a strong link to decent work and economic growth (SDG#8) as the existing gas infrastructure is scheduled to be abandoned and replaced with mainly renewable technologies.

What the challenges further show is that the human capital factor to implement the transition goals is critical, making quality education (SDG#4) a priority. Industry, innovation, and infrastructure (SDG#9) are important for managing intermittent renewable energy sources in the existing national electricity network. Sustainable cities and communities (SDG#11) are important for increased management and coordination, and finally responsible consumption and production (SDG#12) come into play as we need to consider not just transitioning to other technologies, but also promoting reduced energy consumption.

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4.1.2 Hawai‘i

The Aloha+ Challenge is a state-wide public-private initiative to achieve Hawai‘i's social, economic, and environmental goals by 2030. Launched in 2014, the Aloha+ Challenge identified six priority goals and local metrics that reflect the global United Nations Sustainable Development Goals (SDGs). Hawai‘i Green Growth is the organization tasked to oversee the Aloha+ Challenge and work with public and private organizations to facilitate the realization of these goals. Within this framework, a publicly available dashboard features Hawai‘i’s initiatives towards each of the 17 UNSDG goals. The dashboard reflects that efforts are in place to track progress in each of these goals, though the goals are in different stages of development. The challenge for Hawai‘i, as in many places, is to address each goal in a holistic and culturally respectful manner. For example, the goals are generally divided into categories, differentiating environmental concerns from societal ones, which for indigenous cultures such as ones found in Hawai‘i, is not a paradigm that completely resonates with communities. Hawaiian epistemology reflects the belief that humans and the environment are inextricably connected and thus, indicators or goals should reflect this relationship (Pascua, et al., 2017).

Fig. 5. SDGs related to achieving SDG#7 for Hawai‘i

Using the UNSDG framework as a guide, the corresponding goals to support SDG#7 for Hawai‘i include SDGs #1 (No Poverty), #10 (Reduced Inequalities), #11 (Sustainable Cities), #12 (Responsible Consumption), #13 (Climate Action), and #15 (Life on Land) (figure 5). However, there are challenges in attempting to assess

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Hawai‘i’s progress towards the UNSDG goals. First, HGG (the organization tasked with tracking Hawai‘i’s progress) does not have enforcement authority to ensure that these goals are met. In fact, there is no agency that is tasked to enforce these goals. Therefore, HGG relies heavily on public-private partnerships and collaborative efforts to meet these needs. Another related challenge is that according to the metrics shown on the dashboard, the goals are in different stages of development, and it is unclear who is responsible for each goal, and which policies are involved in reaching each target. Lastly, when using a holistic, place-based approach, it is difficult to separate each UNSDG goal from the other. An island ecosystem in particular shows the interdependence of each goal. For example, life on land affects life on water through runoff and pollution. The goal of reducing inequalities is related to the goal of eradicating poverty.

4.2 Comparison of Cases and Implementation Strategies

The challenges show various similarities and differences. For technical challenges, despite the huge difference in geographic settings, there are mostly similar challenges with regard to connecting new and intermittent renewable technologies into an existing electricity infrastructure. The same is found for data management, where both cases show challenges for data gathering, data quality, and transparency or privacy. For governmental and policy challenges there is a notable difference. Both cases mention the time factor of policies and permits as a challenge. Both also mention costs, but for the Netherlands this is a challenge for local governments and in Hawai‘i this is mostly part of the permit process. Societal challenges prove to be the most diverse between these two cases. Both cases face challenges in implementing the energy transition goals while not leaving anyone behind, especially people with less financial resources. For the Netherlands a large societal issue is the lacking human capital, whereas Hawai‘i needs to change the continuous marginalization of the indigenous Pacific Island communities and their rights.

Comparing our two cases in relation to the SDGs, only one of the globally related SDGs is relevant for both our cases, namely #13 climate action. Two new SDGs are relevant for both our cases, namely SDG#11 sustainable cities and communities and SDG#12 responsible consumption and production. This shows the diversity of related goals on a local scale and the need for localized solutions.

Many technical solutions and suggestions for policy reform already exist (Falk & Gaffney, 2019; Hsu, 2020). For the Netherlands, we need to adapt these plans to local small-scale circumstances, and we need to gain stakeholders’ trust and active support, as well as their interest to become experts in energy transition themselves and thereby increase the human capital required for the transition. The available resources in terms

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of knowledge and materials cannot compensate for the people required to implement the plans.

While working towards the UNSDG goals is admirable for any jurisdiction, for Hawai‘i’s context, there is an urgency to do so in a holistic and culturally-sensitive way. A theme that continues to surface in the literature and in work directly relating to communities is a need for a more indigenous, place-based framework that is better aligned with Native Hawaiian epistemology. For non-native researchers and developers interested in indigenizing energy-sector processes, it is strongly recommended to hire a cultural consultant and work closely and collaboratively with these communities. Otherwise, the UNSDG goals, while admirable and important, will not be seen as relevant to Hawai‘i’s communities, and may not be strongly supported.

5 Conclusions

In this study we found both similarities and differences in the different themes of challenged for the local energy transition examples in the Netherlands and in Hawai‘i.

Despite the large geographical differences, the main technical challenges are comparable due to the intermittent nature of the most popular renewable energy systems (solar and wind). Data management challenges we also found to be comparable, with issues of data gathering, data quality, transparency, and privacy. We found notable differences in the latter two themes of challenges. For governmental and policy challenges a comparable challenge is time, whereas funding is handled in a different manner organizationally. For societal challenges, we found widely differing themes. These results, combined with related national policies, also led to different relevant SDGs on the local scale. For the overall goals of the SDGs, leave no one behind, we find that still large strides need to be made when combining the targets of clean and affordable energy systems with no poverty for Hawai‘i; and quality education, and decent work for the Netherlands, when implementing these goals for all people.

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The Role of Influencers for Young People and its Consequences for the Development of Teaching Competence in Nutrition and Consumer Education

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Abstract. In our digital multi-option society, material, social and emotional needs are satisfied to a significant extent through offers from the profit-oriented and highly digitized market system. Social media emerges as a relatively new meta-level between market and consumer regarding the complex factors influencing individual consumption routines. Social media influencers are a central factor in these dynamics as they serve as points of orientation for young people, who are regularly exposed to influencer content on social media platforms and the values and ideologies they reflect and reproduce. Young people's consumption choices regarding nutrition, too, are significantly influenced by their socialization on social media. For nutrition and consumer education, this means that educators need a deeper understanding of the impact of influencers' media content on the nutritional and consumer behavior of children and adolescents in order to grasp their key role as reference points and symbolic power. The EKo-K.I.S.S. project, supported by the 'Zukunftsfonds Steiermark', addresses this issue by developing media-didactic concepts for nutrition and consumer education at schools and universities based on social science studies. This paper contributes to this project by addressing the role of influencers and its implications for the development of teaching competence in nutrition and consumer education. Based on results of a quantitative survey amongst Styrian pupils and educators, it shows the importance of this topic in education and points out ways of integrating it in educational practice.

1 Introduction

The use of digital media and devices has strongly risen in recent years (see Bertsche/Como-Zipfel 2016) as digital media have become omnipresent in practically all areas of our lives. Therefore, the sociologist Simon Lindgren (2017: 5f.) assumes that we should speak of a digital society. According to Oliver Bertsche and Frank Como-Zipfel (2016: 238f.), the current changes brought about as a result of digitalization are based on two factors: technical progress on the one hand and frequency of use on the other. Above all, the development of new hardware and intelligent software for smartphones has significantly contributed to this

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(Beranek/Hammerschmidt/Hill/Sagebiel 2018: 11). Friedrich Krotz (2018: 30) emphasizes that these changes are based on people’s needs and wants, which are due to processes of individualization in the context of economization and globalization.

We experience rapidly changing media (technologies) and, thus, communicative practices: new media (e.g., smartphones, tablets, etc.) and media services (such as messenger services like WhatsApp, social media platforms) are constantly emerging, old media are replaced by newer ones (e.g., music streaming instead of CDs), traded forms of communication such as letter mail are becoming increasingly insignificant or event obsolete, and new technologies seeking to facilitate our daily lives are gaining importance (an example are voice assistance systems such as Siri, Alexa, etc.). Media are no longer used for information only, but also for other purposes (e.g., to collect data). People change in their communicative and media-related actions and shape their social relationships in an altered way (Krotz 2018: 27). “In this respect, people experience this change not only as an increasing presence and growing importance of the media, of which there are also more and more, but also as their increasing penetration into all social spheres and human fields of action, which are simultaneously reshaped in a media-related way” (Krotz 2018: 28, translated).

1.1 Mediatization

In German-speaking countries, the term ‘Mediatisierung’ (see Kutscher/Ley/Seelmeyr 2015; Krotz 2008) describes this phenomenon of digitalized transformation (see Klinger/Mayr 2021). In communication sciences and media education, ‘digitalization’ is understood as the latest form of ‘mediatization’ (Beranek et al. 2018: 10), following the introduction of printing press, radio, and television (Tillmann 2017: 7).

Mediatization implies a change in social communication through the development and incorporation of technologies and new (digitally coded) media. This is accompanied by the transformation of realities that are constructed through communication (Krotz 2008: 53). Mediatization considers two sides of communication – technical and social changes. It refers to the transformation of human beings and their everyday lives, as well as their social relations. Therefore, digital media influence how we learn and work, how we organize our family life, how we establish and maintain different kinds of relationships etc. (Krotz 2008: 53; see Klinger/Mayr 2021). For Krotz, consequences of mediatization processes are not only shaped by technology but are part of people’s appropriation of media and technology and their integration into their everyday lives (Krotz 2007: 12). Mediatization has always determined people’s communicative practice since societies have always been shaped by the media available at a given time. Book printing, for example, radically changed the dissemination of knowledge. Its mass availability had an impact on literacy, the emergence of institutional education and, thus, on the socialization of further generations. The digital forms of media lead to an upheaval in a similarly strong dimension, the consequences of which are not foreseeable (Krotz 2018: 14). This process is neither linear nor unidirectional, but "unfolds via a complex web of individual, social, economic, political, technological, and cultural developments and interactions" (Krotz 2018: 15, translated). This is not caused by the transformation of media itself, but by changing living conditions leading to changing needs and requirements, which are reflected in new media (Krotz 2018: 15).

A distinctive feature of the current transformation of media systems is the transition into a single, interconnected, digital, computer-based infrastructure organized by large corporations, which has become the center of all symbolic operations in society. In it, people's modes of action, such as shaping relationships and seeking information, are taken up by corporations to organize and make them economically useful (Krotz 2018: 35). Overall, this leads to more fields of action and social worlds. In these worlds, relevant forms of social practices and meaning making have become inextricably intertwined with media (Roth-Ebner/Krotz/Rath/Kalina 2018: 16) and have simultaneously been economized.

1.2 Social Media Influencers

Orientation-giving social media influencers are a central factor in all these dynamics, especially for young people, as they already command more influence than classic media formats (see IMAS International 2017; Kilian 2016).

> "Influencers are people who, due to their digital network, their personality strength, a certain topic expertise and communicative activity, have an attributed credibility for certain topics and can make these accessible to a broad group of people via digital channels. [...] Influencers [usually] use multiple channels to communicate their topics" (Schach 2018: 31, translated).

Influencers are therefore an important and attractive component of corporate marketing and communication strategies such as branding, image, sales and product launches (Zerres 2020: 14). Thereby, the influencer-framework is built upon three cornerstones (Solis/Webber 2012: 10): *qualitative and quantitative outreach* (follower count, credibility, and image), *relevance* (follower trust, degree of authority), and *resonance* (influencer engagement, intensity and frequency of interaction with followers). Despite their lower outreach the group of so-called micro- and nano-influencers has particular relevance for marketing companies, due to their high authenticity levels as well as increased interaction and sharing of interests with their followers (Kirchmeier 2018: 311).

The significant economic factor can be seen via net revenue statistics of influencers, and COVID-19-related circumstances seem to have accelerated this trend via the rise of e- and social-commerce businesses through the growth of online shopping. According to the “Influencer Brands Monitor” by Buzzbird, Splendid Research and Pilot (see Buzzbird 2021), investments in influencer marketing continue to rise: In 2020, 18 % more budget was spent on influencer marketing. Globally, the growth of influencer marketing increases from 9.7 billion in 2020 to 13.8 billion in 2021.

As young people spend a considerable part of their daily lives on social media (see Waldner/Mittischek 2020), they are regularly and specifically confronted with the lifestyles of influencers (Hirschfelder 2018: 287) and their advertisements through suggestions placed on social media platforms. According to the Upper Austrian Youth Media Study (Education Group GmbH 2019), the data of which can be used as a benchmark for Austria, “just under two-thirds of young people [...] follow at least one influencer” (ibid: 7, translated) with most of them following several. This finding is supported by data from the EKo-K.I.S.S. study (see chapter 2), where almost 70 % of pupils in fifth grade and above follow influencers on social media sites (Waldner/Mittischek 2020: 171). For 10 % of young people, opinions of YouTube- and Instagram-stars play an important role in their knowledge of the latest trends, according to their own statements (Education Group GmbH 2019: 86f.). In the EKo-K.I.S.S. study, a significant part of the pupils questioned attributed a relevant impact to influencers on their own health and personal environmental behavior (Waldner/Mittischek 2020: 176f.).

Along with the massive number of fans, the career aspiration of ‘influencer’ has become omnipresent among young people and is understood as a “normal profession in today’s digital world” (Bitkom Research 2018: para. 5). This is evidenced by numerous training courses and tutorials for this occupational field, offered by training institutions and through (semi-)academic courses. In addition, institutions such as professional associations for influencer marketing and various influencer agencies bear witness to the increasing professionalization of this field of activity (Altendorfer 2019: 76).

1.3. Media Socialization of Young People

It becomes apparent that especially today, young people experience a very specific kind of media socialization, which is completely new when compared to earlier generations of ‘digital immigrants’. In this process, they outsource certain parts of their everyday lives and social relationships to the internet and thus ‘live partly online’, “which on the one hand exposes them to increasing influence, but on the other also enables diverse new forms of expression, encounters and experiences – with all of this applying, albeit more slowly and sometimes not as extensively, just as much to adults and their lifelong socialization processes” (Krotz 2017a: 31, translated). Adults, due to lacking their own experiences, cannot comprehend these processes in the same way,

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as they have undergone completely different media socialization than children and adolescents growing up in today's media society (De Witt/Czerwionka 2013: 10).

1.3.1. Educational accompaniment in the process of media socialization

The EU-Kids Online survey in Germany (Hasebrink/Lambert/Thiel 2019) showed that about half of the parents in question worried about their child seeing inappropriate content or being contacted by strangers on the Internet (ibid.: 36). Even if 44 % of the parents regularly talked to their children about their online activities, only 17 % conducted joint online activities (ibid.: 8). Furthermore, only every seventh parent was connected with their child's social media profile, and active accompaniment was shown to decrease with increasing age (ibid.: 39). These statistics are surprisingly low when compared to the number of people who were concerned. It is also interesting to note that parents seemed to have massively underestimated the amount of negative online experiences their children had been subjected to from receiving sexual content and messages (according to their own account) (ibid.: 38).

It becomes clear that digital socialization often takes place with little connection to or even no support by the parental home. Young people are exposed to a high degree of personal responsibility, in many cases due to their guardians' lack of digital skills. Nevertheless, it is currently in question which amount of this unaccompanied personal responsibility is explicitly desired by young people and how much of parents' rather low level of accompaniment is built upon young people's emancipation and differentiation from their parents. As Krotz (2017a: 36, translated) says, young people "have also learned to appreciate the possibilities of digital media as a means of demarcation against adults and outdated structures. They use their practical abilities to handle them intuitively, in part also to immunize themselves against learning processes and the social demands expressed in them, because the 'digital world' seems more relevant to them and is also more easily accessible."

Currently, schools also provide inadequate support for young people. In the EU-Kids Online study, around one quarter of young people surveyed stated that they were told at school why certain things on the Internet are good or bad, and almost a fifth stated that they were shown at school how to use the Internet safely (Hasebrink et al. 2019: 42). This lack of guidance, reflection, and knowledge transfer in social media by parents and teachers alike leads to neoliberal, capitalist forces having free play in the digital space, with children and young people being given little to no guidance in their digital socialization and being ill-prepared overall for the dangers of digital reality.

Exploratively recorded pedagogical viewpoints of educators in nutrition and consumer education (see Waldner 2018) pointed out educators' need for more knowledge and didactic, strategic assistance for future media education teaching strategies regarding influencers and the significance of the transported content (ibid.:

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113f). This observation marked the starting point of the project EKo-K.I.S.S. that aims to make visible how this digital reality and the accompanying impact of influencers affect young people in terms of nutrition, health, consumption, and gender equality, and why these topics must be reflected upon in contemporary education.

2 Project Overview

The EKo-K.I.S.S. project is a cooperation of the University College of Teacher Education Styria (Institute for Secondary Teacher Education), the University of Graz (Institute for Educational Studies) and the Styrian Nutrition Center (STERZ). This cooperation project addresses questions on the topic of 'influencers in nutrition and consumer education' since the beginning of 2020 and connects the topics of social media, influencers, the reality of students' lives, as well as teaching practices towards consumerism, nutrition, and health. The overarching aim is to derive gender-sensitive pedagogical concepts and recommendations of action for nutrition and consumer education from the results of quantitative surveys combined with an approach of qualitative research to strengthen teachers' competencies regarding social media aspects (cf. Waldner/Mittischek 2020).

2.1 Key Questions at Various Levels

On the basis of initial sighting of influencer content and influence assessment in literature and social media, key questions were framed at the following levels:

Subject level 'Pupils' (schoolchildren from fifth grade onwards): This level is aimed at gathering information about nutrition- and consumption-related attitudes as well as related information about the receptive behavior of adolescents towards social media influencers, including gender roles and stereotypes. Therein, we pursue questions as to whether and how such an online reality is judged by children or implemented/acted out offline. The key question here is whether and what pupils need to know about these topics at school.

Subject level 'Educators' (schoolteachers, university lecturers and students of teacher education): At this level, questions are explored on how prospective or active educators evaluate the topic of influencers and related content, and whether or how teachers already transport, reflect upon and analyze influencer content in the context of teaching. What do educators demand as support (e.g., in terms of media literacy, methodical-didactical recommendations) to implement the topics in school together with their students?

Meta-level 'Experts' (media education in youth work): We want to shed light on how the topics are seen by experts from the field of open and institutional youth work.

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Therefore, we raise the question of which measures are considered suitable for pedagogically dealing with the phenomenon in context of experience with the lifeworld of the youth. However, due to space limitations, we cannot address this issue in this article and focus is given to the first and second level.

2.2 Derivation from the Results and Project Aims

The aim of the project is to derive impulses and approaches for future gender-sensitive pedagogical means that correspond to the diverse realities of young people's lives and that make the topic of 'social media/influencers' in the context of sustainable nutrition, health and consumption a subject of discussion at different levels. Derived recommendations are intended to serve as elements for strengthening teaching competence in the thematic fields examined. By this, teaching staff should be enabled to apply innovative and critique-promoting methods, which are suitable for pedagogically dealing with the phenomenon at school, particularly in relation to subject didactics in nutrition, health, and consumer education.

In this article, parts of the results are presented, and specific attention is given to the role of influencers and the resulting consequences for the development of teaching competence in nutrition and consumer education.

2.3 Methodical Approach

For the EKo-K.I.S.S. project, a multidimensional, cyclically organized research approach was chosen, which is characterized by interdisciplinarity and triangulation of data, methods, and theories. Through the strategy of a hermeneutic approach as an integrative element, the quantitative analysis is expanded by qualitative perspectives, in which social facts and processes are made comprehensible through individual references. All parts of the research design are processed and evaluated in a gender- and diversity-sensitive manner. The open and adaptable multistage research design includes the following steps (Fig. 1):

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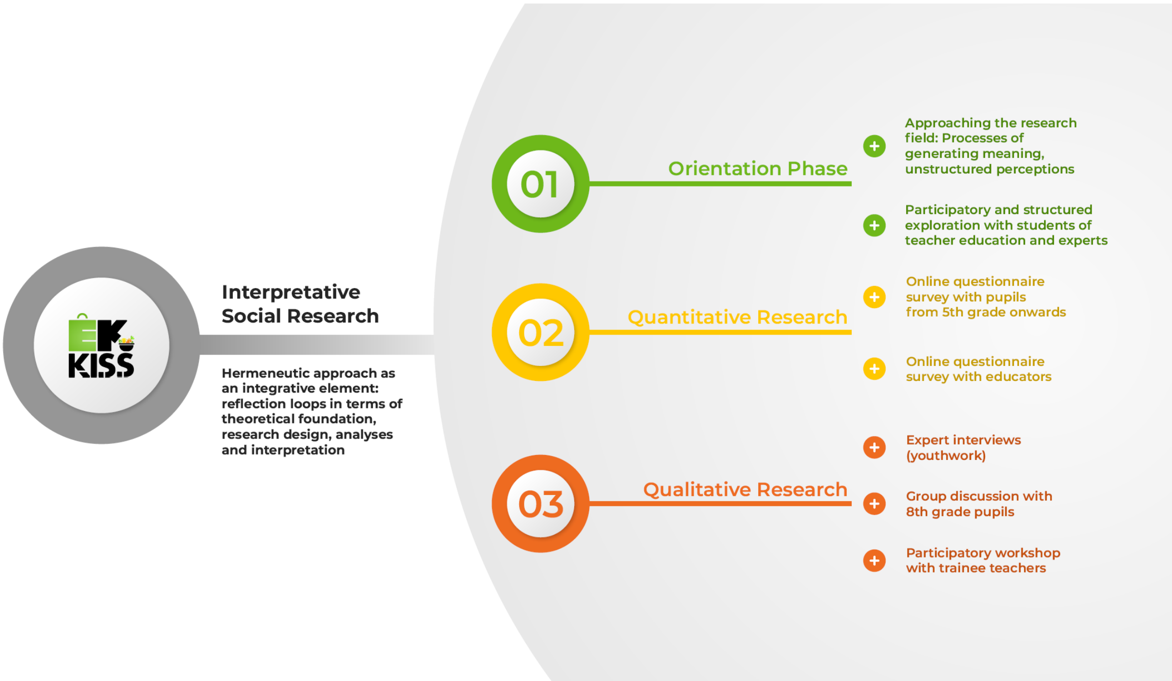

Fig. 1. Research design (own illustration)

The research incorporates perspectives of schoolteachers, university lecturers and students of teacher education ('educators'), as well as children and adolescents at school ('pupils'). Quantitative data was collected via online questionnaires (created with the online survey tool 'LimeSurvey'[1]) and analyzed with IBM SPSS Statistics[2]. The qualitative research approach complemented our quantitative research with a social-constructivist perspective (cf. Scholl 2016: 18). To evaluate the qualitative research areas, we worked with grounded theory (cf. Breuer 2009).

In this article we specifically focus on the results from the following research steps (Tab. 1):

Table 1: Research steps for article data.

Research step	Method	Time of survey	Sample
Quantitative research	Online questionnaire survey with Styrian pupils from fifth grade onwards	June/July 2020	n = 827 (CI*: 99 % +/-4)
	Online questionnaire survey with Styrian educators (schoolteachers, university lecturers and students of teacher education)		n = 385 (CI*: 95 % +/-5)
Qualitative research	Group discussion with eighth grade Styrian pupils; duration 1.5 h	March 2021	n = 6

(*CI: confidence interval)

[1] LimeSurvey Community Edition, Vs. 3.27.0+210525
[2] IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp

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The two online questionnaire surveys were accomplished with support of the Styrian Department of Education and the University College of Teacher Education Styria. The quantitative results have a high data quality due to the representative participation rate in proportion to the total population size. The educators' questionnaire was completed by n = 385 people, resulting in a confidence level of 95 % with a margin of error of +/-5 % for a population size of N = 14,146 individuals[3]. The school principals and class heads attempted to reach a population of N = 75,170 Styrian pupils from fifth grade onwards[4] of the secondary level schools administered by the Styrian Department of Education. This online questionnaire was completed by n = 827 pupils, resulting in a confidence level of 99 % with +/-4 % margin of error.

Results from a group discussion with eighth-grade schoolchildren (n = 6) were used to complement and substantiate data from the quantitative pupils' questionnaire.

3 Addressing the Influencer Issue at School – Consequences for the Development of Teaching Competence

Project findings so far show that young people need reinforcement for their self-reflective decision-making processes in this thematic context. A bridge for young people between subject expertise, as well as media-, consumer- and economic literacy regarding influencer content and impact can be built by educators. Accordingly, the question is how to bridge existing gaps between young people's perceptions, opinions, and actions via pedagogical interventions in nutrition and consumer education (see Waldner/Mittischek 2020).

For this purpose, it is necessary to first map out pupils' demands, because it is essential to consider and include the reality of young people's lives in pedagogical activities to fulfil the educational requirement in terms of lifeworld and future-oriented content. Based on this, we secondly look at whether and how educators assess the situation or already transport, reflect on or analyze influencer content in class. The aim is to discuss further approaches, which will serve as elements for strengthening teaching competence in relation to nutrition, health, and consumer education.

[3] The educator's online questionnaire was sent to all secondary level schools administered by the Styrian Department of Education, with request to distribute it among the teachers. Additionally, it was distributed amongst the university lecturers and university students of teacher education at the University College of Teacher Education Styria.

[4] The sample includes pupils from the age of 10 years old up until the end of school (≥18 years).

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3.1 Results: Perspective of Pupils

In the following, results relating to social media and influencers in the context of 'school and teaching' from the comprehensive, quantitative study amongst Styrian pupils are presented. To provide evidence from the group discussion with eighth-grade pupils, these are supplemented in some parts with quotes from the group discussion.[5]

3.1.1 Social media competences of pupils

Today's young people spend much of their time online, experiencing digital content, opportunities, and limitations as a natural part of their reality. The young people surveyed in the EKo-K.I.S.S. pupils' questionnaire have been shown to spend an average of 3.25 hours (std 1.33) online every day, around 2.5 hours (std 1.38) of which are spent on social media. Online time has been shown to increase with age (Waldner/Mittischek 2020: 169, tab.1).

Our data show that on average, female respondents spend significantly more time per day on social media (2.6 h/d; std 1.34) compared to male respondents (2.0 h/d; std 1.38) (Fig. 1a). At the same time, more female respondents follow influencers on social media sites than male respondents, respectively (Fig. 1b), while there are no significant differences in online time in general.

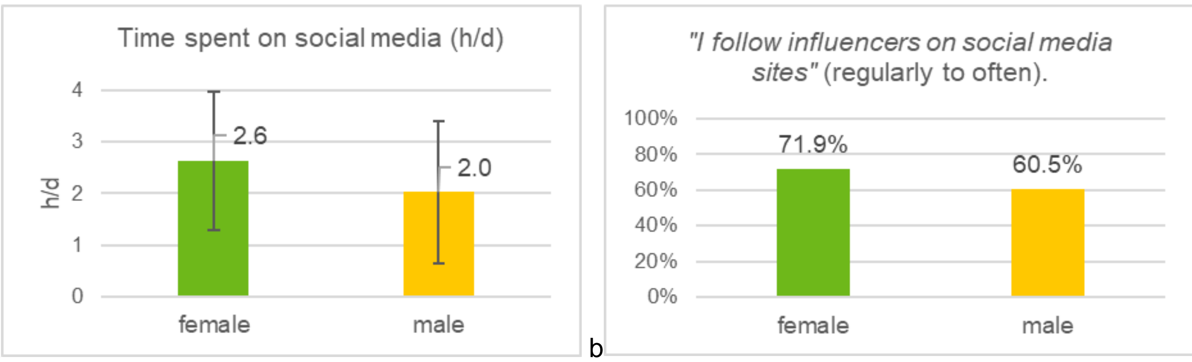
a  b

Fig. 2a. Time spent on social media per day according to gender. Fig. 2b. Percentage of group of female vs. group of male respondents following influencers on social media sites (female respondents: n = 585; male respondents: n = 233; total respondents: n = 827)[6]

[5] Quotes were translated into English from the German transcript, with any stylistic inaccuracies occurring due to the direct translation of colloquial expressions.
[6] Due to the small number of respondents defining themselves as *diverse* (n = 9), the results of this group cannot be considered as representative and therefore cannot be directly compared with the female and male respondents, respectively. Therefore, they were not considered separately in the evaluation.

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Pupils' responses to questions on how they rate their own knowledge of social media and influencers compared to their teachers (shown in Fig. 13 in comparison with teacher statements) revealed that the vast majority considered themselves more adept at social media than their teachers (~73 %). Surveyed pupils did not seem to have an overly high opinion of their teachers' social media skills in general. Furthermore, only 13.1 % felt that many of their teachers were now more comfortable with social media than they had been before the COVID-19 pandemic (and the ensuing distance learning; see Fig. 13).

This result was also confirmed in the group discussion conducted with eighth-grade schoolchildren during the pandemic in spring 2021. Here the moderator asked the pupils: *"Do you feel that you know more about social media and the Internet than your teachers?"* The pupils stated the following: *G1: "Yes? (nods several times) Much more."*, *G3: "Yes." (someone laughs)*.

3.1.2 Importance of the topic 'social media and influencers' in the context of schools

Pupils' responses to questions about whether they want to learn more about social media and influencers in school and whether it is already part of current lessons are shown in Fig. 3. Here it can be noted through the answers of more than half of the respondents that social media and influencers are part of their current educational plan.

Furthermore, our data shows that with increasing age, there is a simultaneous increase in the number of statements affirming that 'social media' and 'influencers' are part of current lessons at school (r = -0.254, p = 0.000; Fig. 4).

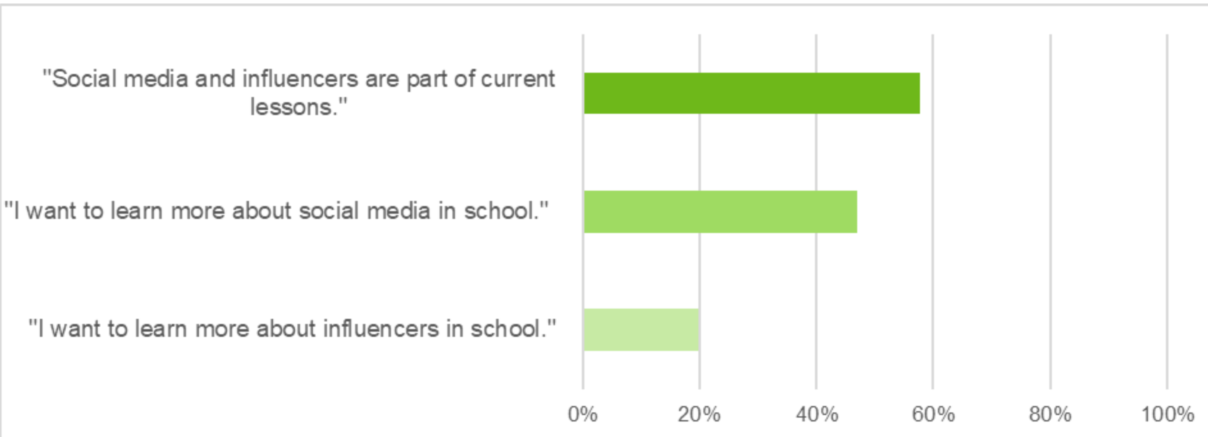

Fig. 3. Answer frequency to various questions about *social media at school* ('fully to rather applies'; n = 827)

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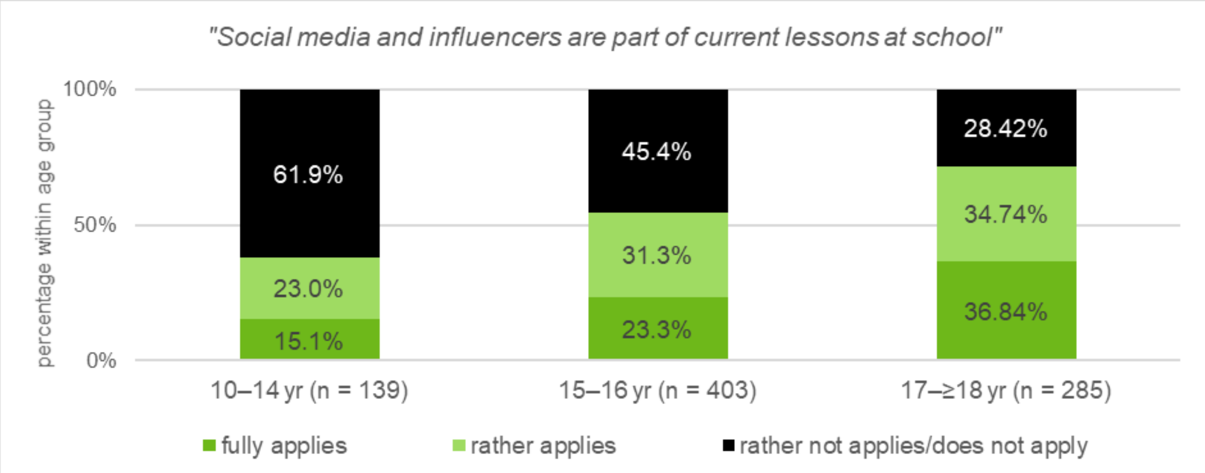

Fig. 4. Answer frequency to the question about 'social media being part of school lessons' according to age groups

However, it is not possible to draw conclusions about the type/method as well as quantity or quality of the integration of these topics regarding school lessons. Statements of the group discussion on this were rather uncertain and reflected selective talks of a few hours (not necessarily in every school level). The pupils mainly mentioned topics about online bullying and safety on the Internet:

G3: "Well, I think in the second [grade] there was something against bullying and online and so, we learned that already, but it was, I think, only one hour or so." G1: "About Mobbing. Yes!" G3: "But otherwise not at all." […] G1: "A two-hour (lecture)... Well, there was some man, and he told us, so...um, watch out for bullying, and security and hackers and things like that." […] D1: "Well, I changed schools first, [...] um, [...] so we had individual project days, and every time [every year] we had at least two project days about that."

In addition, the pupils stated opportunities for elective subject groups to practice creating videos or websites, whereby the underlying focus had also been on rules on the Internet:

G3: "Well, we also have elective subjects at school, and... well, I'm in [note: attend] *an elective course where we also work a lot on the topic of the Internet. We've already made videos about internet safety rules and safety measures."*

3.1.3 How should the topic 'social media and influencers' be addressed at school?

The pupils were asked which social media topics they would like to learn more about at school (Fig. 5): Here, legal topics (more than half of the respondents) lead ahead of content reflection (almost 50 % of total respondents), followed by technical aspects

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and general introduction to social media handling (both approx. 35 % of total respondents). It is noticeable that personal information on influencers or information on 'how to become an influencer' tended to be left out of school, which also fits in with the information that around 80 % of the questioned pupils did not (necessarily) want to learn more about influencers at school (see Fig. 3).

For various items, there are differences in relation to gender (Fig. 5). For example, the topic 'technical knowledge' was selected significantly more often by male respondents (48.5 % vs. 30.3 % of total female respondents). Conversely, significantly more female respondents (54 % vs. 39.9 % of total female respondents) picked the topic 'discussing and questioning content (reflection and criticism)'. Both findings point to a classic division of roles into 'social' (girls) and 'technical' (boys) and clearly show the importance of a gender-sensitive learning setting.

If you look at the selected topics by age group (Fig. 6), the oldest group (17 to ≥18 years) wanted to learn much more about legal topics and wished for far more discussion about and reflection on social media at school than the younger pupils. The youngest group (10 to 14 years) preferred technical topics and social media introduction over the other two groups. It is the same with personal topics about influencers and how to become an influencer. These two topics were of little interest to the oldest group, as was the meaning of being an influencer.

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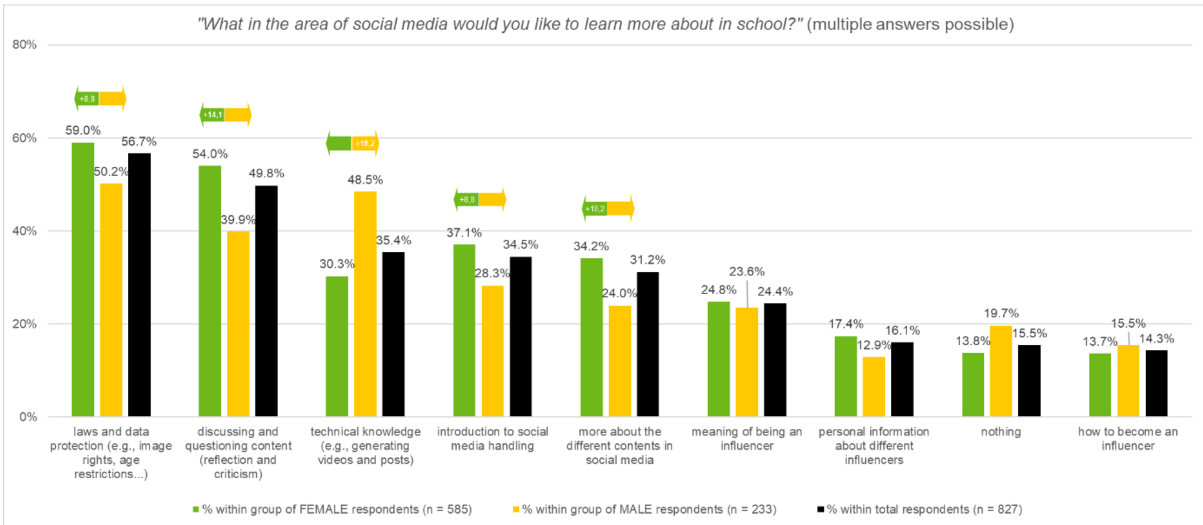

Fig. 5. Social media topics the questioned pupils wanted to learn more about in school (multiple answers possible), shown according to total number (n = 827) and gender distribution[7]

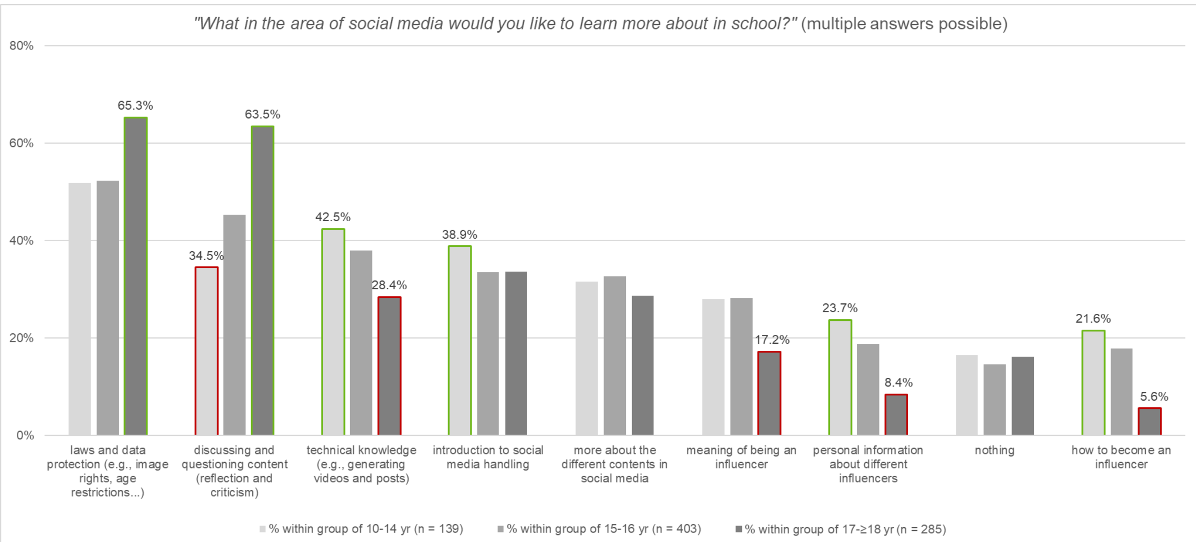

Fig. 6. Social media topics the questioned pupils wanted to learn more about in school (multiple answers possible), shown according to age groups (green frame: significant higher percentage within age group compared to other age

[7] Due to the small number of respondents defining themselves as *diverse* (n = 9), the results of this group cannot be considered as representative and therefore cannot be directly compared with the girls and boys, respectively. Therefore, they are not considered separately in the evaluation.

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groups; red frame: significant higher percentage within age group compared to other age groups; n = 827)

In the group discussion, the pupils also discussed how they would imagine social media in the classroom. A non-compulsory course form was considered conceivable, but they expressed doubt that everyone would take it seriously enough (especially younger kids are assumed to be more disrespectful), where only grading would be a solution.

G3: "[...] So if you incorporate something like that into school – more about social media – but for voluntary students who really want to, but are not required to [...]."

When it came to the question of who could teach these subjects, they tended to speak in favor of external experts, whom they attributed more expertise to than their teachers and would also take more seriously. Nevertheless, in some cases they also expressed a certain lack of trust in a "complete stranger": *G3: "[…] Yes, from people who are well-versed, yes... but somehow with teachers, who are not versed – rather not." […] "Exactly, people are taken more seriously. It's the same with me, I take teachers seriously too, but when other people come to school, somehow experts, then I know they know their stuff and can somehow teach something, so yes."*

The pupils certainly considered themselves to be well-versed enough in social media topics, even though they did not necessarily trust themselves to convey it in class as experts (without a teacher), because they thought that their peers were not likely to listen to them or that younger people were not respectful enough.

B1: "But whether you listen to your peers..." (M3 shakes his head) "...If some fourteen-, fifteen-year-old joins our class (M2 shakes his head negatively) and then teaches like this, then, uh, it's probably even less effective." […] G3: "Well, I would say that the students in the first and second classes are nowadays kind of much more..." B1: "Disrespectful."

In general, the tendency among the panelists suggests that they wanted to learn less 'about' social media and more about 'using social media as a tool' to address a variety of topics. This should form a cross-section in all subjects and there should be more active implementation rather than being given selective talks (the contents of which are also quickly forgotten again, in their opinion). They also emphasized the importance of seriousness and that they really wanted to learn something, preferring a hands-on approach: *M1: "[…] You learn much more when you do something."* (e.g., video and website production).

3.2 Perspective of Educators

In the following, we present an extraction of the results from the comprehensive, quantitative study among Styrian educators (schoolteachers, university students and

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lecturers of teacher education). Even though more comprehensive data was collected, in this article we focus on the main findings according to the article's perspective.

3.2.1 Description of questioned educators in terms of activity fields

Most of the respondents (n = 385; see Fig. 7) are either university students of teacher education and/or are working as teachers at secondary or pre-vocational schools[8] ('Mittelschule', MS & 'Polytechnische Schule', PTS). Since multiple answers regarding this were possible, individual participants may have been working in several different fields. There is broad age diversity among the participants, resulting in the representation of thoughts of different age groups. Nevertheless, it should be noted that the largest response group was that consisting of university students of teacher education (n = 130). This group is also the largest within the youngest age group. In all other age groups, secondary school teachers ('MS/PTS') form the small majority.
49.1 % of the respondents stated that topics around nutrition, health and consumption are part of their curriculum. For 31.2 % this was not the case and they would not address it in class, while 19.7 % had addressed the topic although it is not part of the curriculum (Fig. 8).

[8] The designations of the school types are taken from the English-translated website of the Austrian Federal Ministry of Education, Science and Research:
https://www.bmbwf.gv.at/en/Topics/school/school_syst/st.html [04-21-2021]

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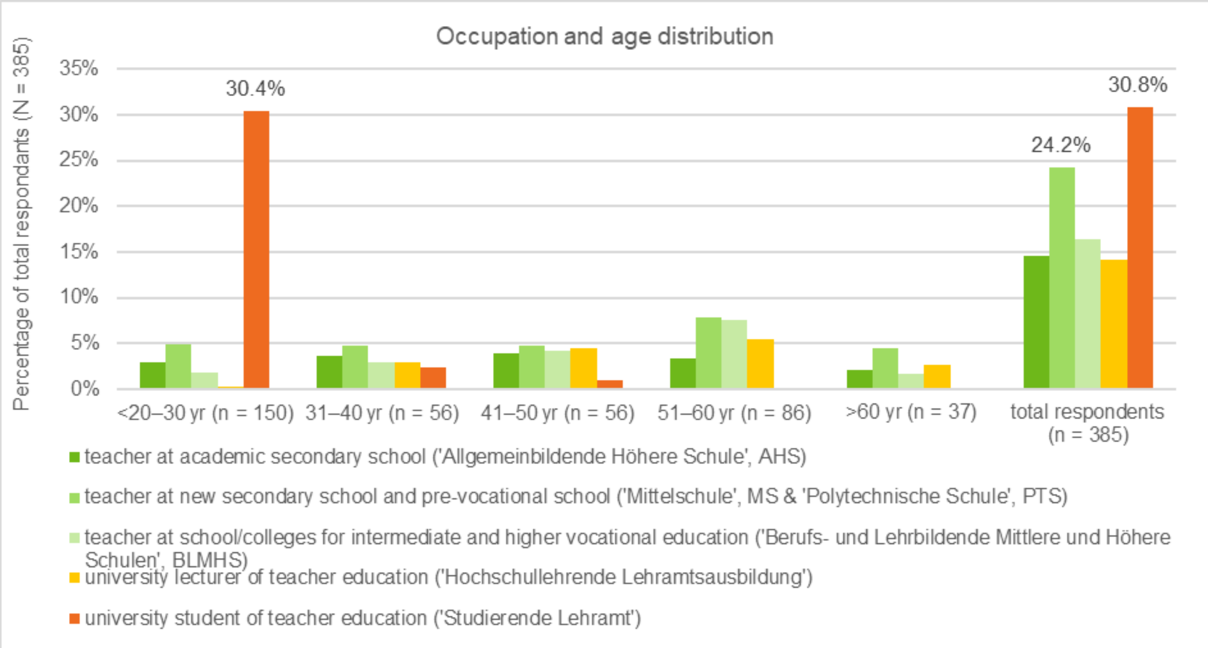

Fig. 7. Occupation of respondents (multiple answers possible) according to age groups[9]; frequencies shown are percentages of total respondents (n = 385)

[9] Note: Due to the small sample size, the age group of those under 20 (n = 12) was integrated into the group of '20 to 30 yr' for evaluation. According to profession, '<20' is not younger than 18 years old since in Austria tertiary education does not start before the age of 18.

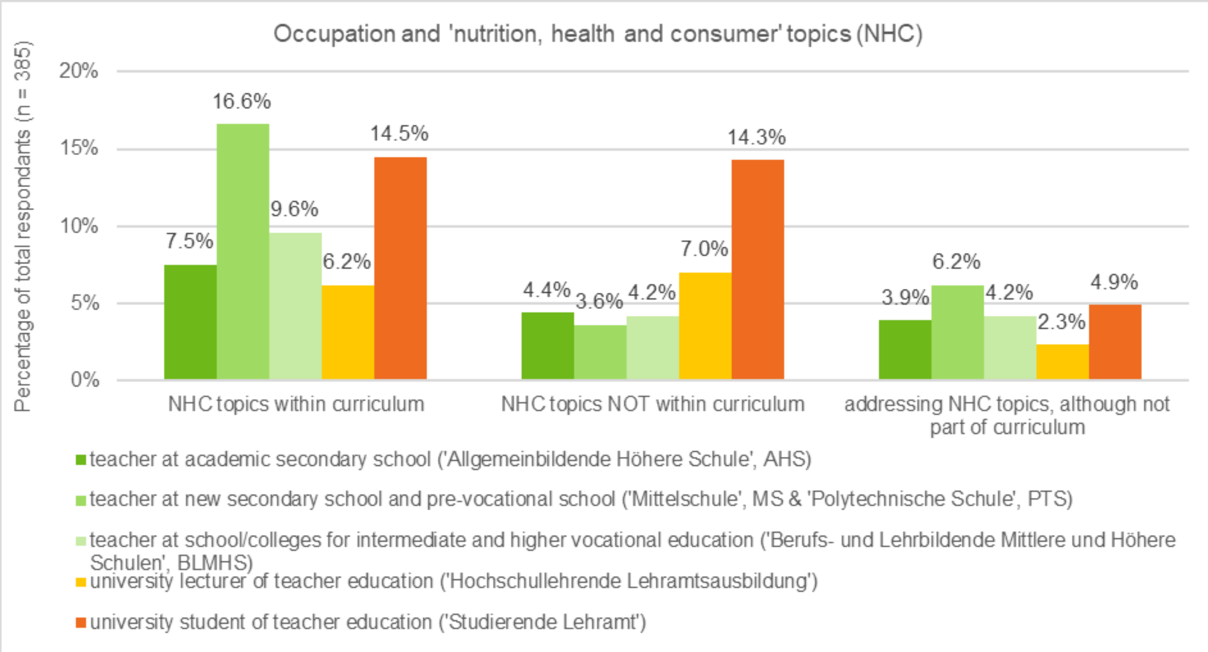

Fig. 8. Occupation of respondents in relation to curriculum-anchored nutrition, health, and consumer topics; frequencies shown are percentages of total respondents (n = 385)

Here it is shown that almost 50 % of the respondents dealt with the topic of nutrition and consumer education and that it was part of their everyday work.

3.2.2 Social media habits of educators

Educator respondents are shown to have spent significantly less time on social media than pupils (those who used social media were included in the analysis here). Among educators, just under 4 % reported spending ‘no time on social media’ (Fig. 9).

As expected, adults used social media platforms to a different extent than the younger people, or other platforms altogether: Surveyed educators, for example, used Facebook more frequently than the questioned pupils, but Instagram, Snapchat and TikTok much less. Pinterest was also used less than among the schoolchildren (and, interestingly, Twitter as well). On the other hand, LinkedIn and Vimeo were used more frequently by the questioned adults when compared with the younger people (Fig. 10).

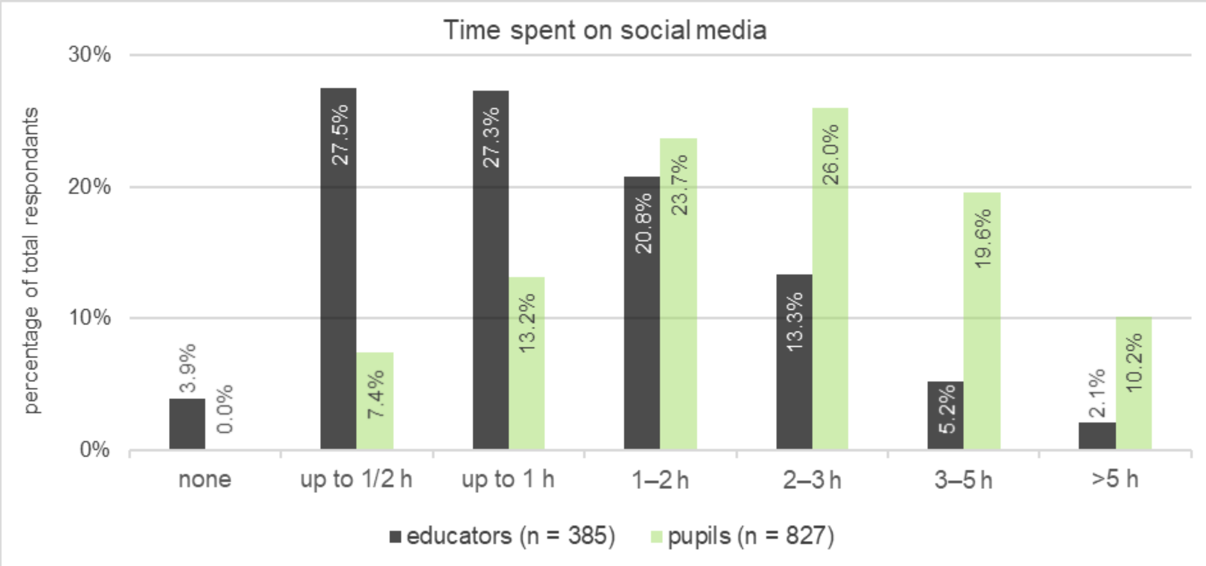

Fig. 9. Comparison of time spent on social media by educators and pupils at the time of the survey

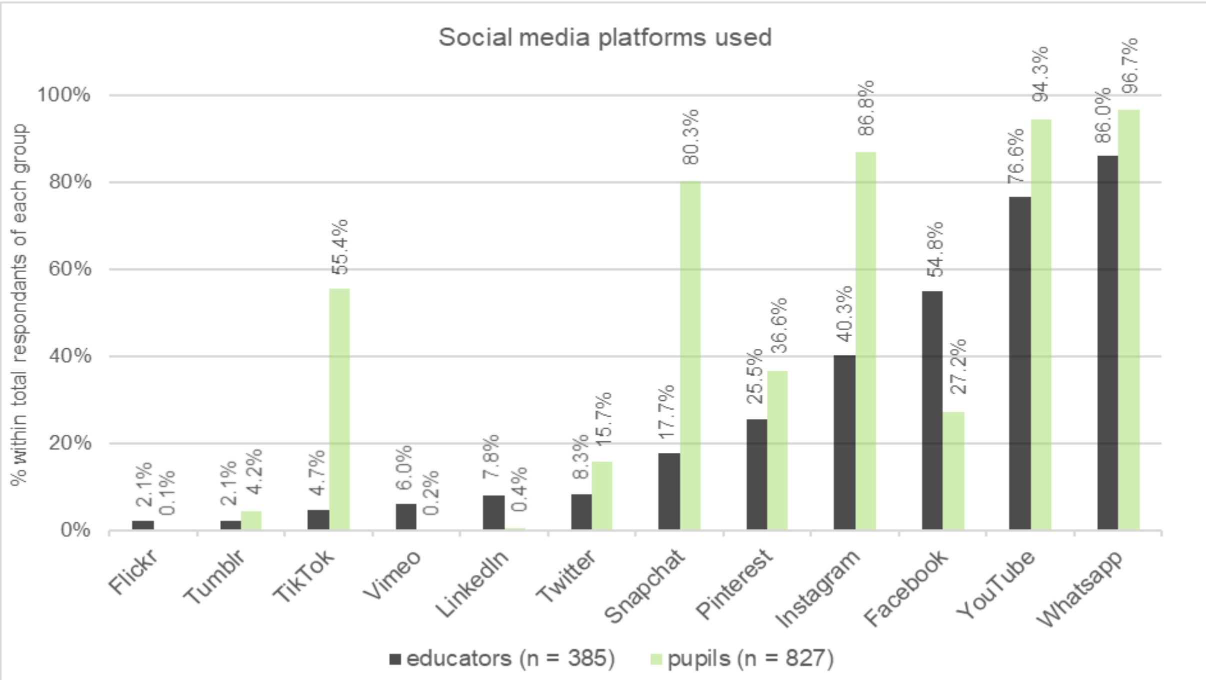

Fig. 10. Social media platforms used – comparison of educators (n = 385; in grey) vs. pupils (n = 827; in green)

It was concluded that educators also followed influencers to a much lesser extent than the questioned pupils. The age of the respondents seems to play an important role here. Regarding adults' social media habits towards influencers, a significant positive correlation (r = 0.477, p = 0.000) between age and 'following influencers' can be detected. Of those up to 30 years, almost 40 % stated to be following influencers,

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while only 7 % of those between 31 and 50 years and almost none of the age group 51 to ≥60 years say they do (Fig. 11).

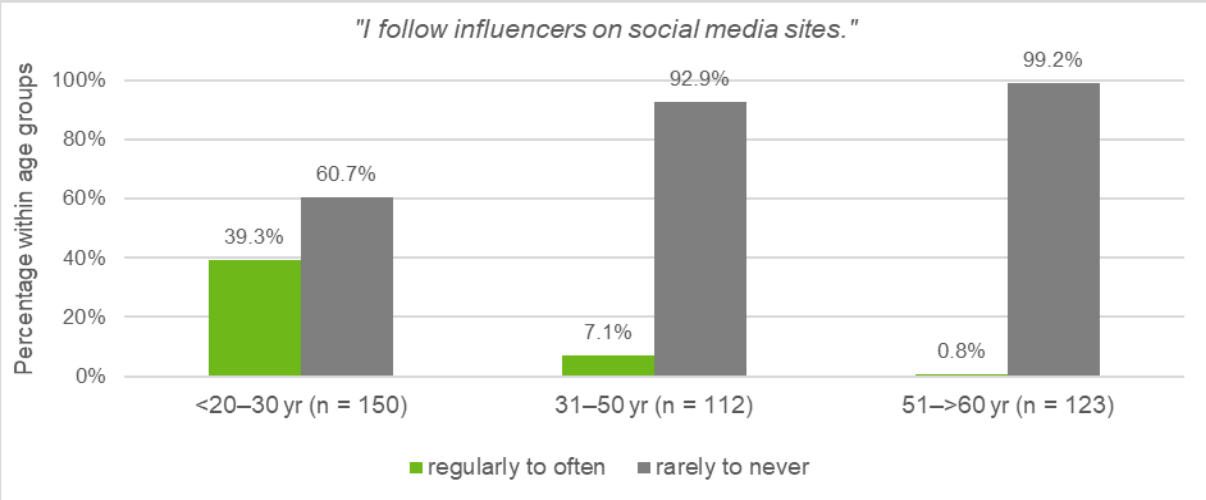

Fig. 11. Following influencers on social media sites according to age groups (comparison of ‘regularly to often’ and ‘rarely to never’)

Although it seems that influencers do not play an important role in the questioned educators’ lives, almost 80 % of all respondents stated their belief that influencers are important in young people’s lives. Even more (~86 %) stated their belief that influencers change young people’s reality/perception of life. These opinions are similarly distributed across all age groups (Fig. 12a), with the group of under 20 to 30 years giving the strongest endorsements in this regard.

It can be argued that the values here also represent the opinion of the professional group, if we consider that in the age group of under 20 to 30 years, mainly university students of teacher education are to be found (78 %); schoolteachers, however, form the majority in the groups from 31 to 50 years and from 50 to over 60 years (over 80 %) – in these two groups, university lecturers are also found, making up about 25 % of each one.

When this is plotted by curricular affiliation (Fig. 12b), it becomes apparent that those educators without the topics of nutrition, health, and consumption (NHC) in their curricula provide the least support for the opinion that influencers are changing the reality of children’s lives.

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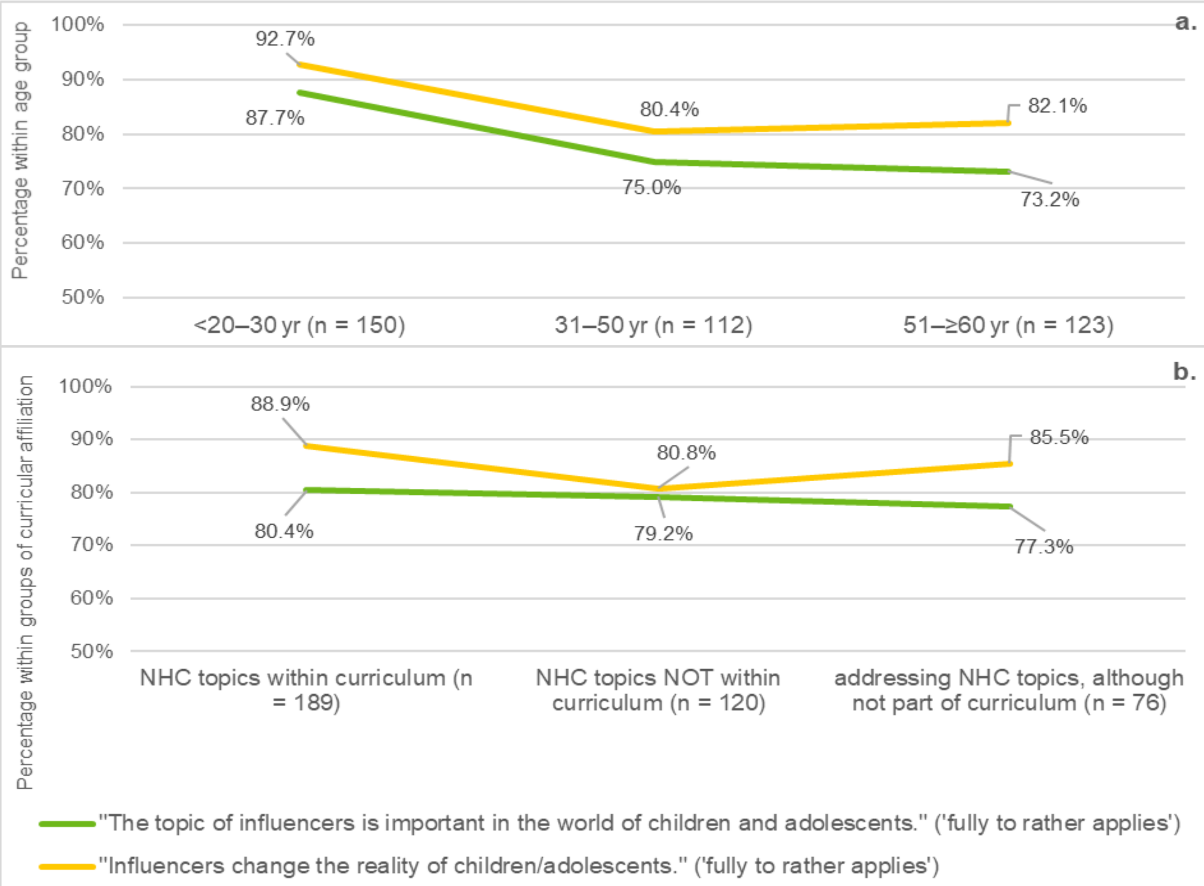

Fig. 12a. Opinion of educators on influencers effecting young people's lives according to age group. Fig. 12b. Opinion of educators on influencers effecting young people's lives according to curricular affiliation

Regarding how educators interpret their knowledge of social media over children and adolescents, their assessments agree well with the pupils' (Fig. 13, first two columns): The pupils largely considered themselves to be more competent (~73 %), and the educators agreed to a similarly high degree (albeit even slightly higher at ~80 %). However, if we compare this with the influence of the COVID-19 pandemic[10], due to this situation pupils rated the increase in their teacher's knowledge much lower than educators did (Fig. 13, right 2 columns).

A clear age discrepancy can be seen regarding the opinions of adolescents having more knowledge about social media than themselves as well as themselves having gained more knowledge about social media through Corona (Fig. 14): Both show an increase according to rising age groups (r = -0.177 / r = -0.208, p = 0.000). Whereas

[10] At the time of the survey, the pandemic had already existed for a whole semester of study, so it is reasonable to assume that the COVID-related 'digital emergency measures' at school and in the tertiary education sector may also have had an impact on social media skills.

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the majority of those between under 20 and 30 years (~65 %) thought that they had gained no or hardly any new knowledge about social media through Corona-related situations, more than half of the respondents in the age group from 50 and over believed to have more knowledge about social media due to the pandemic. Whether younger adult participants assumed that Corona-related situations had less of an effect on their social media knowledge because they already felt well-informed cannot be answered precisely at this point.

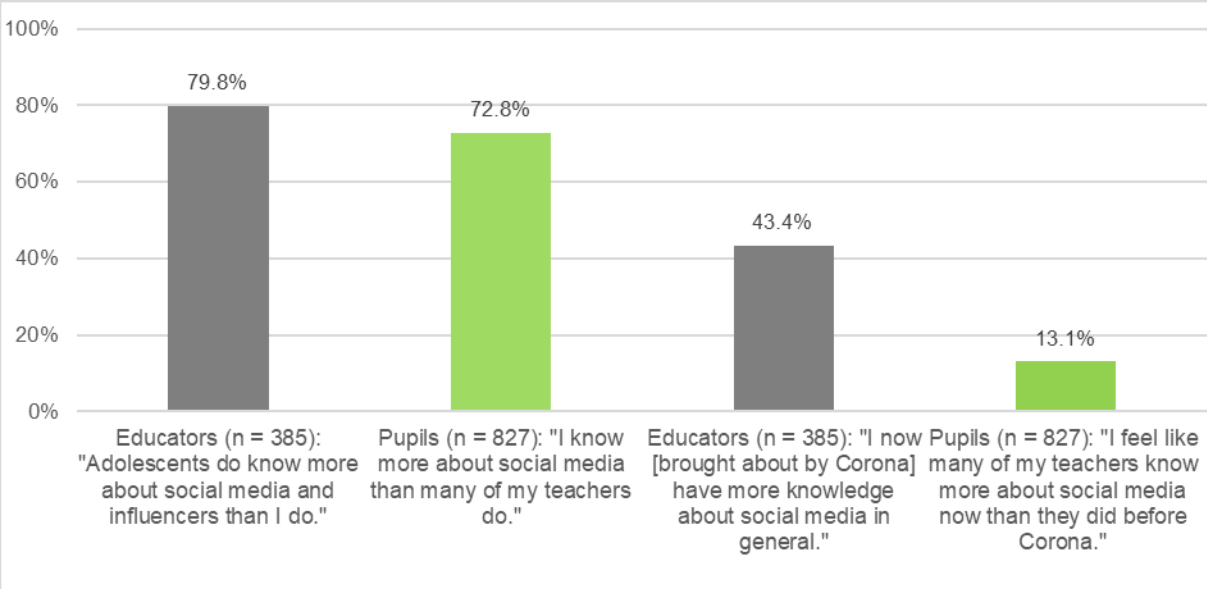

Fig. 13. Assessment of ‘social media knowledge’ of educators (n = 385) compared to pupils (n = 827), (’fully to rather applies’)

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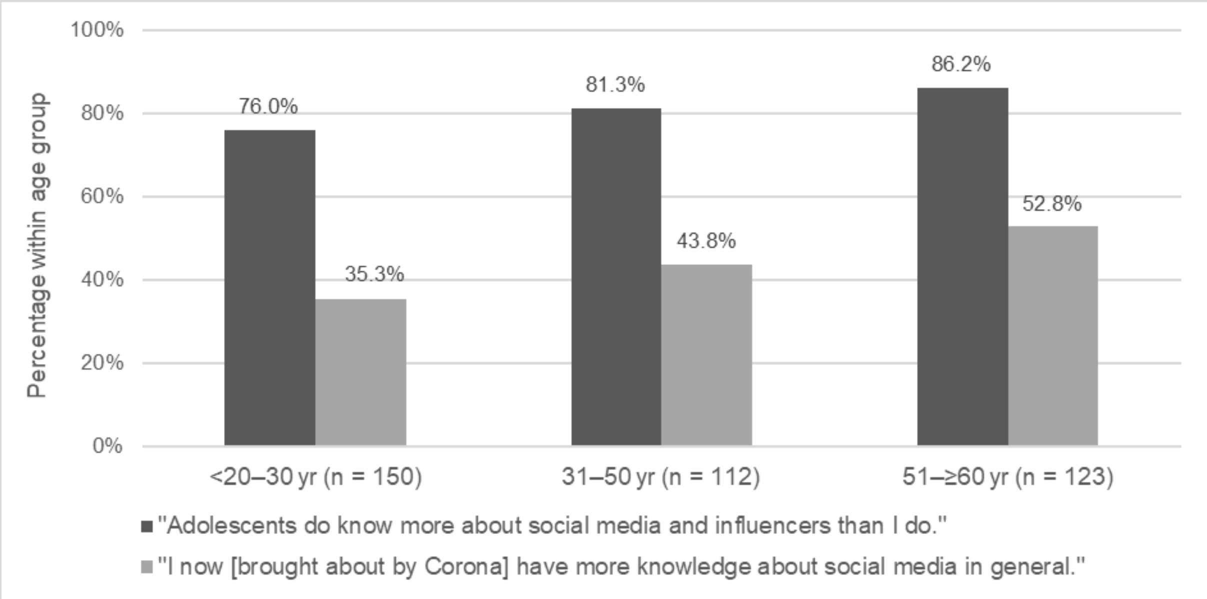

Fig. 14. Educators' opinions regarding adolescents' and their own knowledge about social media, according to age groups ('fully to rather applies')

3.2.3 Current state of social media and influencers in the context of schools

35.4 % of all educators surveyed said ('fully to rather applies') that they had already addressed the topics of 'social media use' and 'influencers' in the classroom prior to Corona (that is, prior to digital upheavals due to Corona-related situations; Fig. 15).

The correlation ($r = 0.247$, $p = 0.000$) shows that the group which had already addressed the topic in class ('fully to rather applies') also wanted to know more about influencers to a significantly higher degree (57.4 %) than the group which had not addressed it yet (rather not or not, 37.4 %). However, the opinion to address the topic of 'influencers' generally more at school is high in both groups, although slightly less in the group that did not or rather not address it yet (70.3 % vs. 83.8 %).

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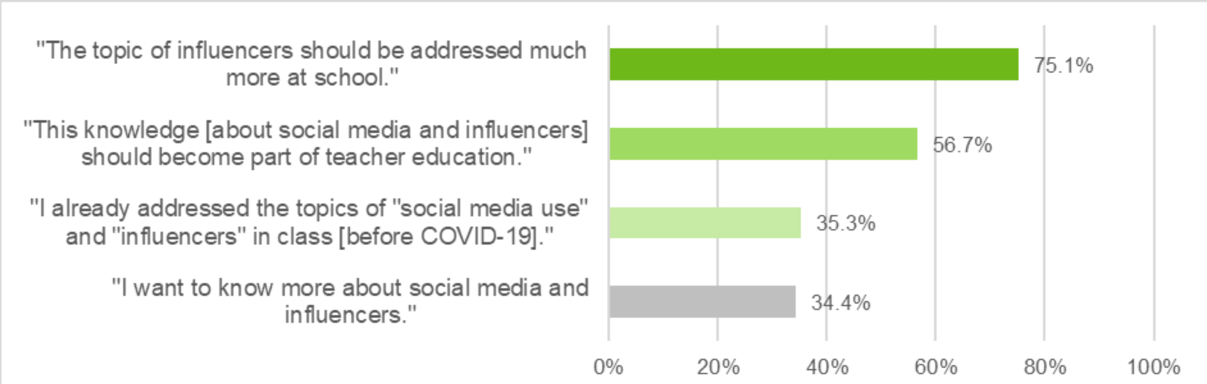

Fig. 15. Opinions of educators (n = 385) about the topics ‘social media’ and ‘influencers’ being addressed at school and in terms of personal interest (‘fully to rather applies’)

About 72 % of all respondents would use advanced professional training [on social media and influencers], which demonstrates a vast general interest in terms of professionalization. The reasons given by those who would not take up a training course (28 %) are mainly disinterest (46 people indicated this) and that it has no relevance to their own teaching (42 people selected this). Furthermore, 27 people saw no benefit in it and 20 said they would soon be retired.

When asked about the conceivable scientific/educational areas in which more professional training on the topic of social media and influencers should be implemented (Fig. 16), the area of ‘nutrition and consumer education’ was chosen the most (by 66 % of the participants), followed by informatics. 55 % considered such training in the educational sciences and pedagogical areas as useful. Natural science fields were mentioned by 38 %. If we look at the distribution by groups with and without nutrition, health and consumption (NHC) topics in the curriculum, the percentage ranking of the mentioned training areas remains almost identical, with one exception: The group without NHC within the curriculum preferred the implementation of professional training in computer science (informatics) before nutrition and consumer education.

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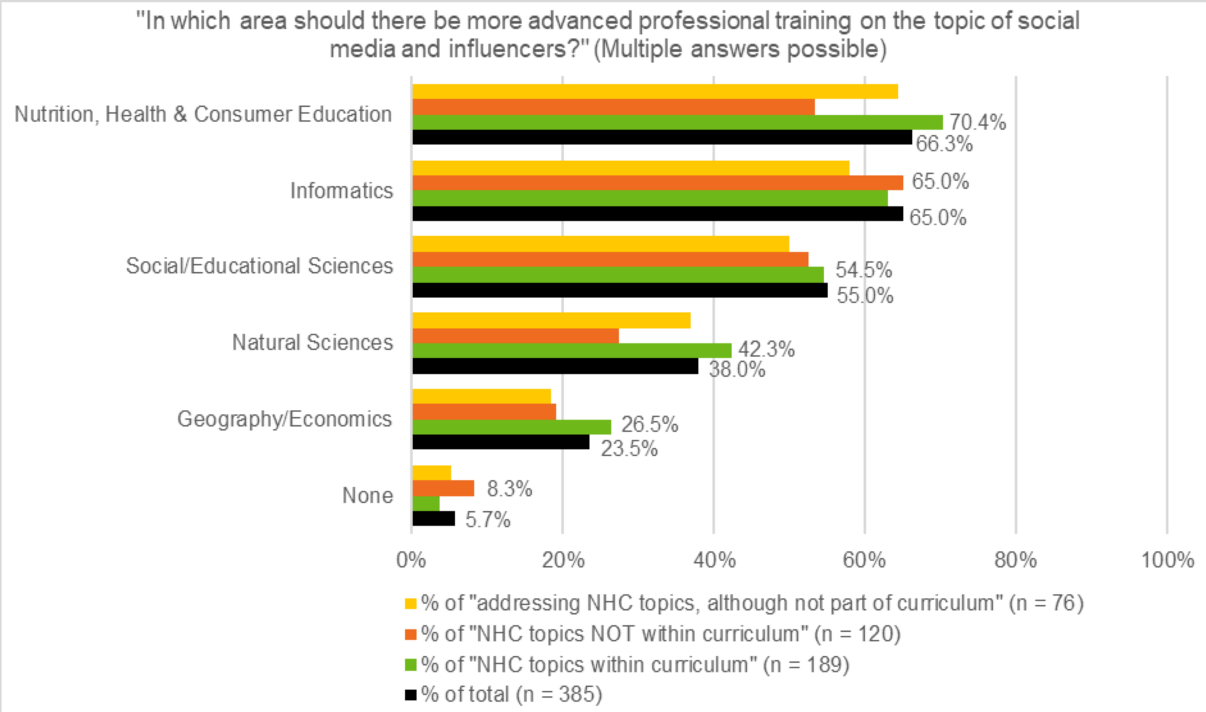

Fig. 16. Scientific/educational areas educators see advanced professional training about 'social media and influencers' to be anchored (multiple answers possible; percentage of hits by total respondents n = 385 and according to different groups of curricular affiliation, respectively)

3.2.4 How should the topic 'social media and influencers' be addressed at school?

Regarding the focus on 'social media' and 'influencer' topics at school (Fig. 17), the educators surveyed put their main emphasis on 'reflection of content', 'introduction to social media use' and 'legal basics', similar to the pupils (cf. Fig. 5 & 6). This was immediately followed by 'consumption topics' and 'nutrition topics'.

The majority (~70 %) of responses advocated for external experts to teach the topic in schools. More than half would see pupils themselves involved in teaching the topic, indicating that they are seen as experts on the topic. Broken down by age groups (Fig. 18), it is evident that the youngest group (representing the profession of future teachers) particularly values the participation of pupils.

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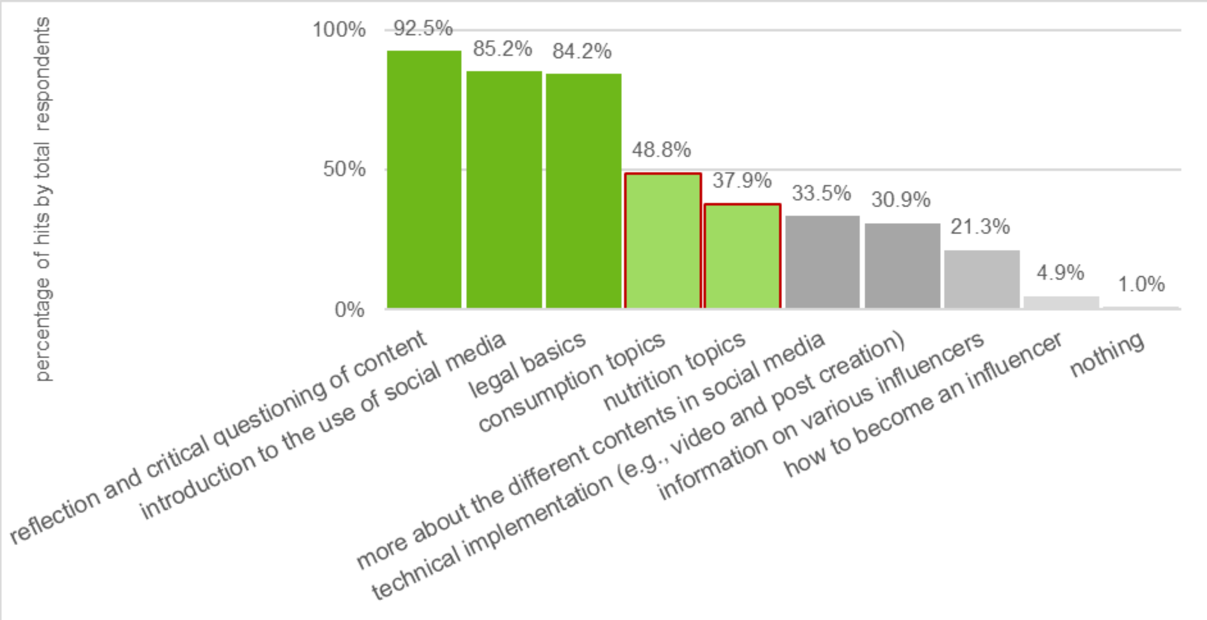

Fig. 17. Topics the respondents suggested being taught [at school] on the issue of 'social media and influencers' (percentage of hits by total respondents, n = 385; multiple answers possible; consumption and nutrition topics are color framed)

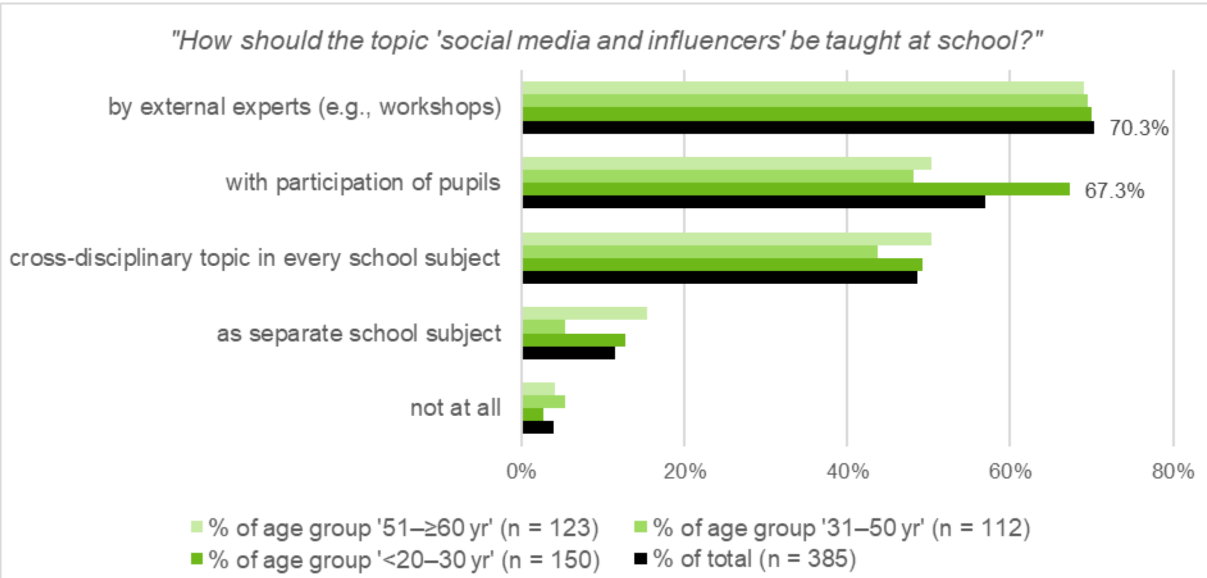

Fig. 18. Answers of educators on how the topic of 'social media and influencers' should be taught at school (multiple answers possible; percentage of hits by total respondents, n = 385, and according to age groups, respectively)

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4 Discussion of Central Findings

In this chapter, we connect the results and discuss central findings. The aim is to establish starting points for subject-related professional concepts that are essential for pedagogical handling of the topics of 'social media' and 'influencers'.

4.1 Generational Gap between Pupils and Educators

It can be observed that the two target groups (pupils and educators) differ on various levels, leading to specific challenges for settings of teaching and learning.

Pupils are online for significantly longer amounts of time when compared to their educators, whereby the intensity of their online activities also differs significantly with gender. Schoolchildren also use social media platforms to varying degrees compared to their educators (Fig. 2a, 9, 10, q.v.). Another gap can be seen in the way to deal with influencers, who are part of everyday reality for most of the surveyed schoolchildren, while it has less relevance for the group of educators (decreasing with increasing age; Fig. 11, q.v.). Both groups, pupils and educators, predominantly admit that teachers do not have sufficient knowledge about social media issues. But apparently, there is a discrepancy in the interpretation of 'social media knowledge' according to pupils rating the increase in knowledge of their teachers due to the current pandemic situation much lower than the educators themselves (Fig. 13, q.v.). The question arises of what both groups understand by 'social media knowledge' – obviously, it does not seem to be the same, indicating a certain gap in terms of the perception of social media as either 'tool' or 'lifeworld'. All of this has an impact on different competencies and experiences, of which both target groups are aware.

A key factor in the divergent media socialization of young people vs. 'digital immigrants' (see Krotz 2017b; De Witt/Czerwionka 2013; see chapter 1.3) is that within this social change, older generations have acquired little to no digital knowledge in adolescence that they could pass on to the youth, because their life reality of childhood and youth in the area of digitalization has no relevance for the new generations, with conditions having changed enormously. Hence, it can be assumed that the difference in knowledge leads to insecurities in the handling within the classroom and to certain reservations about new media on the part of the older generation. This "constant criticism of the new medium", which Rath (2019: 21, translated) calls "moral media apocalypse", is not a new phenomenon. It has been around since Plato's critique of the new medium 'writing' and has continued ever since, with a key characteristic being the narrative of the threat posed by new media to the next generation and the associated moralization. In this process, the state of development is misunderstood as the initial state and seen as a normal form whose change has negative moral

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connotations. Such processes can be found in the criticism of newspapers in the 16th and 17th centuries, as well as in the criticism of cinema, television, or, later, computers. The new forms of social media are no exception (ibid: 21).

Under these preconditions, it is not surprising that older generations often have less knowledge and tend to have a negative moral attitude towards social networks. This can minimize the motivation of the youth to share their reality of digital lives – or to experience it from the perspective of their elders.

For educators, this means that being sensitive for the needs and desires of young people without negative moral assessments of the online behavior of the younger generation is instrumental for constructive and open-minded dialogue.

4.2 ‘Readiness’ of Educators is a Matter of Age

Most educators are aware of how important social media topics are for young people and how strongly they can influence their lives. Fittingly, about three quarters of those surveyed wanted the topic ‘influencers’ to be addressed more at school (Fig. 15, q.v.). Social media is in fact already a topic at school, but quantitative data do not show what content is processed regarding this term. However, results from the group discussion point to a rather one-sided spectrum related to various aspects of safe use of social media, with content- and commercial-related reflective activities not occurring at all. This is manifested by the topic preferences pupils demanded to learn more about at school, with ‘content reflection and criticism’ being considered as the second highest priority following legal issues (Fig. 5, q.v.)

Although both groups, pupils and educators, attest that teachers wield too little social media knowledge, there is only a relatively weak tendency among all educators surveyed to want to know more about social media and influencers themselves. However, compared to the relevance that teachers attribute to the topic for school, a personal interest in more knowledge about social media and influencers does not seem to be related to the aspiration of addressing the topic in school.

When it comes to the question of who can teach these subjects, all target groups tended to speak in favor of external experts, whom young people attribute more expertise and seriousness to than to their teachers, yet depended on their trust and credibility – a motif that also recalls the relationship between influencers and followers (see Waldner/Mittischek 2020: 172ff.). As most educators’ responses advocated for external experts (Fig. 18, q.v.), apparently most of these educators did not yet feel competent enough to take these topics on themselves. Still, about 72 % were willing to attend suitable training courses, although only about 34 % wanted to know more about social media and influencers. This first discrepancy is resolved when we look at ‘wanting to know more about’ on a personal interest level and ‘advanced professional

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training' on a professionalization level, which do not necessarily have to be in conflict with each other.

The approach of involving experts seems promising from our perspective in any case, as it meets with a high level of approval from all sides. Schulz-Zander (2005) argues that collaborative learning with external partners is part of the didactic principle of self-active-constructive and cooperative teaching and learning with media. In this type of teaching, competencies are partially bundled, and the teachers can hand over their expert role while partially becoming learners themselves. Through active exchange with other teachers, they can expand their pedagogical and professional competence (Schulz-Zander 2005a; 2005b: 14). With the involvement of externals, new motivational settings for all learners can be created regardless of age.

However, it would be short-sighted to assume that brief sessions with experts are sufficient to acquire the necessary skills to adequately prepare young people for the challenges of a constantly changing, mediatized, digital society. The results show that particularly young teachers and students of teacher education are aware of this: Alongside the use of experts, they placed great emphasis on participatory learning formats in which young people themselves become active (peer-to-peer settings, inverted/flipped classroom etc.) and that around half of all teachers were aware that this is an interdisciplinary topic which should be dealt with repeatedly at various levels across all subjects (Fig. 18, q.v.).

Nevertheless, the finding that younger educators, compared to older ones, see little impact of the COVID-19-related upheavals on their social media skills in teaching with and about digital media (Fig. 14, q.v.) indicates that mediatization processes related to social media are not due to recent events but must be assumed to be fundamental. Even if the pandemic has certainly moved up the digital education revolution and accelerated discussions concerning this, a sustainable attitude towards digital mediatization is needed in educational processes that do not only map or evaluate 'emergency measures': "If one takes the COVID-19-related emergency distance learning of spring 2020 as a starting point for discussions on a contemporary school in a culture of digitality, one does not do justice to the scope of the necessary discussion in various respects and runs the risk of giving too much weight to unimportant aspects and neglecting relevant aspects in the long term" (Döbeli Honegger 2020: 4; translated).

4.3 Different Requirements for Pupils in Different Age Groups and of Different Gender

Looking at the age-related, differing preferences of social media topics, which the pupils would like to have addressed at school (Fig. 6, q.v.) these results are hardly surprising, as the youngest target group between the age of 10 and 12 can be

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described as ‘explorers’ who are establishing their first contacts with social networks and still have little idea of their practices, wording and content. Accordingly, highly specific wishes for knowledge in the area of social media and influencers are at play in the background. It cannot be assumed that children of this age have already developed a stable online identity, corresponding knowledge, and the associated reflective skills. Older adolescents have already acquired these abilities through prolonged use of social networks, meaning that detailed technical knowledge and reflection are more in the foreground. These different knowledge requirements and life situations should be covered accordingly in school in any case. Younger students need an adequate introduction to and preparation for social networks in order to find their way around more easily and competently. Older pupils, on the other hand, have their own stable identities in social networks, which they do not necessarily want to share with teachers (cf. Krotz 2017a: 36), but instead seek to discuss the topic on a more abstract level and equip themselves with advanced technical know-how.

Considering the different preferences of subjects (girls want to discuss and reflect more on social media content than boys, who in return prefer technical issues) which confirm a classic division of roles into social (girls) and technical (boys), it would be important to pay gender-sensitive attention to encouraging girls in their motivation and acquisition of technical content and, conversely, encouraging boys to participate in the important reflective work (Fig. 5, q.v.). The contents can also be used to take a critical gender perspective, with the goal of opening up role models for young people beyond classic gender stereotypes, and thus contributing to more equal opportunities. Further reflective practice itself offers a great opportunity to discuss topics from different perspectives and to provide young people with essential content concerning nutrition and consumer education without the classic educational setting of instruction. Helge Bonholt, Gerhard Rupp and Regina Schulte already argued in 2004 that aspects of communication and information transfer should be emphasized more strongly to specifically address and reflect upon gender differences. Therefore, they suggested a deeper consideration of cooperative and collective forms of learning (Bonholt/Rupp/Schulte 2004: 153). In this context, tutorial programs, explorative learning structures and instructive elements in open learning formats can promote self-regulated and cooperative learning, as already pointed out by Schulz-Zander (2005b: 13f.).

4.4 Criticism and Reflection – Importance of Nutrition and Consumer Education

Results from the EKo-K.I.S.S. study so far show that topics related to nutrition and consumption in social media are highly relevant for young people (see Waldner/Mittischek 2020): Answers related to nutrition, health, consumption and sustainability revealed a high level of personal interest among the pupils, especially

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the girls, in healthy eating, cooking, shopping, health and fitness, some of which was reinforced by the crisis caused by the COVID-19-pandemic. Interest in these topics is also reflected in the data related to influencers, as well as following food or fitness influencers. Still, seriousness or scientific significance of influencer-messages regarding food trends, eating habits or nutrition details is often not given as in many cases, they do not exhibit specific training or knowledge on a topic and might therefore promote unreflective and unsubstantiated claims and lifestyles. Media and health literacy of adolescents in this regard must be strengthened vastly because critical assessment of influencer content decreases with increasing trust, which can lead to discrepancies between attitude, knowledge, awareness and actual dietary and consumer behavior (Waldner/Mittischek 2020: 183).

Reflection on consumption and countering commercial influence is enormously important, since everything in the digital space is subject to economic, capitalist conditions, including the appearance of influencers. In the online world, everything can be bought at any time (with hurdles such as physical presence or opening hours no longer existing), there are many more and stronger consumption incentives than previously, and advertising is largely personalized. “In the context of digitalization, a computer-controlled digital infrastructure is emerging, organized by large companies, that initially swallows up all the old media and reconstructs them in a new way under the old name […], because these reconstructions function in quite different technical, social, economic ways and terms of content and use. In addition, there is a multitude of new computer-based media, which […] try to pick up on specific ways people act, such as forming relationships or seeking information, organize them, and then exploit that.” (Krotz 2018: 35, translated).

Leaning on our results, it is obvious that young people want to learn more about social media issues at school and are showing a willingness to reflect about content in class as is explicitly stated (Fig. 3, 5 & 6, q.v.). This demonstrates their need for support in this regard, which cannot be ignored by the educational system. Still, the topic of ‘influencers’ itself tends to be left out of current educational programs (Fig. 3, q.v.), which indicates that pupils either believe they already know enough about the topic or that they want to keep such topics explicitly private or separate from typical school contents as a means of differentiation from adults and traditional structures (cf. Krotz 2017b), respectively. Since a critical examination of influencers in a commercial context appears to be indispensable in consumer education, as we have noted above, sensitive ways must be found to address this topic in such a way that pupils do not perceive it as intrusion into their privacy.

It has been shown that teachers also see a need to strengthen pupils’ reflective competence in this regard and attribute an important position to nutrition and consumer education for dealing with the topic ‘social media and influencers’ at school (Fig. 16,

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q.v.). Coupled with high interest by pupils, this could be well-anchored in class in terms of motivation. However, considering the knowledge gap between adults and young people, teachers need more help in gathering information on the background processes concerning influencers and their commercial and market entanglements. Additionally, it is important to pay attention to the gender gap and to motivate boys by, for example, making them aware that nutrition and consumption are also highly relevant to them.

Considering all of the above, 'subject orientation' as a didactic principle is to be preferred for school subjects with particular relevance to everyday life (Bartsch 2012: 54ff.): When using this approach, learners' everyday actions and their wealth of experience are used as a baseline for teaching considerations, while at the same time they help define the object of learning. Aiming at a change of perspective, the pupils' interests and questions guide the general view on the subject matter, considered them as experts regarding their experiences and wishes. Teachers act as experts in their subjects and as coaches for learning processes, without being obliged to be 'omniscient'. These cooperative forms of learning promote subjective discussion among participants.

5 Conclusion

Clearly, the educational system's attention is required in dealing with issues of 'social media' and 'influencers' because the importance of the digital world as part of the adolescent reality of life has become ubiquitous. Most teachers are aware of this, and pupils also desire support to a certain extent. In this context, web literacy plays an essential role in dealing with social media. This includes the competencies of reading (content evaluation and synthesis), writing (creating content and meaning), and online participation (building online communities, networking and content sharing) (cf. Klinger/Mayr 2021: 175).

When it comes to social media, teachers today face the challenge of having to change their role. This means that rather teaching oriented towards traditions based on their own beliefs and experiences, they have to offer settings in which younger generations have the possibility to develop contemporary media practices and digital literacy themselves (cf. Marci-Boehncke, 2019: 143).

By reason of differing levels of expertise in the area of social media and apparent gaps regarding its perception between youth and adults, conventional learning settings are not useful or hardly feasible. This is one of the most important aspects to be considered regarding the implementation of the ideas presented here. Obviously, there must be interlacing on many different levels, whereby it is not a matter of teaching only

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'facts', but a question of integrating the reality of young people's lives into the lessons in a motivating way.

For this purpose, teachers themselves do not have to be constantly active on social media to stay up-to-date, as social networks are too ephemeral anyway. Insecurities due to pupils' multi-facetted knowledge are not necessary in this context since teachers can acknowledge and use the current life reality of young people as a resource.

Thereby, the point is not to instruct and grade in the sense of negative moral evaluation, but to accompany digital socialization adequately and competently by providing basic knowledge during lower school levels and later by supporting with the means of sufficient reflective competence and technical know-how. Due to numerous gender-stereotypical findings, which are obviously reinforced in the area of life-related topics such as nutrition and consumption through social media, it is particularly important to consciously counteract this through gender-sensitive teaching.

To achieve all of this, clearly defined further training opportunities are necessary, since personal interest on the topic and, thus, informal knowledge-expansion of teachers is only partially present and generation-dependent, and must therefore not be assumed as a prerequisite. As the questioned educators were generally highly motivated to attend training courses and assumed the subject matter of being a fundamental part of nutrition and consumer education, further training possibilities must be structurally anchored more firmly in this area. This is important because in Austria, nutrition and consumer education is represented in a dedicated school subject at the secondary level of general education. Teaching qualifications for these subjects are acquired through programs of bachelor's and master's degrees at Austria's University Colleges of Teacher Education. In addition, consumer education permeates most other subjects (yet not every subject must or is even able to accomplish everything).

At any rate, interdisciplinary work and the increased involvement of external experts as well as subject-oriented and peer-to-peer settings should be given preference in dealing with this topic at school.

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Relevance and Limitations of Funding for Structural Change

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Abstract. Gender equality plans have a long tradition when it comes to supporting structural change in research performing organisations (RPOs). Numerous institutions have been supported through structural change projects funded by the European framework programmes. These projects have been evaluated and present an ambivalent picture of the sustainability of change achieved in the funding period. To strengthen the implementation of gender equality plans (GEPs) and increase the commitment of RPOs to pursue gender equality objectives efficiently, the European Commission plans to make GEPs an eligibility criterion for applications in Horizon Europe. If RPOs have to have a gender equality plan when submitting a proposal to Horizon Europe, they will have one. But will this contribute to structural change or will it just become another bureaucratic requirement that RPOs have to fulfil in the application process? Will it be more than just a box-ticking exercise? Which framework conditions will be necessary to ensure that it will be more than that? This paper discusses the potential impact of this approach based on experiences gained in a structural change project funded in Horizon 2020. The paper argues that a European initiative has only limited potential for innovation at national level if gender equality objectives differ at European and national level. It is therefore necessary to embed a European initiative in a political discourse about gender equality. A gender equality discourse of this kind should lead to a shared understanding of gender equality objectives and the rationale behind gender equality policies.

Key words: gender equality, structural change, research funding, gender equality plans, policy discourse

1 Introduction

The phenomenon of persistent gender inequalities despite numerous gender equality initiatives has been discussed intensively in the last decade (e.g. Drew and Canavan, 2020; White and O'Connor, 2017; Demos et al., 2014; Riegraf et al., 2010). European and national research and innovation policies have therefore addressed this problem with increasing commitment and breadth. European research and innovation policy defined gender equality as a three-dimensional construct which aims at (1) gender balance in all fields and hierarchical levels, (2) the abolishment of structural barriers for women's careers, and (3) the integration of the gender dimension in research and teaching. Furthermore, gender equality is one of the six priorities of the European

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Research Area (ERA). To support these objectives, numerous structural change projects have been funded since the 6th European Framework Programme.

However, gender inequalities nonetheless still persist, and the pace of change remains slow. Evaluation studies have identified several reasons for this, namely a merely rhetoric commitment to gender equality or a lack of commitment and support by top management (EC, 2012), problems with the implementation process (Palmén and Kalpazidou Schmidt, 2019), or a lack of gender competence (Wroblewski, 2016).

The European Commission (EC) under president Ursula von der Leyen has reinforced its commitment to gender equality both in general (EC, 2020) as well as in research and innovation. In the new European Framework Programme (Horizon Europe, 2021-2027) gender equality plans (GEPs) become an eligibility criterion for applicants. This GEP requirement represents a massive push towards gender equality, and demonstrates the EC's demand for a clear commitment to gender equality from research performing organisations (RPOs). With this initiative, the EC takes up recommendations which have been made by the gender equality community for many years (e.g. the Policy Manifesto formulated at the first European Gender Summit in 2011[1]; for a more recent initiative see GENDERACTION, 2019). The EC has formulated specific criteria which GEPs should fulfill as well as topics which they should address. For example, GEPs have to be published documents that are signed by top management, contain a commitment in terms of resources and gender expertise to implement concrete measures. Furthermore, the GEP has to be evidence-based and regularly monitored, and contain awareness-raising and training measures for staff and decision makers. Recommended areas to be covered are work-life-balance and organisational culture, gender balance in leadership and decision making, gender equality in recruitment and career progression, integration of the gender dimension into research and teaching content, and measures against gender-based violence including sexual harassment.

However, will this requirement actually be able to initiate institutional gender equality policies and thus contribute to sustainable structural change? In the following, I will discuss this question from the perspective of an evaluator of gender equality policies based both on a simple theory of change as well as experiences gained in the H2020-funded project "TARGET – Taking a reflexive approach to institutional transformation for gender equality".[2] TARGET supports seven research organisations in Mediterranean and former Eastern countries in developing and implementing GEPs.

[1] https://www.gopetition.com/petitions/european-gender-summit-policy-manifesto.html

[2] For more information see www.gendertarget.eu

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2 Theory of Change for GEP requirement

Evaluation studies use a theory of change to explain how activities are understood to produce a series of results that contribute to achieving the final intended impacts (Funnell and Rogers, 2011; W.K. Kellogg Foundation, 2004). A theory of change can be developed for any level of intervention – an event, a project, a programme, a policy, a strategy, or an organization – and for the short, medium, and long term. It is usually represented in a visual diagram that supports a narrative.

The key element in a theory of change is to explicate the assumptions for why interventions should lead to the expected outcome and impact. It should indicate the goal at the top (intended impact), the changes (outcomes) that need to be made to achieve that goal, as well as all the things that need to be delivered (outputs) to bring about those changes and the activities that need to be carried out in order to ensure that the planned outputs are delivered.

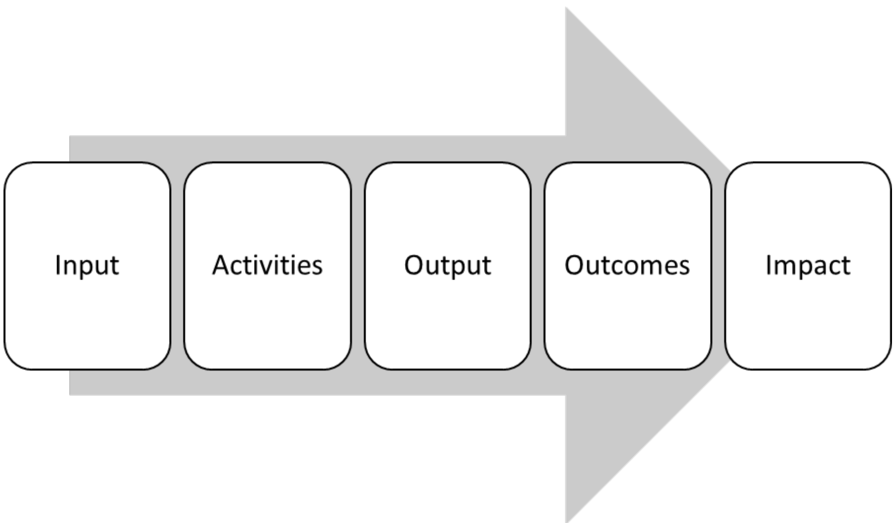

Fig. 1. Theory of change

The simple theory of change formulated below is designed to provide input for the discussion of the potential effects of the GEP requirement and necessary preconditions to realise the expected impact.

The GEP requirement in Horizon Europe aims at supporting the development and implementation of gender equality policies at institutional level. By formulating building blocks and recommending thematic fields, the EC also defines specific quality standards that GEPs should fulfil. The explicit assumption is that RPOs formulate targeted GEPs. It is also assumed that by fulfilling this formal requirement (adoption of a GEP by top management) awareness of gender inequalities will increase and existing structures will be reflected upon from a gender perspective regarding any

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inherent gender bias. In an ideal world, structures will be altered when a gender bias is identified, and structural change will thus take place.

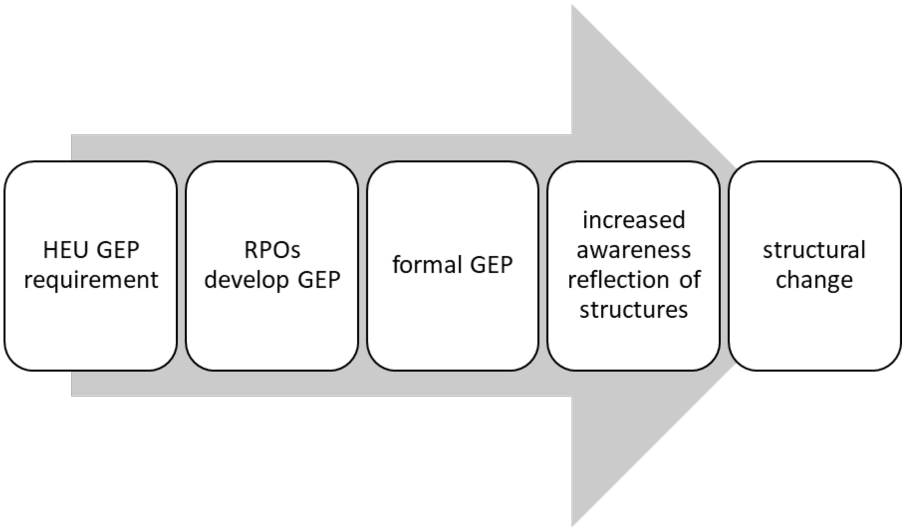

Fig. 2. Theory of change for GEP requirement

When considering the building blocks for GEPs formulated by the EC, it is evident that they support the theory of change:

- A publicly accessible GEP expresses the commitment of top management to gender equality and provides a basis that bottom-up initiatives can address.
- Sufficient resources – in both financial and personnel terms – are a precondition for successful implementation of a GEP.
- The fact that gender expertise has to be available for the implementation of the GEP is of specific importance as it increases the visibility of internal gender expertise or forces institutions to build it up.
- Training for staff and decision makers to increase awareness of unconscious bias also contributes to the effectiveness of GEP implementation.

With these building blocks, the EC follows recommendations from evaluators, gender experts, and activists. However, experiences from the TARGET and other projects show that the successful implementation of the initiative depends on specific conditions which are not mentioned explicitly in the GEP requirement or the underlying theory of change. These specifically address the stage between the formal adoption of a GEP and its implementation in the organisation.

3 Lessons learned from TARGET

To discuss the potential impact of the Horizon Europe GEP requirement, I will refer to experiences gained with the implementation of the TARGET project as well as results

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from the GENDERACTION project. TARGET aims at supporting GEP development and implementation in seven organisations in countries which have been identified as being rather inactive with regard to gender equality in R&I (Lipinsky, 2014; EC, 2009). The national contexts of the TARGET implementing partners are characterised by a lack of a national discourse on gender equality in R&I, thus creating a specific and challenging situation for structural change policies at institutional level.

One task of the GENDERACTION project is to monitor the implementation of Priority 4 of the ERA Roadmap (Council of the European Union, 2015). To implement the ERA Roadmap at national level, Member States formulated national action plans (NAPs) which address six priorities (Priority 4 focuses on gender equality in R&I). An analysis of these NAPs (Wroblewski, 2020) points to a significant gap between EU15 and EU13 countries. The NAPs of the “new Member States” (EU13) are more likely to focus on a narrower concept of gender equality than those of EU15 countries. While most EU15 countries follow the ERA’s multidimensional gender equality concept, most EU13 countries focus on the first dimension – women’s participation especially in Grade A. Objectives regarding structural change or the integration of the gender dimension in research and teaching remain the exception. Although some EU13 countries did develop their gender equality policies and objectives further in the context of the NAP, the dominant gender equality concept still remains unchallenged in most. This is also due to a lack of policy discourse at European level (between the EC and Member States) which leads to a shared understanding of gender equality objectives.

The gender equality objective pursued by the structural change project and the (lack of a) national discourse on gender equality in R&I proved to be a major challenge for implementing institutions in the TARGET project. Such challenges in the national context have to be considered alongside any institutional factors that support or hinder GEP implementation, whereby the discussion usually tends to focus on institutional barriers and ignore the external ones. Accordingly, I will now discuss the relevance of the interplay between institutional and national context factors for a successful implementation of structural change policies (GEPs), drawing thereby on the experiences gained in the TARGET project.

3.1 Relevance of National Context

In countries where gender equality has not been formulated as a priority for R&I policy, it is mostly reduced to women’s participation, which represents just one of the three ERA gender equality objectives. This understanding is heavily supported by the ERA monitoring system (EC, 2019b). The ERA progress reports refer to the headline indicator “share of women in Grade A” in the context of Priority 4. The two supporting indicators (“share of women among PhD-students” and “share of women among authors”) play a minor role. Hence, countries with a high share of female professors

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are ranked as top performers when it comes to gender equality in R&I. While this defines countries like Romania and Bulgaria as top performers in gender equality (EC, 2019a), it does not mean that women there have an equal share in decision making or that the gender dimension is integrated in research and teaching (EC,2019c).

Institutions developing and implementing a GEP in such a context are confronted with the problem that their own ambitions regarding gender equality go beyond the national objectives. This becomes a specific challenge for institutions which are state funded or work on a state mandate. Even if these organisations implement internal policies which go beyond the national objectives, it is difficult for them to communicate this to an external audience. In such a case, the implementing organisation has to initiate a gender equality discourse with the relevant national stakeholders, which is a really difficult undertaking since a single organisation can scarcely compensate for the lack of a national discourse on gender equality in R&I.

However, the national context is not a fixed factor and might change in parallel to GEP implementation. This has been the case in Greece. The new focus on gender equality in national R&I policy supported the implementation and sustainability of the GEP in TARGET's Greek partner organisation. In particular, a new law on substantive equality that was passed in March 2019 has raised the importance of the GEP as an appropriate and effective tool that public and private organisations in Greece, including universities and research foundations, are encouraged to deploy. A further law passed in 2019 aims at restructuring some universities and foresees the establishment of Committees for Gender Equality in all Greek universities. It envisions such committees as consultative bodies to assist university administrations in their efforts to promote gender equality. One of their main responsibilities is to develop Action Plans to promote substantive equality in the educational, research, and administrative structures of higher education institutions. In this national context, the implementing institution became visible as a pioneer with regard to GEPs in research organisations and played an active role in the policy discourse (e.g. Anagnostou and Avlona, 2019). The latter included an exchange of experiences with GEP development and implementation with universities.

The Greek example shows that changes in national policy can raise the interest in institutional gender equality policies. A similar situation occurred in Serbia, where its status as an accession country introduced gender equality into R&I policy, with the TARGET implementing partner also becoming visible as a pioneer institution at national level. This was further supported by the fact that the current rector of the implementing university is a woman. In the media, the university is often referred to as a progressive institution because it has a female rector. She uses the attention this creates to refer to gender equality whenever possible and to present the university as a good practice example. One interview partner from the implementing university

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described her approach as follows: “She uses every opportunity to raise these issues and push the matter forward within the university. Any kind of public presentation, opening speech, conference, meeting, whatever, she uses the opportunity to mention if not the gender equality plan then some of the aspects of the gender equality plan.” In addition, representatives of the university – especially the rector – have had several meetings with the Serbian Ministry of Labour and Social Affairs, which is responsible for the implementation of a new Gender Equality Law in the country.

The possibility to influence the national discourse on gender equality in R&I is different in situations where the implementing institution has gender expertise but lacks a competent or responsible opposite number (e.g. in the government). It is almost impossible for an implementing partner to compensate for a lack of a national discourse. In extreme cases, this lack of interest at national level may even diminish an existing commitment from management to gender equality. However, the lack of a gender equality discourse in R&I from the government side could be compensated (at least in part) by bottom-up initiatives coming from the research community or NGOs focusing on gender equality. Such initiatives allow them to identify allies and bundle their strengths.

3.2 Relevance of Institutional Context

Barriers for GEP implementation have been discussed at length in recent years. One of the main reasons for ineffective GEP implementation or its lack of sustainability is an absence of support from the top (EC, 2012). The EC’s requirement that the GEP must be published and signed by top management addresses precisely this barrier. However, the support of top management may change due to changing priorities or changes in management. Four of the seven TARGET implementing partners faced changes in management during the project period, which led in one case to severe problems with the implementation of the GEP.

Aside from this one very pronounced example of open resistance to the implementation of a GEP, implementing partners have also been confronted with more moderate forms of resistance. A typical form of resistance – and one which is supported by the definition of gender equality in national R&I policy – is the perception of gender equality as a non-issue due to high female representation in the organisation or R&I in general. Several interview partners reported that gender issues are not seen as relevant at their institution.[3] This is primarily due to the high representation of women among students and staff. “In general, the issue is not that problematic because 64% of students are female, and in engineering 48% of students are women.” (I2) “According to statistics, X [country] does not perform badly. The number of female

[3] The following quotes are taken from the TARGET interim evaluation report (TARGET. 2020).

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students is very high." (I3) "There is no problem regarding female participation at all levels – including professorships and management positions." (I8)

This form of neglecting the gender issues represents a type of resistance which might be explained by a lack of gender competence within the organisation. This is a specific problem in cases where gender expertise is provided by an external expert who joins the organisation for the duration of the project. Hence, the requirement that GEPs have to include training and awareness-raising activities regarding unconscious bias for staff and management also responds to a factor which has been critically discussed in the context of effective gender equality policies. However, the GEP requirement does not insist on internal expertise. It likewise does not specifically address the challenge of establishing internal gender competence and awareness in a country without a gender equality discourse in R&I.

Experiences within the TARGET project not only pointed to hindering factors, they also revealed supporting factors for GEP implementation which compensate (at least in part) for the lack of support at national level. The implementation of gender equality policies is facilitated if gender equality objectives are linked to key objectives or strategies of the institution. An important aspect in this context is the self-perception of the organisation as modern and open-minded. According to the interview partners in the implementing institutions, this requires that gender equality is ensured and all forms of discrimination are combatted. Hence, gender equality as an objective is not questioned by the interview partners, who see it instead as a requirement for a modern organisation. All of the interview partners are aware that dealing with gender equality is a must in European funding procedures. This forms the basis for the generally high acceptance of gender equality issues.

In an ideal scenario, this first step of recognising the relevance of gender for one's own organisation is accompanied by a willingness both to reflect on the way things have been done in the past from a gender perspective and to change practices in the event of an unintended gender bias. This became very obvious in the context of a gender sensitive language. Referring to the existing regulation in his institution, one interview partner noted that "the regulation makes you think about how to express things and understand a gender bias".

Resistance to gender equality becomes more unlikely when gender is considered a relevant dimension in the dominant research fields. The acceptance of gender relevance in research also allows people to discuss gender issues within their organisation. However, this requires a responsible change agent who is accepted by the management as well as the research community and a participatory process which is open to critical discussions and self-reflection.

In institutions where the relevance of gender issues is accepted and there is a willingness to reflect on gender bias, the TARGET approach of establishing a

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community of practice worked well. This approach was based on the assumption that the sustainable implementation of a GEP requires it to be viewed as a common endeavour within the institution and not assigned to one expert who is responsible for GEP development and implementation. As the examples given above also illustrate, the establishment of a community of practice is linked to or builds on measures to develop and augment gender competence.

4 Conclusion

Experiences gained in the TARGET project show that a financial incentive alone is not sufficient to support the development and sustainable implementation of gender equality policies at institutional level. Difficult national contexts can even hamper existing institutional commitment to gender equality. Referring to the experiences gained in the TARGET project and a simple theory of change model allows us to depict the potential stumbling blocks for the Horizon Europe GEP requirement.

With the GEP requirement, the EC takes up recommendations which have been formulated by gender experts and gender activists for many years. It has been constantly claimed that gender equality should be linked to funding and sanctions for non-compliance. However, such an incentive is more likely to achieve its objective when requirements at national (e.g. from funding organisations) and European level are compatible or identical, since this would imply that gender equality objectives are also similar at both levels. Wroblewski (2020) analysed the implementation of national gender equality policies in R&I and showed that EU Member States formulate different gender equality objectives and refer to diverging gender equality concepts. EU15 countries are more likely to pursue the comprehensive gender equality objective formulated in the ERA, while the new Member States (EU13) still tend to focus on female representation in the gender equality in R&I context.

Hence, the realisation of the potential effects of the GEP requirement in Horizon Europe depends strongly on a shared understanding of the gender equality concept, gender equality objectives, gender equality plans, and related quality criteria between the European Commission and the national policy makers. This is of specific importance in times of anti-gender movements and a renaissance of traditional norms and values. A policy discourse on gender equality in R&I is a precondition for the proper functioning of a steering mechanism like compulsory GEPs. It is also needed in order to avoid a widening of the gap between EU15 and EU13 countries with regard to gender equality in R&I – especially when access to European funding depends on it.

In addition to a policy discourse between the European and the national policy makers, a similar discourse should take place at national level between all relevant

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stakeholder groups. It will also be necessary to provide support at national level for those institutions that are developing and implementing a GEP for the first time or further developing an existing GEP.

In an ideal world, the gender equality policy discourse at the national and European levels is accompanied by possibilities for mutual learning and exchange of experiences. This will also contribute to capacity building. The need to build up competence and expertise in GEP development and implementation applies not only to the institutions affected by the GEP requirement but also to the Member States themselves (e.g. the stakeholders responsible for higher education or R&I policy in government ministries).

From the perspective of RPOs, funding alone is not a sufficient incentive to pursue sustainable structural change. Hence, it is important that RPOs are addressed by a European or national policy discourse on gender equality as described above. The motivation to engage in gender issues increases when gender equality is perceived as a criterion for excellent research and a characteristic of a modern organisation which is attractive for both national and international experts.

At the institutional level, it is helpful if gender equality objectives are compatible with or supported by other strategic organisational goals (e.g. excellence, organisational reform). Institutions also need to build up internal gender competence and establish cooperation with gender experts who can support the development and implementation of gender equality policies. This underlines the importance of ensuring that responsibility for gender equality is not assigned to one expert or a specific unit in the organisation but is instead shouldered by a community of practice.

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Connecting.Ideas4Research: Exploring Options for Increasing Responsiveness and Responsibility in Science, Technology and Innovation

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Abstract. This paper provides an overview of the project *Connecting.Ideas4Research* (CI4R) that has given its name to session "A5" of the conference track "A – Open Science: Rethinking the science and society relationship." The project is divided into two major thematic strands: (1) "Digital Ethics and Responsible Research and Innovation (RRI)" and (2) "Crowdsourcing in Research". In a first step, this paper describes the project's overall aims and its approach. In a second step, for each of both subproject strands considerations concerning the framing of central notions and categories are presented and corresponding reference frameworks are sketched and discussed. The paper closes with some remarks on the relationship between the two subproject strands.

1 Overview on the Project *Connecting.Ideas4Research*

Universities are and all other research organizations are confronted with increasingly complex demands from their societal environment—such as digitalisation, the emergence of new disciplines, exploitation orientation or transdisciplinarity—which point to opportunities but also to the need for change. The project *Connecting.Ideas4Research* (CI4R)[1] tries to reflect how people which are affected by research and innovation (R&I) can be integrated in the research process – e.g., by direct integration into a research project. The focus of CI4R was sharpened by the needs of the involved partners, universities and research organisations who are both: research performers as well as affected by R&I and research policies. These organisations are confronted with highly demanding international projects, increasingly complex and wide-ranging digital technology, and increased involvement of individuals, organisations, stakeholders, etc. in the research process itself. Moreover, researchers are being increasingly attributed with responsibility for the impact of research results and the consideration of needs of society in their research.

[1] The project ConnectingIdeas4Research is part of WTZ Süd (Knowledge Transfer Centre South: https://www.wtz-sued.at/en/). The project is conducted by CAMPUS 02 Graz, Graz University of Music and Performing Arts, Medical University of Graz, Montanuniversität Leoben, University of Klagenfurt, University of Applied Sciences FH JOANNEUM Graz (lead), and Carinthia University of Applied Sciences. The WTZ Süd is financed by aws, by means of the National Foundation of Research, Technology and Development (Austrian Funds).

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In the project CI4R we approach these topics from two perspectives and in two separate subproject strands: (1) Digital Ethics & Responsible Research and Innovation (RRI); (2) Crowdsourcing in Research. The *Digital Ethics & RRI subproject* undertakes the examination of ethical implications of digitalisation for research practice (and research organisation). The *Crowdsourcing subproject* focuses on the integration of specific professional groups or other directly affected groups like patients in the process of identifying relevant research questions as well as in the generation of new ideas for solutions for practical problems.

The CI4R project is designed as a knowledge transfer project between the partners as well as other involved higher education institutions, (research) organizations and stakeholders. This major characteristic given, the project organizes knowledge flows concerning the project topics and to enable mutual learning—between the participating partners as well as by learning from external expertise. Also, by opening its project events and activities to external audiences, the project aims at practicing knowledge transfer and networking along the whole project life cycle, not only at the end of the project. The results represent the learnings of all partners as well as the preparation and promotion of findings for implementation. Rather than trying to address its topics exhaustively in all details, the project takes a pragmatic approach to its subjects: The topics that are addressed in the project are derived from concrete issues and interests at the participating organisations rather than by theoretically driven considerations.

1.1 Digital Ethics and RRI

In the last years, not only in academia but also in more popular or policy related debates ethical issues related to digitalization are increasingly being discussed. In the face of polarization, hate and fake news in social media, of the power and practices of big (quasi-)monopolized platform tech companies, or of the rise of automated decision making and machine learning algorithms, it is obvious that there is a need to discuss how we want to live with digital technologies, to which intentions they should be applied, and how these technologies should be designed (cf. exemplarily Werthner et al. 2019, Nida-Rümelin/Weidenfeld 2018, Spiekermann 2019, Zuboff 2019). While the scope of topics addressed in these debates goes far beyond the notion of digital ethics that can be applied in the context of this project, these debates underline the claim that universities and universities of applied sciences – as important actors in innovation systems – must be responsive to such public debates and concerns.

In academic discourse ethical consideration of information and communication technologies (ICTs) and digitalisation has received growing attention in the last years, and a lot of research projects and literature has been produced focusing on ethically relevant impact of ICTs in society, economy or the environment (cf. Reijers et al. 2018,

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Mittelstadt 2019, Bogner 2013). Evolving from information ethics[2] the general perspective of digital ethics is quite broad: Based on the observation that in information societies it has become impossible to assume separated online or offline spheres of life, digital ethics in principle means no less than to address the (morally relevant) "impact of ICT on society and the environment" (Capurro 2009, also cf. Capurro 2017, pp. 187 ff.)—or to be more general: "What kind of mature information societies do we want to build? What is our *human project* for the digital age? (Floridi 2018, p. 2). Floridi also points to the entanglement of digital ethics with digital regulation and digital governance: These fields should be seen complementary to each other, and their distinctive normative approaches should be recognised. Ethics of the digital should be understood as the study of moral problems relating to data and information, to algorithms as well as to problems of corresponding practices and infrastructures, in order to identify morally good orientation or solutions. In this sense, digital ethics produces knowledge for the moral underpinning and shaping of digital governance (ibid., pp. 2ff.).

Beside this ethics boom in the last years the Responsible Research and Innovation (RRI) approach came up and has widely been adopted (von Schomberg 2011, cf. Stahl et al. 2014). Representing one of the central "keys" of RRI, ethics takes a prominent role in this influential concept. Additionally, ethical argumentation has been widely used in technology policies in the last years and ethical advisory is in many cases being requested by policy makers (cf. Bogner 2013). Regardless its popularity for scholars in innovation research or science and technology studies or for policy makers, it has to be acknowledged that the RRI approach is adopted by scientists overall with some more reservation. Also, regarding implementations in different fields of research as well as in different kinds of R&I conducting organisations there is a wide range of interpretations of the meaning of doing science with and/or for society (Carrier/Gartzlaff 2020).

This overview illustrates the need to narrow the scope of the digital ethics subproject and the notion of "digital ethics" that shall be applied. Given the project's main character as a cooperative knowledge transfer project, this narrowing also has to reflect the specific situations at the participating universities, their profiles and interests. These considerations have led to a rather pragmatic perspective and understanding of digital ethics for our project:

The focus in the digital ethics and RRI project stream is to explore ethical challenges for research practice (and research organisation) in the context of digitalisation.

[2] And its neighbouring disciplines like computer ethics, media ethics, data ethics, ethics of technology, and likewise.

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Corresponding major interest of our activities can be expressed by the following questions:

- In which ways are we (as universities / universities of applied sciences) confronted with digitalisation related ethical challenges in our research and innovation activities?
- And how can we put ourselves in a position to be able to deal with such challenges adequately?

1.2 Crowdsourcing in Research

The core idea of the substream on crowdsourcing in research is to analyse the process of generating innovative research topics and questions in collaboration with practitioners. This is done in a participative approach with a variety of methods and disciplines. To this end, four exemplary and interdisciplinary use-cases from the fields of medicine, physiotherapy, music pedagogy and architecture were set up. All of these four use cases are collaborating with a specific “community of practice”[3] from their field (=”crowd”). The use cases address specific professional groups from their field as well as other relevant groups (e.g., patients, users) that are directly affected by research content and results, but that typically not have the opportunity to co-design research projects.

The groups addressed differ from use case to use case; and different methods have been used to get in contact and work with the specific target groups. In addition, the “crowds” addressed by the four use cases are very different (by size, motivation, shared understanding, level of academic training, access to research and infrastructure, etc.). Some of them are very homogeneous, while other groups are not easily identified as a “community of practice” in the first place.

The focus of in the Crowdsourcing for research project stream is to experiment and learn in practice and identify challenges in an interdisciplinary diverse setting with practitioners and their “Community of practice”.

This diverse setting of the projects made it necessary to find a practical working definition of “Crowdsourcing” as a method for research that suits the interdisciplinary and multi-methodological character of this knowledge transfer project. Therefore, in this paper the reference framework of “Crowdsourcing” that underlines the project will be shortly presented and discussed.

[3] The definition of “community of practice” follows largely the definition by Wenger-Trayner (2015) “Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.” This term was coined in the early 1990s in several publications by Etienne Wenger, William Snyder, Jean Lave and others.

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2 Digital Ethics and RRI

According to the project's narrowed notion and approach to digital ethics at universities and universities of applied sciences, as described in chapter 1, we want to present some considerations concerning reference points for the development of suitable perspectives on digital ethics and RRI at our organisations.

At first glance, new ethical challenges of universities' research activities in the context of digitalisation can be seen on two levels:

First of all, the results of scientific research and innovation activities might prove to be an issue. In the last years, the enormous *impact* of the digital technologies in almost all spheres of our lives has become visible. Especially potentially negative impacts point to the problem of responsibility and accountability in research and innovation.[4] While negative effects are to be avoided, certainly chances shall be used, and positive impact must be realised. Already this rough juxtaposition between negative and positive impact points to the fact that societal expectations on science, technology and innovation (STI) are in many cases quite variable: The valuation of potential effects will highly depend on one's value orientations and interest (and also on individual concern or involvement in decision making).[5] Secondly, besides such an *output* (or *outcome*) *oriented view* the R&D *processes* themselves prove to have normative implications: E.g., digitalised R&D practice is increasingly based on big mounds of data (and produces big mounds of data). Therefore, suitable arrangements for an appropriate handling of such big data sets have to be established. This applies to the handling of personal data, but also the access to the research data, possibilities to re-use data and data provenance.

Re-framing the distinction between output and process orientation can stress that the focus of digital ethics in the context of scientific research and R&I is not limited to ICT development and engineering disciplines: Regarding *objects of research*, technologies of digitalisation may be subject to ethical consideration as well as their embedding in societal practices, their adoption by users or emerging demands for regulation. Ethical implications will be easier to attribute with increasing application readiness of technology, and specific areas and goals of applications, as well as organisational forms, emerging economic models, societal adaptations to (or drivers

[4] Albeit, it has to be acknowledged that the field of ICTs and digitalisation rather than in universities the main drivers of technology development will be found in commercial environments.

[5] For the differentiation of effects as intended/unintended, expected/non-expected, desirable/non-desirable (and corresponding implications) see Gloede 2007.

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of) applications or regulative frameworks can be investigated from an ethical[6] At the same time, digitalisation alters the *methods* with which scientific knowledge and new technology is being produced. Digitalisation and data driven changes in research methods are not restricted to technoscientific disciplines but do also affect social sciences and humanities, as it is reflected in notions like digital humanities.

These considerations show that in the context of digitalisation universities face challenges that apply to different dimensions of their R&I activities. Also, it becomes clear that such ethical challenges in principle may occur in all disciplines or fields of R&I and are not limited to computing departments and related engineering disciplines.

2.1 Research Ethics and Ethics in R&I

As described at the beginning, in our project we are not aiming at giving answers to ethical questions in the context of digitalisation and research. We rather aim at identifying options to prepare our organisations to become able to (better) address such issues in future STI activities. With reference to the different dimensions sketched above a closer look at understandings of research ethics and ethical consideration of impact of STI can help to identify and assess suitable approaches for our leading questions.

Reijers et al. (2018) distinguish in their literature review two research paradigms and corresponding ethical approaches: “traditional” research (and “traditional” research ethics) on the one hand, and research and innovation (and ethics in R&I) on the other hand. Insofar R&I is being characterised by its guiding interest in application (and thereby in intervention into its societal, economical, or natural environment), ethics in R&I needs to take an outcome or impact-oriented perspective. In contrast, the focus of traditional research ethics is primarily seen in proper research conduct: Traditional research ethics are perceived as a “professional ethics of researchers, including for instance considerations of scientific integrity and treatment of human subjects in experiments” (ibid, p. 1438). As digitalization related activities at universities and universities of applied sciences certainly cannot be limited to one of these two paradigms, both branches of ethical consideration are relevant in our context and may provide productive connections and insights.[7]

[6] Digital ethics, understood as applied ethics investigating the moral problems in regard to digital technologies and corresponding practices and regulation (see chapter 1), can largely be assigned to this dimension.

[7] It is obvious that the distinction proposed by Reijers et al. roughly reproduces the distinction between basic research on the hand and application oriented research and technology development on the other hand. Of course, this distinction has to be seen as opposing two ideal types. For a similar approach to ethical assessment in R&I see Brey et al. 2015.

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Reijers et al. also point to problems of conflicting values in the normative assessment of impacts of R&I. Value conflicts may be grounded in different ethical claims that apply to a subject—e.g., privacy and security in the field of security technologies. But check lists or principled approaches to research ethics often do not give orientation for weighting or prioritizing in value conflicts (ibid., p. 1457). Additionally, ambiguity in the normative assessment of impacts may occur from very general or abstract value orientations: Referring to very fundamental values, like human rights, has the potential of being highly agreeable; on the other hand, especially in cases of conflict such fundamental value references can show a significant interpretive flexibility and are not necessarily able to ensure shared problem views or even solutions.[8]

Concerning the impacts of R&I, ethics assessments are well established on different levels like research organisations, national funding organisations, project funding by the EC[9]. Another way of addressing impacts of R&I projects (and R&I policies) may be accompanying Ethical, Legal, Social Aspects (ELSA) and Ethical, Legal, Social Impact (ELSI) usefulness, both approaches have in common that the ethics related activities keep in a way detached from the actual research practice: In case of ethics assessments by or for institutional review boards this applies as ethics assessments typically are done ex-ante. And in case of accompanying research limitations may arise because commonly such studies are conducted by separated sub-teams that do not directly contribute to the R&I activities and look on its objects from outside (Stahl et al. 2019).

2.2 Implications for the Project

For our CI4R project, we try to reflect these considerations in the project's specific working formats. In a first series of roundtable discussions, we analysed current topics and issues in our organisations with respect to ethics, research and digitalization: Promoting and Communicating RRI; Ethical Aspects of Video Recordings of Teaching Situations; Application of Machine Learning Methods in Health-Related Research; Ethics Assessment Schemes for Digitalization Related Research; Design, Technology and Ethics of Online Exams. The chosen topics can be attributed to specific aspects of the distinctions discussed above, as they address different problem dimensions, types of actors or fields for action.

Based on the evaluation of the round table discussions, in a small series of more implementation-oriented workshops we want to identify options and starting points for

[8] To point to the gap between reference to very basal value orientations and demands for practical orientation for action is of course not very new, see for example Pimple 2002.

[9] E.g., as ethics self-assessments done by researchers in the course of funding proposals; and/or as decisions or consultancy by ethics boards or committees.

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practical measures in our organisations. Such measures may address, on an *individual level*, researchers and research groups and their competences, skills and awareness for ethical issues in their research (concerning both, outcome dimension and process dimension). On the *level of organisations* they may show a need for the extension of support structures for researchers and they can emphasise options for the embedding of digitalization related ethics in the organisational culture. And on the *level of regional cooperation* it shall be discussed, if and how an (institutionalised) cooperation for the ethical assessment of research related to digitalization can be suitable and feasible.

2.3 The Case of ICTs

Even though we have stated that digital ethics (understood as ethical consideration in digitalisation related R&I) is not limited to computer sciences, data sciences or ICT development, a closer look at suggestions for implementation of ethics in these fields can be rewarding.

In the last years we have faced high dynamics in the application of new digital technologies, of corresponding business models and usage practices. “Artificial intelligence” (AI)—regardless if it makes sense at all to use this term when talking about machine learning algorithms – stresses some socio-technical aspects of the latest developments that it might be justified to ascribe new qualities to current digitalisation. Rather than pure computing capacity and performance of modern devices it is networking, automatisation, and increasing autonomy of ICT systems that point to significantly new socio-technological conditions. In particular, informational and material contexts of human agency become increasingly overlain and modified by information technology, thereby questioning and blurring established perceptions of artificiality and naturalness of environments (cf. Greif et al. 2011). In this sense, the ubiquity and pervasiveness of digitalisation applies to almost all spheres of human agency – and is widely accepted. Additionally, decision making in information societies is increasingly assisted by or completely delegated to machines. Recent ethical discussion about digitalisation has reflected this and has focused on algorithms for machine learning, automated decision making or methods for big data analysis. Consequently, “ethics of algorithms” is evolving as a significant field of research (cf. Mittelstadt et al. 2016). Such approaches are particularly interesting for our project because they may be able to tackle some of the problems of ethics assessments or accompanying ELSA/ELSI research (as indicated above) by integrating ethical consideration into the core of technology development.

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2.4 Integration of Ethical Consideration into R&I Activities

Approaches to ethics in R&I located inside or at the core of proper R&I practices can be framed as "intra methods".[10] The overall aim of such intra approach can be seen in "enabling, organising and ensuring ethical technology design … by integrating ethicists in R&I practises, identifying ethical issues in design, embedding values in design and organising ethical design in the R&I process" (Reijers et al. 2018, p. 1451). For example, in the field of ICTs proposals for such intra methods are discussed in the ICTs as "Value Sensitive Design"[11]. about 15 years now. Following the insight that ICT systems "are intentionally or unintentionally informed by moral values of their makers" (van den Hoven 2007, p. 67), procedures for the integration of ethical expertise have been proposed and tested in various projects and contexts in the last years (cf. Simon/Wong/Rieder 2020, Reijers et al. 2018, Brey et al. 2015, van den Hoven 2007).

Regarding machine learning algorithms, the concepts and tools for value sensitive design and related concepts still need to be further developed and spread more widely (Morley et al. 2020). Calls for the integration of values sensitive design, like ethical consideration into IT design, are of course not new; the current debate and adoption of such approaches in the context of RRI may offer a chance to promote these methods and to benefit from each other. Whilst having different and specific starting points RRI and the intra methods in ICT design can be performed complementary and thereby enriching each other (Simon 2016). Intra methods may work against the detachment of ethical consideration from research practice and a pro forma performance of ethics assessment without significant consequences for research practice ("tip box mentality", cf. Stahl et al. 2019). They may also supplement shortcomings of the variety of existing guidelines and professional codes of conduct. Such guidelines and codes may give clues concerning properties of "ethical ICT systems", but in many cases they fail to provide insights regarding the question how ethical goals can be achieved in practice. In other words, to include and promote intra methods in RRI might contribute to a shift "from what to how" by "translat[ing] principles into practices" (Morley et al. 2020, see also Mittelstadt 2019).

We will see to which extend such approaches will be established in future and which effects they can generate. If these methodological innovations in ICT design succeed to contribute to systems that, for example, have less biases and avoid discrimination of certain user groups, these methodological innovations might open additional links to adjacent debates: E.g., claims for value sensitive approaches can be substantiated

[10] In distinction to ex-ante and ex-post methods.

[11] Originally introduced by Friedman et al. (2006) the term evolved into to an umbrella term, covering also similar approaches and concepts like values in design, or disclosive computer ethics (cf. Simon 2016).

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not only with moral argumentation but also with the prospect of better products in terms of quality (and acceptance). In addition, the integration of value sensitive methodologies into teaching might be a leverage to spread such approaches beyond specific (academic) circles.

3 Crowdsourcing: Harmonization and Reference Framework

Crowdsourcing is an actively discussed topic[12] and promises remarkable advantages over classic research approaches at first glance: Researchers can get additional resources (that are always hard fought for) and inputs to complete their research tasks. Furthermore, crowdsourcing promises to be a possible way to integrate the needs of society in research, or at least to integrate the public into the research cycle in some way.[13]

But Crowdsourcing also might touch some ethical issues. Tasks are outsourced to other (largely disadvantaged) groups outside of academia motivated by monetary incentives. In practice, both Crowdsourcing as a way to do transdisciplinary and participatory research as well as a tool for outsourcing are often combined in projects.

Methods of Crowdsourcing are used in a wide range of applications. The wide range of application areas in- and outside of academia and the very different approaches to crowdsourcing, results in a large variety of definitions for crowdsourcing itself.[14] In our interdisciplinary project CI4R with its four different use cases we are also addressing, engaging and experimenting with different ways of approaching different methods of crowdsourcing.

To provide a basic approach for all four use cases, all disciplines, various methods and all partners involved (see section 1), a common ground for a definition of Crowdsourcing had to be developed. Therefore, in this short paper three perspectives on definitions of Crowdsourcing will be discussed—all three related to the specific characteristics and topics of the CI4R project.

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[12] See for example Gordon (2021), showing a significantly increase of research content tagged with crowdsourcing (or variations), since the first coinage of the term crowdsourcing by Howe (2006).

[13] Crowdsourcing in Research is often seen as a method of democratic engagement and participation. In addition, Crowdsourcing as tool for integrating a variety of perspectives and inputs from a crowd is also a matter of Responsible Research and Innovation (RRI). Related policies might increase the acceptance of research, democratize funding of research projects as well as provide efficient research, See Fossum et al. (2019).

[14] For other definitions and approaches not mentioned in this short paper see for example: Hosseini (2016), Lichten (2018), English (2018).

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First, the project stream of "Crowdsourcing in research" is dealing with a professional community and their needs from R&I, but also questioned how they are affected by it. Taking a RRI perspective we can identify benefits using this approach similar to benefits of Citizen Science (CS). As Resnik et al. (2015) state, CS increases or provides valuable resources for the research as well as it contributes to a better understanding of scientific research of the participating "Citizens". In addition, a widely stated beneficial output of CS methods is to "democratize the research process" (Resnik et al 2015, p. 477), providing the possibilities for CS participants to engage in the design of R&I topics, processes, output, etc.

The project CI4R also works with professionals from a specific field. Their motivation, in contrast to CS participants, might be highly affected by their professional interest. Therefore, the first perspective presented here will be dedicated on the (presumed) dialectic characteristics between Crowdsourcing in Citizen Science and Crowdsourcing in a professional setting like "Clickworking" or paid Microtasks. This perspective on Crowdsourcing is supplemented by a definition based on the use of Crowdsourcing in the research cycle, regardless of the research framework. In a second perspective, crowdsourcing is defined as a broad methodical set that amends traditional research methods and processes. A definition strong intertwined with research process, not covering non-academic use of Crowdsourcing. Therefore, a third perspective, a 4-Field approach to "Simple Crowdsourcing" was developed that harmonizes different definitions of crowdsourcing and serves as a basis and reference framework for the project itself. While this approach serves the project and knowledge transfer as a reference framework, it is applicable for many fields in- and outside academia.

3.1 Definition "Participation and Democratization": Citizen Science and Clickworkers

First, in citizen science, definitions of crowdsourcing are often based on the classification introduced by Muki Haklay[15]. Haklay sees Crowdsourcing as a "Level 1" approach, where participating citizens are simply defined as "sensors" for data in a project. This is an easily applicable definition for crowdsourcing in research, but also very limited in some sense.

In practice this "sensor" approach of crowdsourcing is common, especially in projects for environmental observations and monitoring[16] that create large amounts of data. In this context, the tasks for the individual members of the crowd are very easy and

[15] First published Haklay (2013).

[16] See for example recently the Working paper of the European Commission (2020).

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comprehensible, which makes it a perfect tool for citizen science projects.[17] In that way, a very large and heterogeneous "crowd" can be addressed and participate in the project.

On the downside, due to the limitation to very simple tasks and the understanding of the "crowd" only as "sensors", the generated input is predefined and simple. In a critical view, crowdsourcing in this perspective is mainly outsourcing of data collection. But at least it is based on voluntary action, in general for a good cause, and helps to integrate public into research.

Another form of outsourcing in scientific projects are paid micro tasks and data collection (and to some extent design and development tasks). With the catchword "Clickworkers", a method has been established that leads to ethically questionable constructs as well as doubts about their scientific quality. For example, platforms like "Mechanical Turks" (Amazon) or other "Clickworkers" platforms[18] provide a tool to find fast and cheap support in projects, like small tasks to solve, data harmonisation, making descriptions of online objects, etc. These platforms provide an excellent approach for scientists to get data[19]. But there are several negative effects, regarding the underpayment of participants[20], reproducibility of the collected inputs from the participants[21] as well as other possible downfalls of the methods.[22]

In our project, we do not rely on paid participation in the form of "Clickworking". Instead, self-motivation and voluntariness play a major role. However, to avoid misunderstandings in the communication and especially when working with professional groups, it is important to clearly distinguish between paid work and the Crowdsourcing approach chosen for our project. In this context, we can refer to the basics of measures for Citizen Science project[23] when it comes to a responsible and appreciative approach in such projects.

However, we would also like to question the narrow definition of Crowdsourcing in Citizen Science projects as a pure network of human sensors. Not only does this

[17] See for example the large community of https://www.zooniverse.org/ providing "people-powered research" and hosts especially a lot of projects that uses citizens involvement for data clarification and tagging of objects and images.

[18] See for example Peer et al (2017).

[19] See for example the use of Crowdsourcing in Behavioral Sciences Chan et al (2016); Chandler et al (2016).

[20] Koaro et al (2018), showed "that workers earned a median hourly wage of only ~$2/h, and only 4% earned more than $7.25/h" in Crowdsourcing projects down with Amazon Mechanical Turk Platform.

[21] See Shapiro et al (2013).

[22] See the Best Research Practices of the Use of Crowdsourcing in clinical Research by Chandler et al (2016) suggesting to pay especially attention to "Pay a Fair Wage", to "Disguise the Purpose of the Study Until the Task Is Accepted", "Reduce and Measure Attrition", "Prescreen Unobtrusively", "Prevent Duplicate Workers", "Avoid Obtrusive Attention Checks", etc. in Crowdsourcing projects.

[23] See for example Haklay et al 2020.

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definition seem very limiting, but it also negates the needs of the participants as well as their interest to deal more closely with the subject matter and not just perform a one-to-one measurement job.

3.2 Definition “Crowdsourcing is Everywhere”: The Crowd in the Research Cycle

Crowdsourcing in science might be a part of citizen science and vice versa, but it is not limited to the integration of non-researchers as sensors or collectors of data. In a meta-study, Uhlmann et al. (2019) show that “crowdsourcing” in a broad definition is used in different types and at different stages in the research cycle, from ideation and study design to writing research reports and help to replicate published and unpublished findings.

Uhlmann et al. (2019) distinguish two types of addressing the “public” in research projects: “vertical integration” and “horizontal distribution”. “Vertical integration” describes the approach that, researchers conduct their study by themselves, and the “public” is mainly addressed as a recipient of dissemination activities later in the research project. In contrast, the idea of crowdsourcing as “horizontal distribution” of ownership, resources and expertise encompasses involvement of the crowd along the entire research cycle. Accordingly, Uhlmann et al. identified crowdsourcing approaches in the full research cycle from ideation to publication, namely ideation, assembling resources, study design, data collection, data analysis, replicating findings, writing research reports, peer review, replicating published findings and deciding future directions.

From this perspective, crowdsourcing promises to provide additional resources to solve complex problems, improve results in research, increase reproducibility, provide transparency, include the needs of society in research etc. In conclusion, the “horizontal distribution” approach is very detailed and aligned directly with the process of the research cycle. The focus on the research cycle, however, might have limits when addressing development and innovation, transdisciplinary projects, public engagement, etc.

Even if this model describes very precisely and in depth the different applications of crowdsourcing within science, crowdsourcing methods are also used outside the scientific process, whether in the economic field, in technical development, or in political and social interactions. And especially the latter can be observed in transdisciplinary projects, as well as Citizen Science projects. It can also be found in combination with approaches of "classical" research in one project.

We want to be more open minded and claim for a perspective of Crowdsourcing that is not fixed to the research cycle. For this reason, we would like to present another possible definition of crowdsourcing, which comprehensively covers several areas of

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possible application. At the same time the proposed understanding provides an easier access, especially for the communication of crowdsourcing processes to groups that have little contact with academia and are not familiar with the research cycle at all.

3.3 Definition “Simple Crowdsourcing”: 4-Field Approach to Harmonization for Practice

Finally, we want to highlight the approach of a definition of crowdsourcing that is now serving as reference framework for the project CI4R. The goal was to harmonize different approaches of crowdsourcing, providing a basis for all of the project’s use cases. This approach[24] uses a simplified definition of crowdsourcing and identifies four fields (see Fig 1) of crowdsourcing aspects: *Microtasks*, *Macrotasks*, *Crowdfunding* and *Contest and Competition*. In practice, these four fields are not isolated from each other, but are rather often found together and mixed in research projects. They are used as well in business or organizational processes beyond academia.

While we cannot present every aspect of this model in this paper, we will give a brief overview of the most important features of the 4-fields of perspectives of Crowdsourcing. In general, this model is suitable for comparing crowdsourcing projects within and outside of academia and even for characterizing historical examples or, if applicable, specific processes within the research cycle.

[24] A similar model is described in Simperl (2015), p. 19ff based on inter alia “The Daily CrowdSource”-Umbrella (now inactive homepage); In addition, see Nakatsu et al (2014) providing a taxonomy of Crowdsourcing based on the “task complexity” similar to the two fields of Micro- and Macrotasks, with another focus; Very Comprehensive approach to a definition of Macrotask Crowdsourcing can be found in Lykourentzou (2019); For Crowdsourcing contests / competition see Segev (2020) and also Cheng (2015) for an example of breaking down macrotasks to microtasks in a crowdsourcing project; Literature on Crowdfunding is manifold – for an first impression see Moritz (2016), Böckel (2021).

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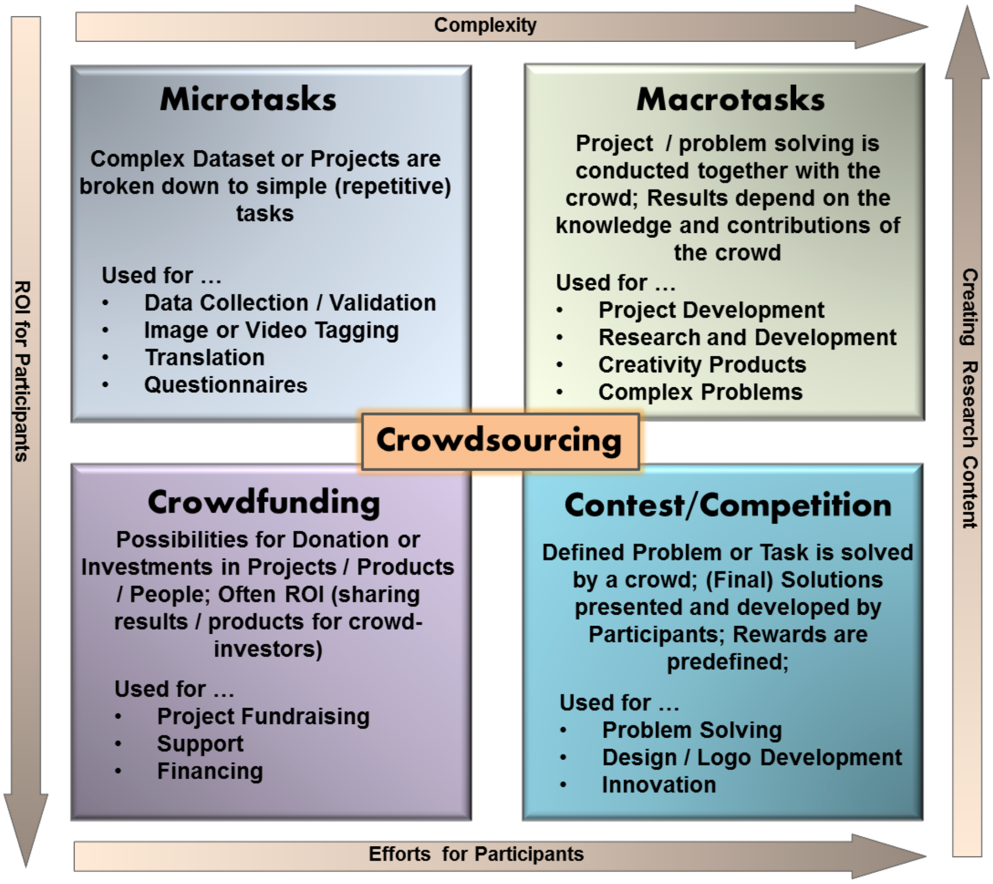

Fig. 1: The 4-Fields Model of Crowdsourcing in Practice – A framework for a definition of Crowdsourcing in the Connecting-Ideas4Research project.

First, the **microtasks** aspect is similar to the definition by Haklay (2013), where “cititzens” are used as “sensors” for projects. In this field, individuals of the crowd perform simple, mostly repetitive, tasks. The simple tasks are often used to improve or validate complex datasets or for translations of sources.

Second, the back to front approach—**macrotasks**: Here, initially the project and its tasks are only defined rather generally, and project results depend significantly on the knowledge of the crowd. Research results or problem solutions are developed together with the crowd in a process that is often time and resource consuming. This is especially interesting for generating new research questions together with crowds—or to develop complex solutions.

The third aspect, **contest and competitions**, is related to macrotasks: A predefined problem or task is solved by a crowd. In contrast to the macrotasks approach however, the solution is not developed in the project with the crowd itself. Rather, the crowd has to deal with a problem and individuals, or teams submit a possible solution and might be rewarded if the solution works. Collaboration between groups is not necessary, but competition is the driving force here.

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Fourth, **crowdfunding (or crowdinvesting)** aspect is often used for funding projects, innovations and ideas. The crowd's input is usually money and therefore the influence on the development of the final product is limited. For the participants, the return on investments is important. After the projects are (successfully) finished, participants get monetary refunds, the developed product or access to specific outputs of the project.

This approach defines crowdsourcing in research on a more neutral fundament than Haklay (2013). In our view Crowdsourcing starts in the collection of data and sorting it into information as well as it includes the interpretation of data and information. In addition, Crowdsourcing also refers to approaches that are based on collaborative work in group of persons in transdisciplinary settings in and outside of academia. Crowdsourcing deals with some possible cross-cutting issues of all forms of part of collaborative, open and participative science, without making a hierarchical classification, categorized in four fields Microstasks, Macrotasks, Crowdfunding as well as Contest and Competition, that can also be mixed in practice.

This simple and open approach to a definition to Crowdsourcing by the **4-Field model or "Simple Crowdsourcing" approach** promises to fit not only for "classical" and interdisciplinary research projects and the research cycle but also for Participatory and Citizen science projects, for Paid Clickworkers or other Outsourcing activities, etc. Therefore, this 4-Field model fits perfectly as reference framework for the diverse and interdisciplinary character of the Connecting.Ideas4research project.

Naturally, there are also some limitations with this model. A definition of crowdsourcing at such a meta-level offers many reference points but cannot be accurate in detail for all projects and may require individual adaptations. However, this model supports the development of a first foundation and understanding of crowdsourcing in projects that works with various approaches and methods of crowdsourcing. In addition, this simple model also be used to subsequently explain the different approaches and methods of crowdsourcing to potential participants in the crowd.

The choice of the type of the method for a project Crowdsourcing also heavily influence the possibilities of participation on the one hand but also determine the possibilities for the individual and the crowd on the other hand. While based on the 4-field model presented here, a Crowdsourcing approach via easy microstasks enabled participants to join with little time effort and few prior knowledge. In this approach, a diverse group of people might be able to provide input. But on the other hand, the creative leeway of each participant is very limited.

Similar low-threshold access for participation is provided by crowdfunding models that allows the crowd to support personal relevant projects with money or other assets. But likewise, with microstasks, participants ("the crowd") have a very limited creative

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leeway (only choosing) and decision making is interlinked with available financial resources of the participants.

Macrotasks (and to some extent also contests and competitions), however, are often limited to smaller groups of people with specific prior experiences, enough (time) resources and in general the opportunities and contributions for designing and develop a possible solution or result is higher.

In CI4R approaches via microtasks like for example questionnaires or digital open platforms as well as elaborate workshops for co-design, co-design for prototyping of communication tools, mini symposia, expert's roundtables and similar are used as tools. In addition, the focus on a specific professional group, "community of practice", provides limited access for all, but also ensure that focuses on needs and topics of R&I that are for particularly interest of the specific community.

4 Final Remarks

Both subprojects of Connecting.Ideas4Research—"Digital Ethics & RRI" as well as "Crowdsourcing in Research"—explore, in each case with specific perspectives, ways to increase responsiveness and responsibility of scientific research and innovation activities. In doing so, some options for mutual impulses become apparent.

On the one hand, insights from the digital ethics fields can be applied to the design of crowdsourcing processes. Crowdsourcing practices heavily rely on the use of digital environments for communication and collaboration. Hence, awareness for ethical aspects of technology use or choice of methods can influence the design of crowdsourcing projects. In turn, crowdsourcing can be used for widening ethical consideration in research and innovation. As crowdsourcing contributes to opening up STI activities for knowledge and problem views of people from respective application fields, for example awareness for (morally relevant) impacts of technology design decisions might be raised.

The 4-fields model for crowdsourcing presented in chapter 3 shows that the scope and depth of participation of non-scientists can vary significantly in crowdsourcing projects. The choice of approaches will thereby depend on topics, aims and research interests of a project. Accordingly, crowdsourcing may turn out to be an expansion of methods that can contribute to increasing the responsiveness in R&I. Then again, crowdsourcing in research can be conducted simply for pragmatic reasons and without a noteworthy normative claim. Regarding the choice of crowdsourcing approaches and corresponding sets of methods (including the decision if a crowdsourcing approach shall be chosen at all) the 4-fields-perspective proposed in this paper provides some useful orientation.

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