Dipl.-Ing. Andreas Strasser, BSc

Analysis of an Open Workshop Maker Days for Kids Event

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Priv.-Doz. Dipl.-Ing. Dr.techn. Ebner Martin

Institute for Interactive Systems and Data Science
Graz University of Technology

Graz, February 2019

Affidavit

I declare that I have authored this thesis independently, that I have not used other than the declared sources/resources, and that I have explicitly indicated all material which has been quoted either literally or by content from the sources used. The text document uploaded to TUGRAZonline is identical to the present master's thesis.

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Kurzfassung

Making beschreibt den Prozess ein eigenes Produkt aus verschiedenen Einzelkomponenten zu bauen oder ein bestehendes Produkt zu erweitern und kann von jedem ausprobiert werden der Interesse an der Erstellung von eigenen Produkten hat. Solche Projekte können dazu benutzt werden eigene Fähigkeiten zu verbessern und zu trainieren durch die Verwirklichung von eigenen Ideen. Aus diesem Grund haben auch schon Schulen das Making für sich entdeckt und spezielle Plätze installiert in denen Making durchgeführt werden kann und werden Maker Spaces genannt. Diese Maker Spaces können sowohl permanent aber auch temporär installiert werden mit der Möglichkeit an eigenen Projekten zu arbeiten. Im Gegensatz zu Europa bietet Nordamerika bereits seit Jahren Maker Spaces an Schulen an. In den letzten Jahren wurde in Europa ein eigenes Maker-Konzept für Kinder erarbeitet. Dieses Konzept berücksichtigt die pädagogischen Bedürfnisse von Kindern. An der Technischen Universität Graz wurde eine Making-Veranstaltung für Kinder durchgeführt die dieses Konzept berücksichtigt. Während dieser Veranstaltung wurden die angebotenen Kurse, sowie geschaffenen Produkte lückenlos dokumentiert um besser zu verstehen wie bestimmte Zielgruppen wie etwa Mädchen besser angesprochen werden können um zukünftige Veranstaltungen dieser Art besser zu optimieren.

Diese Masterarbeit beschreibt die Maker Days Veranstaltung, die im August 2018 von der Technischen Universität Graz angeboten wurde. Die Arbeit beschreibt zum einen Allgemein die Veranstaltung und bietet darüber hinaus noch eine Auswertung der aufgezeichneten Daten. Die Auswertung enthält weiters eine Diskussion und Interpretation der Ergebnisse und könnte verwendet werden um zukünftige Veranstaltungen besser auf spezifische Alters- und Geschlechtergruppen optimieren zu können.

Abstract

Making describes the process of building your own products by using different components or extend existing products and can be performed by anyone that is interested in realizing their own ideas. These projects can support and advance existent skills. The skills are advanced through project-based learning. For this reason, schools have started to introduce the concept of making to schools by installing special tinker places that are called Maker Spaces. Maker Spaces can be temporary or permanently installed spaces and offer the possibility to work on projects. As opposed to Europe, in North America, educational Maker Spaces in schools are widely spread. In the last years, a special Maker concept for children has been designed in Europea that considers the pedagogical needs of children and this concept was used to organize a Maker Days for Kids event at Graz University of Technology. During this event, the workshops and products were gap-less recorded to improve further events and to understand the attractiveness of certain workshops for specific groups such as girls.

This master thesis describes the Maker Days for Kids event of Graz University of Technology in August 2018. The thesis also provides an evaluation of the event as well as discussions about certain observations and can be used to improve and optimize future events for specific ages and interest groups.

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Chapter 1

Introduction

"The goal is to teach in such a way as to produce the most learning from the least teaching. - Seymour Papert

Seymor Papert was one of the first scientists that suggested the big potentials of computers for the development of young childrens. He had the idea that every children should have his own personal computer to use it as an instrument for learning and enhancing skills such as creativity, innovation and computational thinking. Back in the 1960s most of the people laughed about his vision but nowadays time has changed and personal computers have already been replaced by ubiquitous devices such as smartphones, tablets and smart watches [pro]. Against all critic Papert pursued his vision and created during his lifetime many concepts and methods that still influences children nowadays. One of the most famous is the Lego Mindstorms concept that is based on his book "Mindstorms: Children, Computers and Powerful Ideas." [Pap80]. Lego Mindstorms is a hardware software robot platform [PRK10]. The whole platform is adapted for young children without any prior programming knowledge to support children in developing computational thinking [CASS16]. The concept is based on Paperts learning theory "Constructionism". Constructionism emphasizes that constructing real objects is the most efficient way of learning because during this process participants will encounter problems and they need to be solved on their own [Kha13].

Do-It-Yourself (*DIY*) is a concept where the users are building parts or the entire product themselves. The swedish furniture shop "Ikea" has introduced this concept in the 1960s successfully to the masses [ikea]. In 2016 there have been almost one billion visitors inside their shops worldwide [ikeb]. As a result *DIY* seems to be suitable for the mass. In the *Information and Communications Technology* (*ICT*) domain *DIY* is also known as "Making". Making describes the process of creating technical artifacts by personal projects. During this process the "Makers" have to evolve themselves to complete their project by learning new technologies, concepts,

methods and scientific background [JL13]. To enable a faster learning process and to get access to tools Makers are joining "Makerspaces". Makerspaces are physical locations where Makers can access tools and share their knowledge with others [KB17]. In 2018 the Hackerspace Wiki lists about 1420 active Makerspaces worldwide [hacb]. Harnett et al. have determined that temporary established Makerspaces are positively influencing students during their projects, especially for upkeeping the motivation as well as the steady increase of technical skills and the positive influence on teamwork [HTP14]. As a result the concept of Makerspaces were introduced to high schools with great sucess. Banks-Hunt et al. emphasizes the excitement of students and the increased interests in engineering tasks and that the students have requested for more project activities [BHAGB16].

The introduced contributions [PRK10, JL13, KB17, hacb, HTP14, BHAGB16] demonstrates that Paperts learning method Constructionism has already been established in our society as well as in school. Schön et al. have introduced an optimized concept of Making with children [SE17] This concept has already been applied in a four days open workshop lab in Bad Reichenhall [SER16].

The "Makerdays for Kids" at Graz University of Technology are based on their concept and have their focus on awaking interests in Science, Technology, Engineering, Art and Mathematics (STEAM) to children between 10 and 14 years. In 2015 the European Union has published a report where about 42% of all STEM professionals are between 45 and 64 years old and that in the next years a gap arises and this will affect the European innovational strength because the digitalization requires more STEAM skilled employers [UR15]. The open workshops at Graz University of Technology is a step into this direction to awake and support STEAM interests in children to change our future positively.

1.1 Motivation

To understand how "Makerdays-for-Kids-Event" appear on children between 10 and 14 years and to improve the understanding as well as the output of future workshops it should be statistically evaluated and scientificly analyzed.

1.2 Idea

The concept of a Maker Days for Kids event by Schön et al. [SE17] has been applied the second time to children and this enables the possibility to compare the results of the last evaluation as well as considering established theses about these workshops.

1.3 Objective Targets

This thesis should fulfill the following targets:

- Give an overview about related work about Making, especially in combination with children.
- Summarize the open workshops Making-for-Kids event that has been hosted by Graz University of Technology in August 2018.
- Evaluation of the Makerdays-for-Kids event.

1.4 Layout

This thesis is divided into six different Chapters:

- **Chapter 1 Introduction** can be found on page 2 and is about introducing into this thesis as well as list the objective targets of this thesis that should be fulfilled.
- **Chapter 2 Related Work** can be found on page 5 and gives an overview about Related Work in the field of Making with children.
- **Chapter 3 Maker Days for Kids** can be found on page 15 and gives an overview and detailed description of the Maker Days for Kids event.
- **Chapter 4 Evaluation and Interpretation** can be found on page 41 and gives details of evaluation of the Maker Days for Kids event evaluation.
- **Chapter 5 Discussion** can be found on page 136 and provides an interpretation about the evaluation results of Chapter 4.
- **Chapter 6 Conclusion** can be found on page 143 and summarizes the work of this thesis.

Chapter 2

Related Work

In this section the Making movement and all related terms will be introduced, a short overview about the roots of the Making community, how they meet together as well as Making with Kids projects in the past such as the Maker Days for Kids in Bad Reichenhall will be introduced and described.

2.1 Making

Making describes the physical creation of products by using tools and materials. Members are calling themselves "Makers". AnnMarie [Tho14] describes that a "Maker" is not someone that passes an exam or degree program it is more a self-identification. A Maker is someone who is building robots, sewing clothes or constructing houses [Tho14]. From this perspective it is comprehensible that Making is not just related to computing or computer science it is more about doing handcrafted products.

Making is not a novel trend, it is something that is human [Tho14, Hat14]. Human have always created shelters or tools and even other species are makers such as birds that are creating their nests [Tho14]. In the last decades making or building has become less because of the whole global economic system. Nowadays gigantic global manufactuers are building products and humans are just buying them or request professionals for technical services. In 2009 Nuts, Bolts & Thingamajigs has found out that about 58% of the adults in the United States have never built a toy themselves [Tho14]. This is one fact why the making trend has started to become famous in the last years. The Making movement has simple rules that was released in a manifesto.

2.2 Maker Movement Manifesto

Hatch [Hat14] has released a manifesto for the maker movement. The top slogans are: Make - Share - Give - Learn - Tool Up - Play - Participate - Support - Change. These slogans indicates that making is about ongoing development with other participants through making products and continous learning to achieve the completion of a project. Nowadays Making is widely known and the Making community is exchanging ideas and projects around the world in online and offline communities.

2.3 Maker Communities

Makers are connected in communities and are typically located in Makerspaces, FabLabs or Hackerspaces. Basically, all three concepts have the same idea to establish a central area where Makers can met each other and work together on their projects. They just differ in their history, their management and their focus.

2.3.1 Hackerspaces

It all started 1995 in Europe with a Hackerspace called "c-base" in Germany. This space was created to unite computer enthusiasts and programmers together. The reasons why this space was called Hackerspace is because historically skilled computer expert that used their technical knowledge to solve computer problems were called "Hackers" [haca]. Just in 2007 this idea was taken up by exchange students and brought to the United States and the "NYC Resistor" and HacDC" Hackerspaces have been created [hac13].

Over the time members started to be interested in electronic design and the spaces acquired tools and materials to fulfill the interests in physical computing. With this evolution the traditional definition of a hacker was expanded by excersising with physical objects [hac13].

These Hackerspaces are spaces where serious business ideas and products can be developed. This is obvious when we are looking to the 3D Printer market. Because the 3D Printer revolution started in the "NYC Resistor" with the "MakerBot Industries" [hac13].

2.3.2 Makerspaces

Makerspaces have been introduced by the MAKE magazine by registering the domain "makerspace.com" in 2011. The MAKE magazine labeled all publicly-accessible places to design and create as "Makerspaces". The main idea of these places is that professionals and hobbyists can use the provided materials and tools to build something from scratch [hac13].

For Cavalcanti the biggest difference between Makerspaces and Hackerspaces can be seen through the management. Hackerspaces are managed by collectivism and radical democratic processes. Makerspaces instead are more like a business because tools are expensive and also the general expenses such as electrical energy. Consequently the Makerspaces have more code of conducts to use the tools responsibly [hac13].

2.3.3 FabLabs

FabLabs are the last type of Maker community places and is a trademark name. The Fablab community is a network of spaces that were introduced by Neil Gershenfeld. Each FabLab needs to met the requirements of the founding principles. The principles contain a specific set of tools and space and must be open to the public on a regulary basis [hac13].

2.4 Making with Kids

Making with kids is different than traditional Making by professionals or hobbyists because children gets inspired and guided by tutors. Nevertheless there is still enough design flexibility for the childrens to advance self-organized learning, knowledge acquisition and knowledge exchange [SE16].

The idea that children build their own toys and products for aquiring knowledge has already been introduced by Seymour Papert at the *Massachusetts Institute of Technology* (*MIT*) and is called "Constructionism". Papert [PH91] describes "Constructionism" as learning by doing and illustrates it with children that are carving objects out of soaps. During carving children have time to think and to dream and can evolve ideas or speak with others as well as seeing reactions from others [PH91].

Schön et al. [SE16] describes that towards traditional learning methods, Constructionism can be used for setting and reaching individual learning goals because Making is always related to projects and student-centered. Making a product contains

learning to deal with new tools and products and everyone can find their own speed and is a place where failures are allowed [SE16].

2.5 Makerspaces for Kids

Makerspaces for kids can be implemented temporary or permanently. Both options have already been successfully tested [SER16, KB17] and they work. Making suggests that it relates to learning and this leads to the common idea that these spaces should be implemented in schools. But Schön et al. [ESN16] introduced ideas about Makerspaces beyond the everday school life such as permanent spaces in libraries or youth clubs. Beside the permanent spaces they can also be established as temporary Makerspaces in bigger rooms or for a single day as a workshop. For this reason Makerspaces for kids can vary in time, tools and space [ESN16].

2.5.1 Permanent Makerspaces

Permanent Makerspaces for kids are not that widely spread as temporary spaces, at least in Europe. In USA it is a little bit different. The following paragraphs are describing permanently Makerspaces in Europe and USA.

Freien Aktiven Schule Wülfrath

In Europe, there is just a single permanent Makerspace for kids at the "Freien Aktive Schule Wülfrath". In an old building, as seen in Figure 2.1 on page 9 teachers, children and their parents have created a creative space on their own and have been completed in 2016. The Makerspace is separated in four rooms [ESN16]:

Figure 2.1: Concept overview about the permanent makerspace of the Freien Aktiven Schule Wülfrath. (Source: [ESN16])

- **Workshop (Werkstatt)**
  The workshop contains tools to process wood and soft metal such as electric drill, grinding machine, moulding tools and saws.
- **Warehouse (Lager)**
  Collection of materials and recycled parts for all kind of making activities and open for pupils.
- **Machine Room (Maschinen-Raum)**
  Primary electric machines for wood processing such as drill, grinding and sawing.
- **Laboratory (Labor)**
  All kind of electronic tools for physical computing such as oscilloscope, power supplies and multimeters.

The idea was that this space is not just used as a school subject instead this space should be open for every children of this school anytime.

MENTOR Program USA

In 2012 the USA introduced the MENTOR (Manufacturing Experimentation and Outreach) Program by the Department of Defense. This program supports the establishment of Makerspaces inside schools with the following goals [top]:

- Self-directed learning
- Realizing projects with low costs as possible

- Introduce social and engaging to making activities

Their focus relied on the implementation of 1000 low-cost makerspaces in high schools in the next four years and they have reached their goal [top].

2.5.2 Open Digital Workshop - Temporary Makerspaces

Schön et al. [SER16] have created a concept for temporary established Makerspaces that is aligned to children. In 2015, this concept was implemented at the Maker Days for kids in Bad Reichenhall, as seen in Figure 2.2 on page 10. The Maker Days were held as an open workshop series, where children can join and leave the workshop whenever they want to. The organisation of the workshops had six simple didactical principles [SER16]:

1. Workshops should be open and a low-threshold for participation
2. Participation of the attendees
3. Advancement of ideas and innovations
4. Self-regulated skill acquisitation
5. Gender-sensitive communication
6. Long-term availability of tools for participants

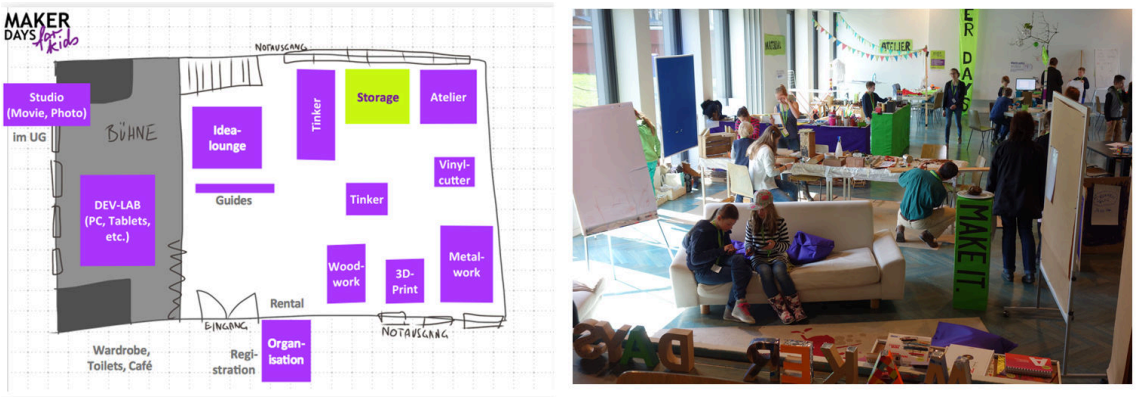

Figure 2.2: Impressions of the Maker Days for Kids in Bad Reichenhall in 2015. (Source: [SEG18])

As already mentioned before Making activities with kids is different than the usual Making process because children need to be guided. For this reason Schön [ESN16] has modified the famous Maker manifesto to become suitable for children.

Maker Days for Kids Principles

The following nine principles have been introduced by Schön et al. and are derived from the Maker manifesto by Hatch [ESN16, SEG18, Hat14]:

1. Be creative! Make it different! Try it!
2. Be curious! What the others are doing?
3. Copy! Good ideas are meant for copying.
4. Share! Share your ideas, materials and tools.
5. Work sustainable! Use garbage, avoid waste.
6. Ask for help! Look for support! Ask! Fail! It does not hurt.
7. Tidy up! (A stupid principle has to be there too)
8. Have fun! And now start...

2.6 Maker Days for Kids Event in Bad Reichenhall

In 2015 the first "Maker Days for Kids" event has been organised with the concept of Schön[SER16]. This event was held as an four days long open workshop Makerspace event for children between 10 and 14 years. During these days children were guided through the workshops by tutors and peers. The tutors and peers collected information and data about their participants and this made it possible to evaluate and analyze these days from a scientific point of view [Gap18].

2.6.1 Organisational Facts

The following sections gives an overview about the organisational methods and tools that were used to perform the event.

Workshop Cards

For workshop organisation during the Maker Days they introduced workshop cards where details about the workshop can be filled in. These workshop cards got displayed on a daily plan board. Every participant had the possibility to register for a workshop on these cards. The backsite of these cards had additional fields about

the procedure of the workshop and were filled after the workshop was held by the tutors [Gap18].

Stations

The Maker Days for Kids event in Bad Reichenhall offered about eight different workshop stations [Gap18]:

- **Digital Fabrication**
  The Digital Fabrication station offered workshops with topics such as vinyl cutting, 3D modelling, 3Doodler and cookie cutter creation.
- **Programming**
  The main focus was on visual programming with Pocket Code, Scratch and Lego Mindstorms.
- **Physical Computing**
  In this station children experimented with the Makey Makey kit, Lego, Leap Motion and i-Wonder.
- **Green Projects**
  The Green Project station focussed on environmental projects such as seed bombs and building insect hotels.
- **Electronics**
  Children used the soldering iron to built their own electronic circuits such as LED cubes, LED letters or vibrobots.
- **Textile Manufacture**
  This station focussed on handcrafting textile equipments.
- **Media**
  In the Media station children worked with new media equipment to produce their own movies, lightpainting or building their own google glass.
- **RC Flying Objects**
  This station contained two remote controlled flying objects: Quadcopter drone and a flying fish.

Room Overview

The event was held in a single room, as seen in Figure 2.2 on page 10, where all workshops were held. This had the advantage that the participants could see other activities and stations to get infected by their impressions.

2.6.2 Evaluation Results

For evaluation Schön et al. [SER16] has used questionaries, interviews, video materials and field observation. Gappmaier also mentioned that there were no other evaluations about Maker Days with children available. Details about the participants have been collected during the registering process with questionaries [Gap18].

Attendees [Gap18]

During the four day event 67 individual children have been reached. From the 67 children were 32 girls and 35 boys. Most of the participants have visited more than one day of the event and 14 of them visited all four days .

Workshop Participation [Gap18]

Gappmaier described that about 2.3 workshops were visited per attendee every day in average and all attendees had about 5.3 visited workshops. There were about six participants that had no interest in any workshop. The most interesting stations were the vinyl cutter and 3D printer from the Digital Fabrication domain. About 80.1% of all workshops were about computer and new media and 19.1% about traditional handcrafting such as wood processing and textile manufacturing.

Age Distribution [Gap18]

The Maker Days for Kids event in Bad Reichenhall was designed for children between 10 and years old but because of free space also younger and elder children had the opportunity to participate. Gappmaier describes that the average age at the event was 10.9 years and at the most workshops the participants the average age was between 10 and 11 years. The younger attendees had the most interest in technical and computational workshops.

Gender Distinctions [Gap18]

The event had a special focus on attracting girls for STEAM related fields. Gappmaier comes to the conclusion that this has been achieved because of the high participation of girls. In the first two days, girls were slighty below the half but the other two days they exceeded the half .

The workshop participation varies between girls and boys. Essentially the Physical Computing workshops were participated twice more from the boys than from

the girls as well as the Electronics workshops. Girls instead participated more workshops in the field of Media with workshops such as Lightpainting, Textiles and Green Projects. For this reason, Gappmaier describes that the genderspecific differences are confirmed because Textiles are characterized as female and robotics more characterized as male.

The least differences between girls and boys were at workshops within the Digital Fabrication and Programming stations. Gappmaier annotates that the reasons could be that these workshops had more focus on creative activities.

Hypotheses

The work of Gappmaier contains hypotheses about the behavior of girls and boys for open workshop Maker Days events. To compare these with the results of the evaluation of this thesis an overview of them is provided [Gap18]:

1. The most frequently visited workshops have a focus on Computers, Electronic and New Media such as 3D-Printer and Vinyl-Cutter.
2. Pure Programming related workshops are less frequently visited.
3. The more days of attandance, the more workshops on average will be visited by the individual participant.
4. Girls are less attracted to pure technical or computer science related workshops such as 3D-Printing, soldering or programming.
5. Children are preferring adjacent stations when they move to other workshops.
6. Girls are more attracted to stations that are supervised by female tutors and peers.

Chapter 3

Maker Days for Kids

Figure 3.1: Overall impressions of the Maker Days for Kids Event at Graz University of Technology in 2018 (Source: [ESG18]).

In this section the "Maker Days for kids", as seen in Figure 3 on page 15, of Graz University of Technology, that was held in 2018, will be introduced and described.

3.1 General Overview

In 2018 Graz University of Technology acted as a host of the ”Maker Days for kids“ event between the 13. August and the 17. August. This event was held by members of Graz University of Technology as well as members of ”BIMS e.V.“. During this event children between 10 and 14 years had the oppurtunity to tinker and get in touch with the ”Making“ Community. The event offered open workshops in different fields of STEAM such as soldering, coding, handcrafting, sewing and others.

Figure 3.2: Flyer of the Maker Days for Kids of the Graz University of Technology in 2018 (Source: [ESG18]).

3.1.1 Room Layout

The workshops were held in two different workshop rooms that were separated and connected through a hall as well as some outdoor activities.

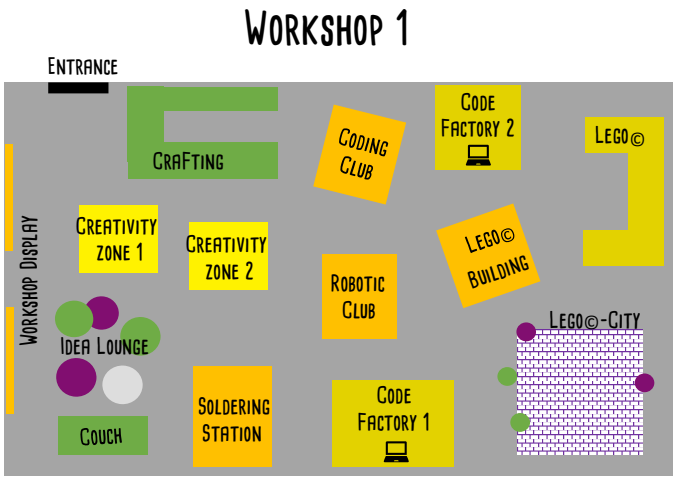

Figure 3.3: Room Layout of the first workshop room of the Maker Days for Kids (Source: [ESG18]).

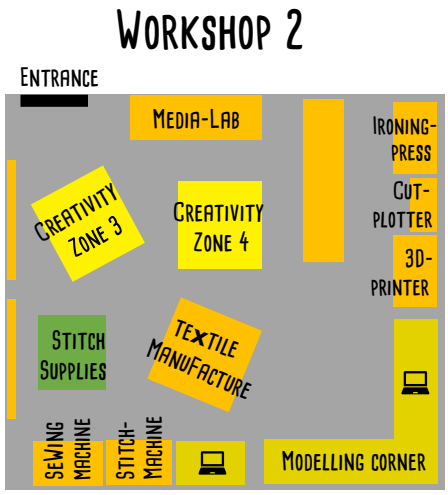

Figure 3.4: Room Layout of the second workshop room of the Maker Days for Kids (Source: [ESG18]).

Each station held different workshops and children had the opportunity to choose workshops as they like. For advertising workshops the Workshop Display in workshop room 1 was used.

3.1.2 Workshops

The workshops are a central concept of the ”Maker Days for kids“. Children can get an overview about future offered workshops on a central point called ”Workshop Display“. The ”Workshop Display“ was a magnetical blackboard with a timeframe and children had the opportunity to register for a workshop. The workshop card as

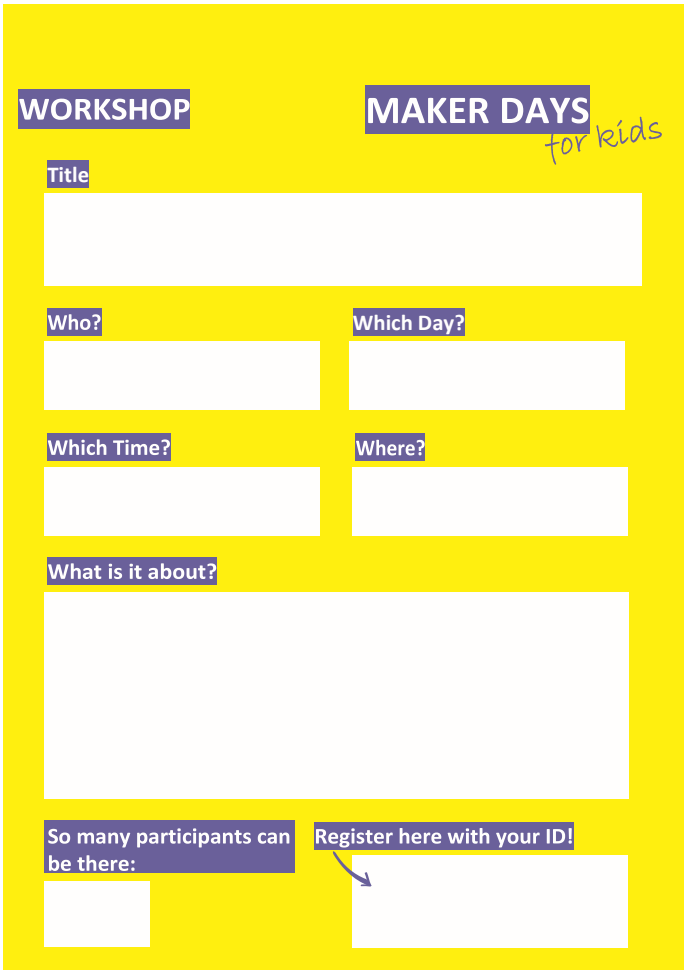

Figure 3.5: Example of an empty workshop card (Source: [ESG18]).

seen in Figure 3.5 on page 18 gives an overview about the offered workshop as well as further details such as participants limit. It was necessary to introduce this limit for organizational reasons because of limited number of workplaces as well as to guarantee best tutor-children ratio. The children could register for the workshop by registering on the specific workshop card. Workshops can be organized by everyone tutors, peers as well as from childrens.

3.2 Stations

Stations are logically grouped working places where station related domain workshops are held. These stations are equipped with specific tools and materials that are necessary for the offered workshops. The stations are separated in two different workshop rooms. In Figure 3.3 on page 17 and Figure 3.4 on page 17, the layout of both workshop rooms can be seen.
The stations are divided into four different domain sets:

- **Digital Fabrication**
  The Digital Fabrication stations are highlighted in dark yellow and have their focus on programming and modelling.
- **Physical (Computing)**
  The Physical (Computing) stations are highlighted in orange and have their focus on making physical products by using handcrafting tools such as soldering iron, tongs and screw drivers. Many of these products also contains microcontrollers to control or to smarten up these devices. Therefore the computing tag is also part of thes physical stations.
- **Supply Stations**
  The Supply Stations stations are highlighted in green and are central points for materials and tools as well as a meeting point to craft on ideas.
- **Creativity Zones**
  The Creativity Zone stations are highlighted in yellow and offer temporary workshops that are just held for a single day.

3.2.1 Digital Fabcrication Stations

Digital Fabrication stations offer workshops that are concentrating on programming and modelling. Consequently these stations output are digital products and can further be used for physical computing workshops. The following stations are part of this concept:

- Code Factory 1
- Code Factory 2
- Modelling Corner

Code Factory 1

Code Factory 1 was also known as the Game Development station. In this station children used the Scratch programming language to extend available games or created new ones. One of the most famous game was the two-player tank game that could be played in versus mode [SEG18].

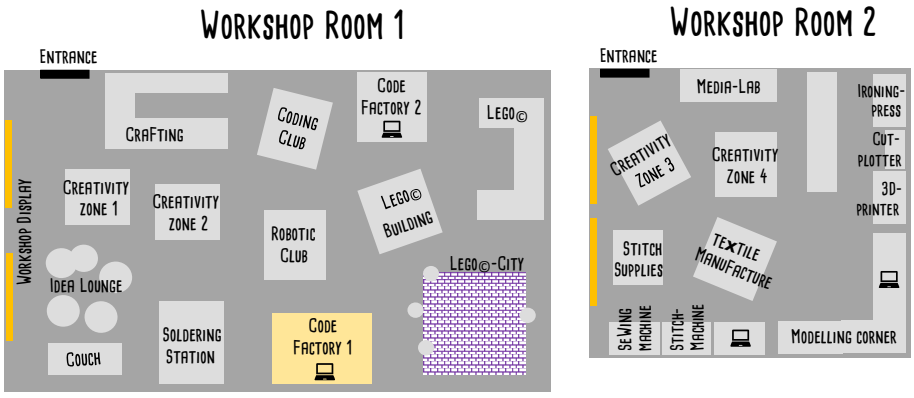

Figure 3.6: Room overview of the Digital Fabrication station "Code Factory 1". (Adapted from [ESG18])

Workshops

- **Thymio learn get to know his environment**
  Kids have the opportunity to meet Thymio, a small robot that is able to discover the universe of robotics, with the opportunity to control him to discover the universe together.
- **Make your own game**
  In this workshops kids had the change to implement their own game in Scratch.

Scratch is a visual programming language that is aligned to kids and programming beginners.

- **Jump-controller for Pacman**
  Get an introduction into the famous Makey Makey invention kit. This kit allows to connect everday objects together and connect them to computer programs [mak]. This workshop transforms bananas into a mighty controller for Pacman.

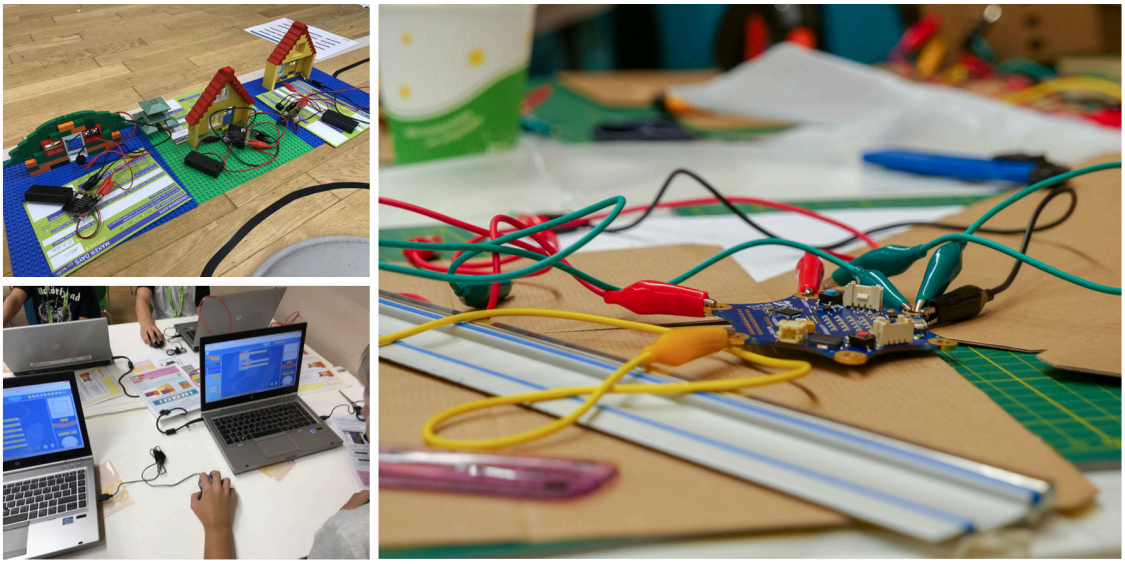

Figure 3.7: Photo Impressions of the Code Factory 1 station. (Source: [ESG18])

Code Factory 2

Code Factory 2 was the software supplier station of the Lego Building and the Coding Club station. Both stations used the BBC micro:bits to enable smart products. Children had the opportunity to visually program their devices in this station [SEG18].

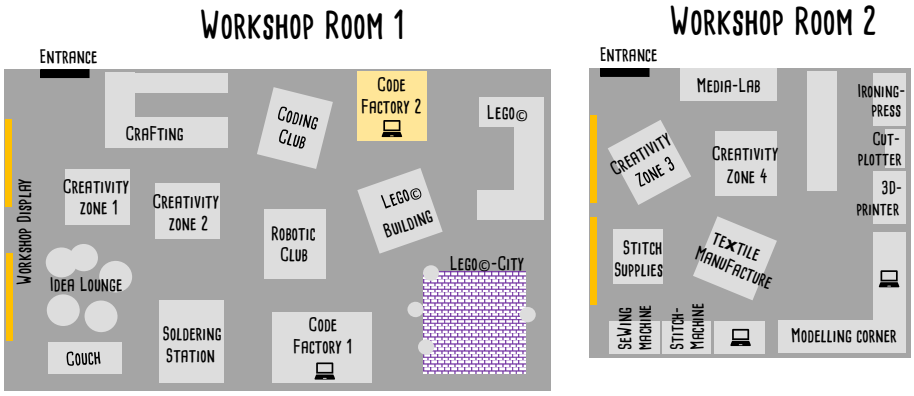

Figure 3.8: Room overview of the Digital Fabrication station "Code Factory 1". (Adapted from [ESG18])

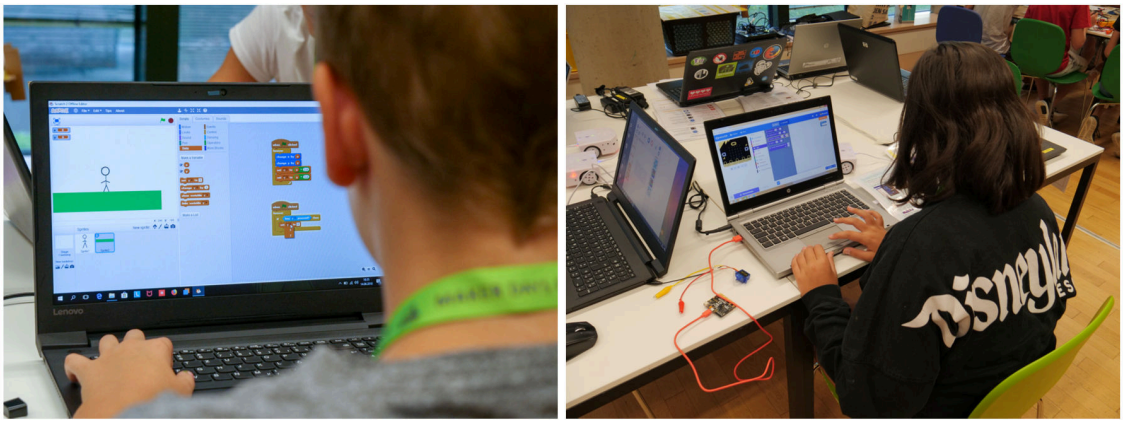

Figure 3.9: Photo Impressions of the Code Factory 2 station. (Source: [ESG18])

Modelling Corner

The Modelling Corner was used by the 3D-Printer station and the Ironing-Press and Cut-Plotter station to create 3D models and logos [SEG18].

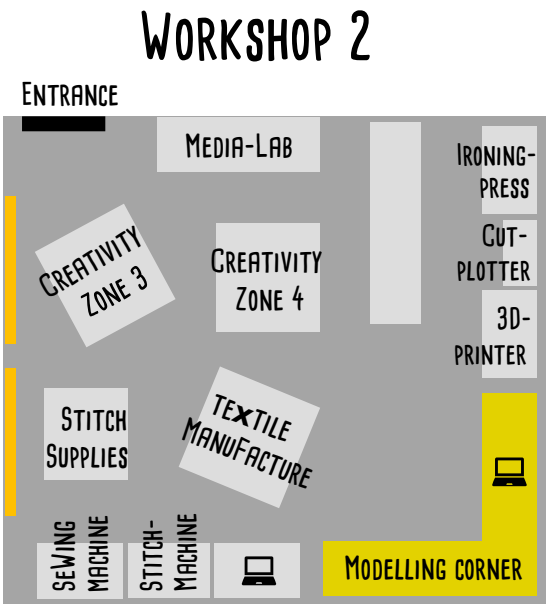

Figure 3.10: Room overview of the Digital Fabrication station "Modelling Corner". (Adapted from [ESG18])

Workshops

- **3D-Printer Modelling**
  In this workshop kids had the chance to create their own 3D models such as houses, trees or keychains. The designed models were printed with a 3D-printer.
- **Vinylcutter**
  Create your own bag with your individual design. Kids had the opportunity to design their own logo to print in on their own bag.

Figure 3.11: Photo Impressions of the Modelling Corner station. (Source: [ESG18])

3.2.2 Physical (Computing) Stations

Physical (Computing) stations offer workshops that are concentrating on making physical products. These products are made with handcrafting tools and physical materials. It is possible to awake the physical product by programming a microcontroller. For this aspect the inclusion of Digital Fabrication stations is necessary. The following stations have their focus on Physical (Computing):

- Coding Club
- Robotic Club
- Soldering Station
- Lego Building
- Media-Lab
- Ironing-Press and Cut-Plotter
- 3D-Printer
- Textile Manufacture

Coding Club

The "Coding Club" was a mix about programming and handcrafting hardware. The station used the BBC micro:bit and the Calliope mini. Both devices are microcontrollers that are specially developed for children and can be programmed visually. The big advantage of these systems is the possibility to add sensors such as a servos or input devices. Children of this station created milky monsters, traffic lights, electronic pianos, reaction games and oracles [SEG18].

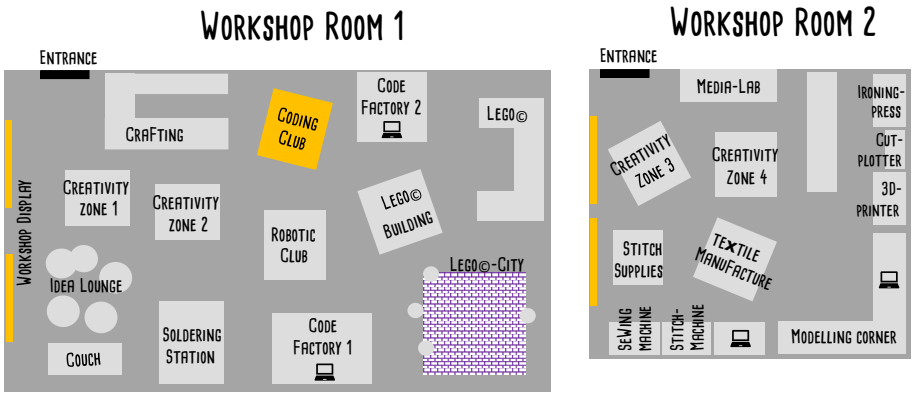

Figure 3.12: Room overview of the Physical Computing station "Coding Club". (Adapted from [ESG18])

Workshops

- **Milk monster**
  Create your own scary monster by using a milk carton and micro:bits. The micro:bit is controlling a servo that moves the mouth of the milk monster.
- **Oracle monster**
  Invoke your own oracle monster, with a micro:bit and craft stuff, that is able to tell your own fortune.
- **Traffic light**
  Building and programming the classic green - orange - red traffic light, using the micro:bit as control device and LEDs as lights.
- **Calliope-piano**
  Transform the Calliope into a music device and program your own piaono.
- **Calliope board game**
  Test your own reactions against your friends with the calliope board game. This game is built with the Calliope-mini and much tinfoil.

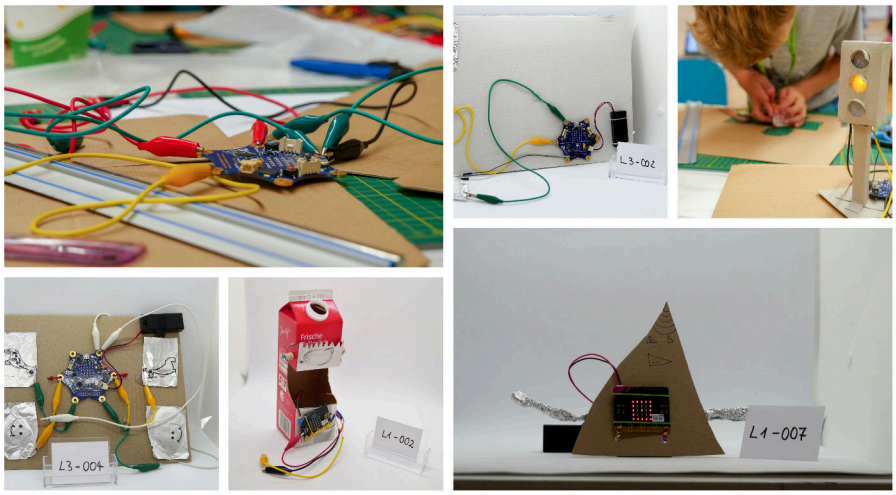

Figure 3.13: Photo Impressions of the Coding Club station. (Source: [ESG18])

Robotic Club

Robots are mechanical structures that are controlled by software implemented control systems. The Robotic Club station is conquered by the Ozobot and the Thymio. Ozobots are little robots that can be controlled by color codes or visually programmed [ozo]. Children can control their own Ozobot by drawing lines and control blocks in different colors. The Thymio is a full open-source robot that contains several sensors and actors and can be programmed textual or visual [SEG18, thy].

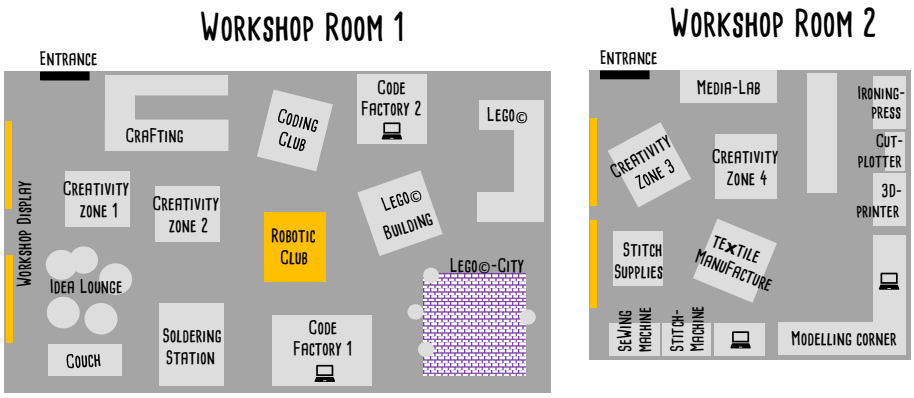

Figure 3.14: Room overview of the Physical Computing station "Robotic Club". (Adapted from [ESG18])

- **OZO-action for beginners**
  Meet Ozobot and learn how to control him with special color codes.

- **Rollercoaster Control**
  Create a device that is able to control the big Lego rollercoaster.
- **Color codes for Ozobots**
  Write your own name by controlling the Ozobot with special color codes.
- **Create your own penguin**
  Transform a Thymio into a penguin by using craft stuff.
- **Fun with Ozobots**
  Get in touch with the Ozobot and learn about his functionalities.
- **Fun with Ozobots 2.0**
  Advanced Ozobots course for advanced programmers.
- **Thymio learns to walk**
  Meet Thymio and learn how you can control him by using easy programming languages.

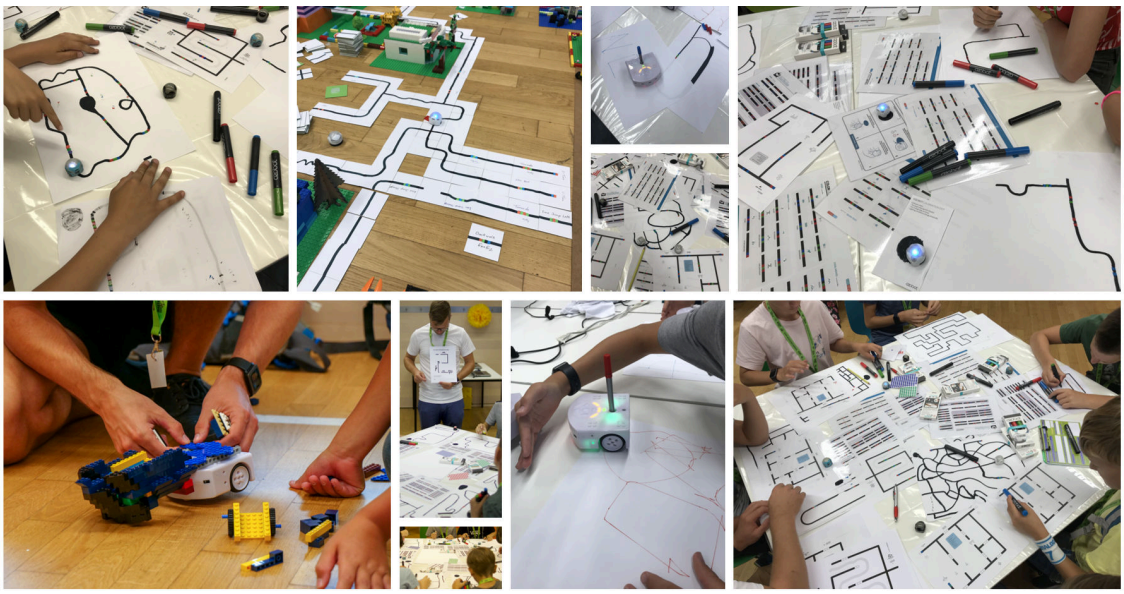

Figure 3.15: Photo Impressions of the Robotic Club station. (Source: [ESG18])

Soldering Station

The Soldering Station is part of the Physical Computing domain and invites children to get in touch with electrical engineering. The workshops are using common tools of electrical engineers such as soldering iron, pliers, screw drivers and power supplies. With these tools children can build small robots that can automatically swirl around or more complex eletronic circuits such as LED-Roulette or Binary Counter [SEG18].

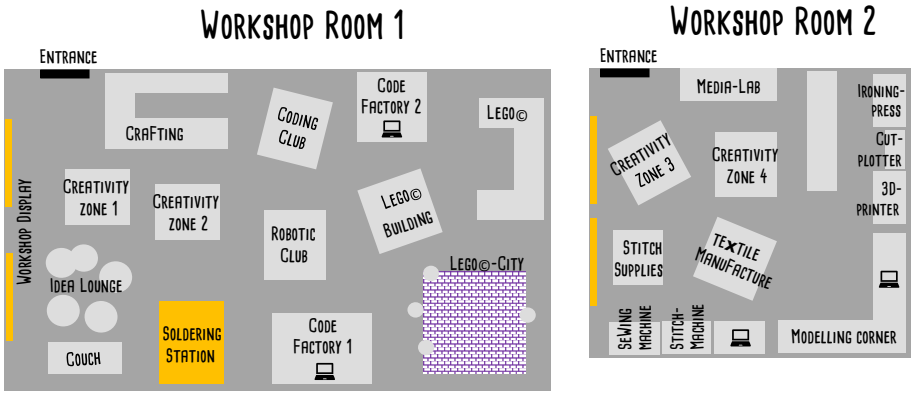

Figure 3.16: Room overview of the Physical Computing station "Soldering Station". (Adapted from [ESG18])

- **Electronic Tinkering**
  Create your own uncontrollable Vibrobot or your own fancy LED shield with your name.
- **Advanced Electronic Tinkering**
  Solder your own LED Roulette game.

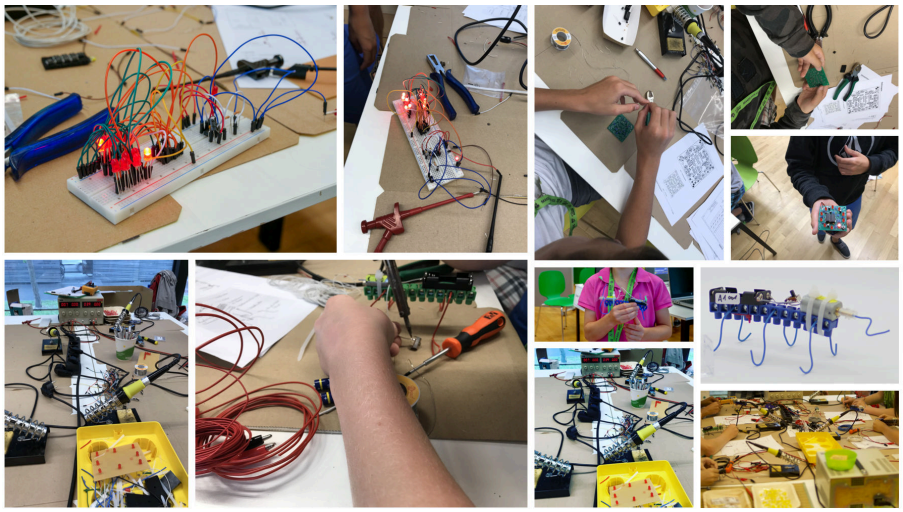

Figure 3.17: Photo Impressions of the Soldering station. (Source: [ESG18])

Lego Building

The Lego Building section was the building site of the Lego city. The Lego Building station had daily themes such as build, mobile, child-friendly and eco-friendly and invited children to build up their own perfect city. During the week the city grew with houses, sport facilities, robots and memorials [SEG18].

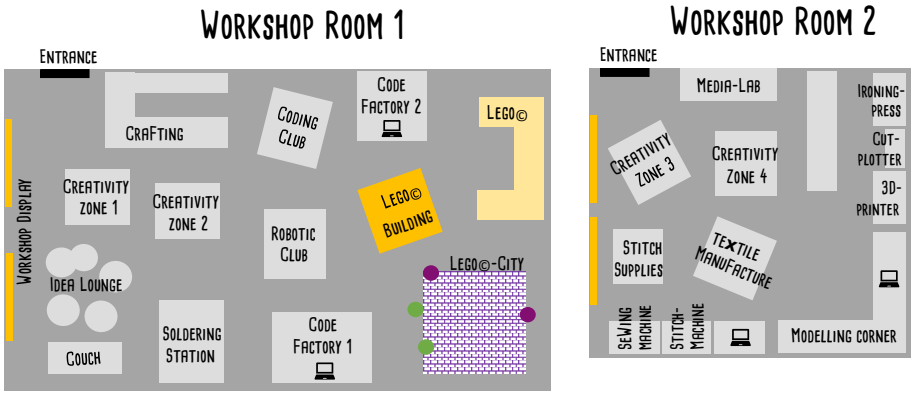

Figure 3.18: Room overview of the Physical Computing station "Lego Building". (Adapted from [ESG18])

- **Alarm system**
  Create an alarm system to protect the Lego citizens in their houses against burglars.
- **Boom barrier**
  Create a boom barrier for Ozobots by using Lego and Thymio.
- **Lighting system in the Lego house**
  Build an automatic lighting system for Lego houses to support the Lego citizens.
- **Idea workshop**
  Brainstorm ideas how the Lego city can become more ecofriendly.
- **Build up the Lego-city**
  Create houses, streets, castles and sights in the new Maker Days Lego city.
- **Lego city lights**
  Lighten up the Lego city by using the micro:bit microcontroller.
- **City design in** 360°
  In this workshop a 360° picture of the future Lego city is created.
- **Lego city road building**
  The Lego city needs streets for their Ozobots and Thymios.

- **Sketch the Lego city in** 360°
  Using "panoform.com" to sketch the Lego city in 360°.

Figure 3.19: Photo Impressions of the Lego Building station. (Source: [ESG18])

Figure 3.20: Photo Impressions of the Lego City station. (Source: [ESG18])

Media-Lab

The Media-Lab was a mixed station of unconventional Making kits such as the Makey Makey kit. This kit enables the use of everday objects into touchpads such as bananas, chairs or other childrens. Children created their own controller to play Pacman. Another bestseller of this station was the scary radio-controlled flying shark [SEG18].

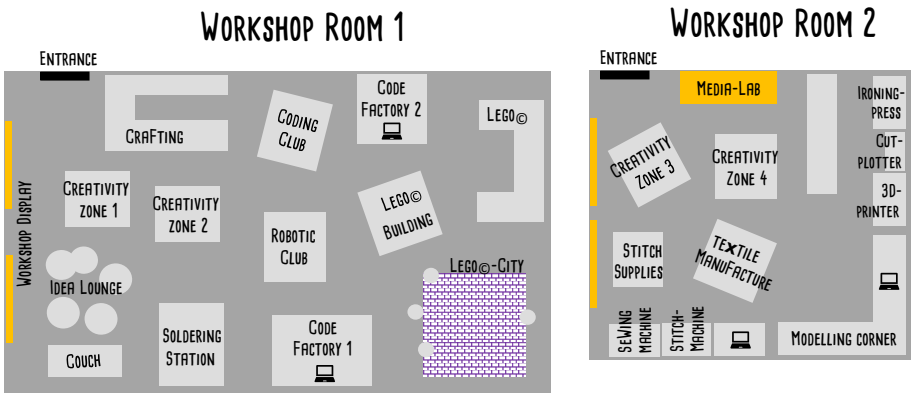

Figure 3.21: Room overview of the Physical Computing station "Media-Lab".(Adapted from [ESG18])

- **Zap box**
  Create your own mixed-reality glasses by using your smartphone and the official app.
- **Dash robot**
  Control the dash robot with your smartphone.
- **Flying fish**
  Create a remote controlled flying fish and fly off with the help of helium.
- **Osmo playing**
  Build tangrams against your friends by using the challenge smartphone app.
- **1x1 with Alexa**
  Test your math 1x1 skills by using Alexa's voice recognition.
- **Osmo coding**
  Control Awbie a cute monster with logical blocks.
- **Flic buttons - wireless smart buttons**
  Control your smartphone by using the Flic buttons.

Figure 3.22: Photo Impressions of the Media-Lab station. (Source: [ESG18])

Ironing-Press and Cut-Plotter

In this station children had the opportunity to create their own logos in the modelling corner and to assign it onto textile surfaces such as T-Shirts. For this purpose the Cut-Plotter and the Ironing-Press was necessary [SEG18].

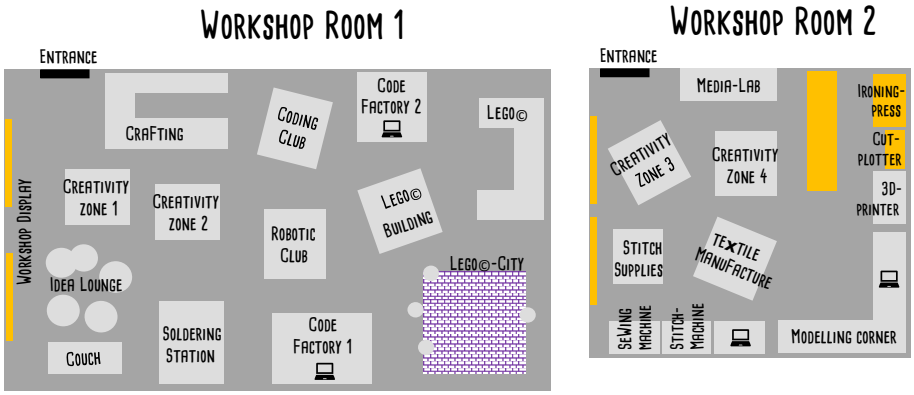

Figure 3.23: Room overview of the Physical Computing station "Ironing-Press and Cut-Plotter".(Adapted from [ESG18])

- **Vinylcutter**
  Create your own bag with your individual design. Kids had the opportunity to design their own logo to print in on their own bag.

Figure 3.24: Photo Impressions of the Ironing-Press and Cut-Plotter station. (Source: [ESG18])

3D-Printer

3D-Printers are the new revolution in the mechanical engineering domain and offers the possibility to print self-created complex structures. In our 3D-Printer station children created their own models in the modelling corner and printed them on a Ultimaker 3 printer [SEG18].

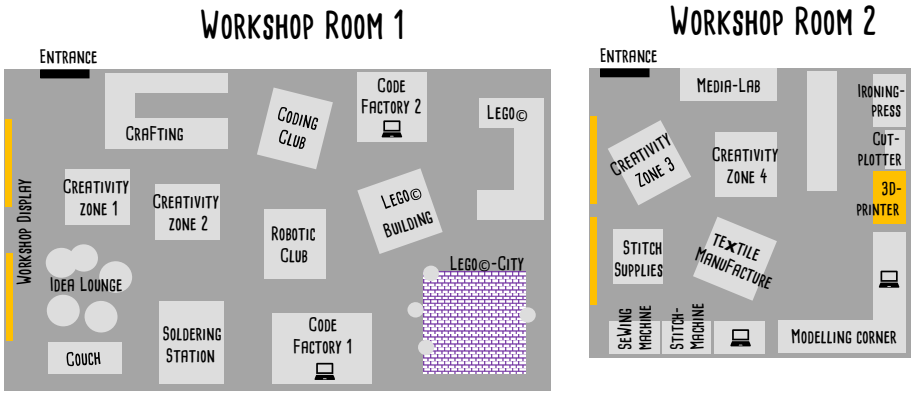

Figure 3.25: Room overview of the Physical Computing station "3D-Printer". (Adapted from [ESG18])

- **3D-Printer Modelling**
  In this workshop kids had the chance to create their own 3D models such as houses, trees or keychains. The designed models were printed with a 3D-printer.

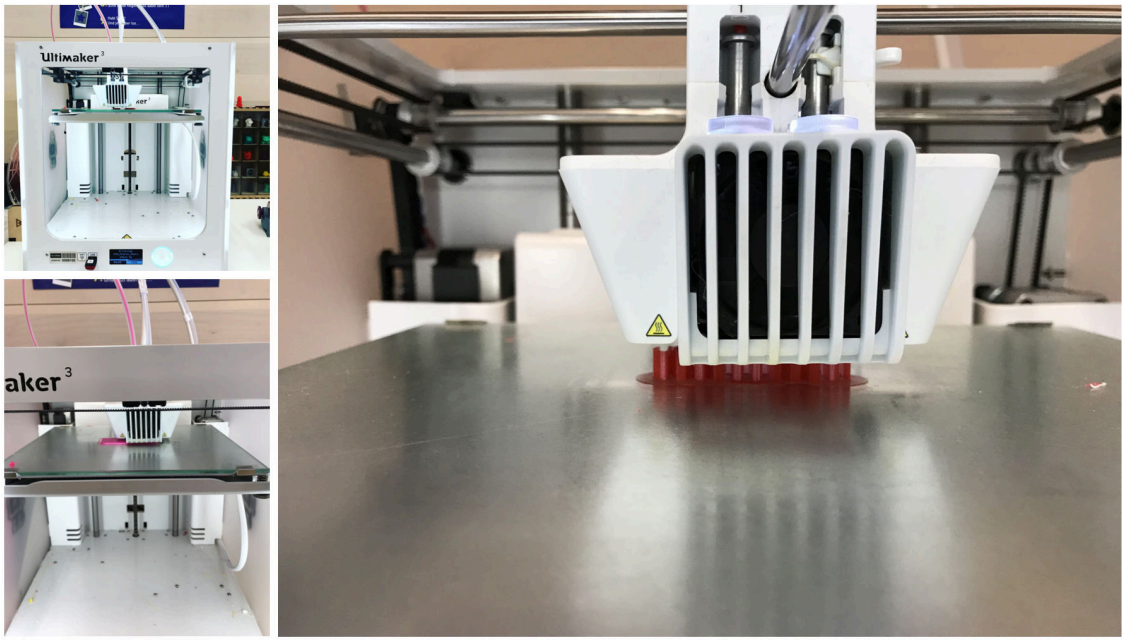

Figure 3.26: Photo Impressions of the 3D-Printer station. (Source: [ESG18])

Textile Manufacture

The Textile Manufacture station contained the Sewing-Machine and the Stitch-Machine stations. In these stations children had the opportunity to use a programmable embroidery machine to stitch their own programmed pattern on a textile surface [SEG18].

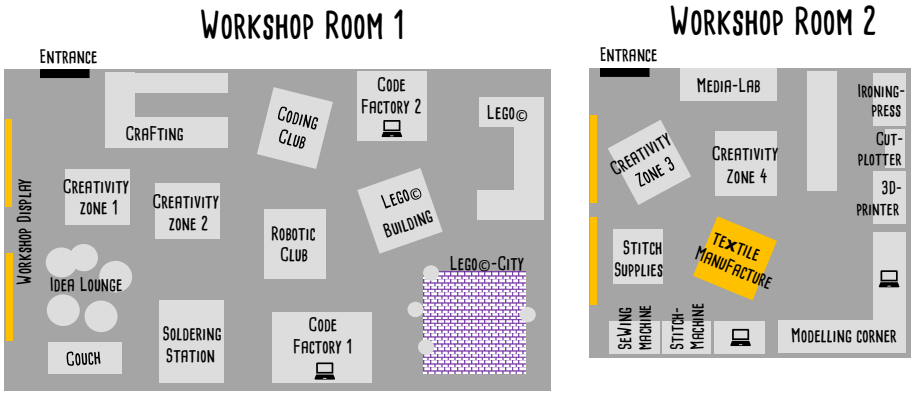

Figure 3.27: Room overview of the Physical Computing station "Textile Manufacture". (Adapted from [ESG18])

- **Notebook stitching**
  Create your own fancy notebook.
- **Programming stitch machine**
  Control the stitch machine with program code and stitch your own patterns.
- **Pillow stitching**
  Stitch a pillow with the stitch machine.
- **Bag stitching**
  Stitch your own bag with the stitch machine.
- **Make your own jewellery**
  Create your own wire jewellery and solder it together.

Figure 3.28: Photo Impressions of the Textile Manufacture station. (Source: [ESG18])

3.2.3 Supply Stations

Supply stations are centralized stations where children can obtain ideas, tools, materials or motivation. Some of the Supply stations also offered workshops such as the Crafting station. The following stations were part of the Supply stations:

- Crafting
- Stitch Supplies
- Couch
- Idea Lounge

Crafting

The Crafting station offered handcrafting products with tools such as brushes, colorfull paper and scissors. Children painted pictures and embellished products with colors and pipe cleaners. This station was also the central point for Making materials and tools for all other stations in Workshop 1 [SEG18].

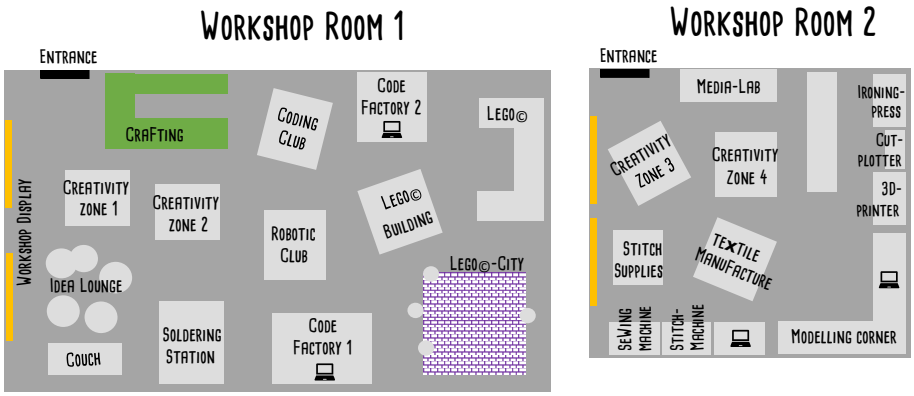

Figure 3.29: Room overview of the Supply station "Crafting". (Adapted from [ESG18])

Figure 3.30: Photo Impressions of the Crafting station. (Source: [ESG18])

Idea Lounge

The Idea Lounge offered a place to relax between two workshops as well as to get in contact with other participants, but there were also workshops in this station such as finding ideas for building up the Lego city. [SEG18].

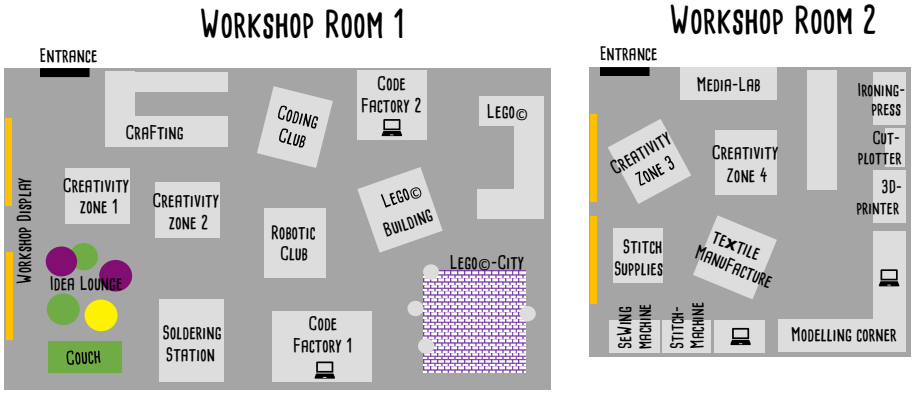

Figure 3.31: Room overview of the Supply station "Idea Lounge". (Adapted from [ESG18])

Figure 3.32: Photo Impressions of the Idea Lounge station. (Source: [ESG18])

3.2.4 Creativity Zones

The Creativity Zones were separated in four different stations and offered different workshops. Some of the workshops were offered a single time such as creating a speaking garbage can.

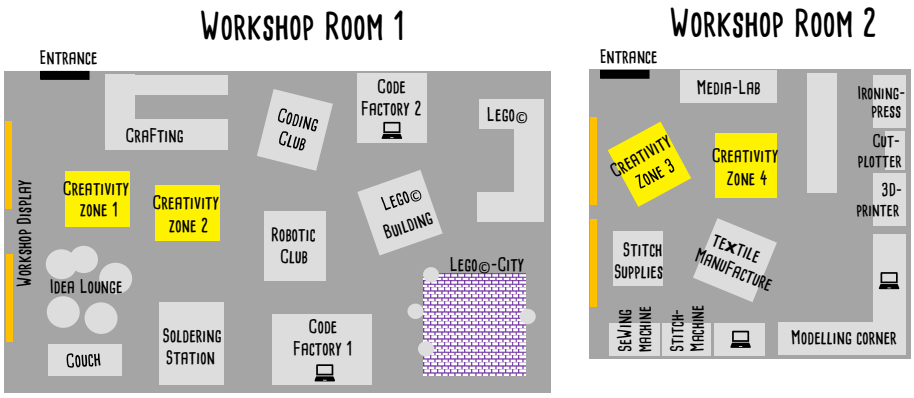

Figure 3.33: Room overview of the "Creativity Zones". (Adapted from [ESG18])

Figure 3.34: Photo Impressions of the Creativity Zone stations. (Source: [ESG18])

Chapter 4

Evaluation and Interpretation

This Section provides a statistical overview about the Makerdays for Kids event at Graz University of Technology. The whole event were gapless documented by recording the participation of all attendees at all stations, during all four days of the event. The results and the interpretation of these data can be depicted in the following paragraphs.

4.1 Evaluation Method

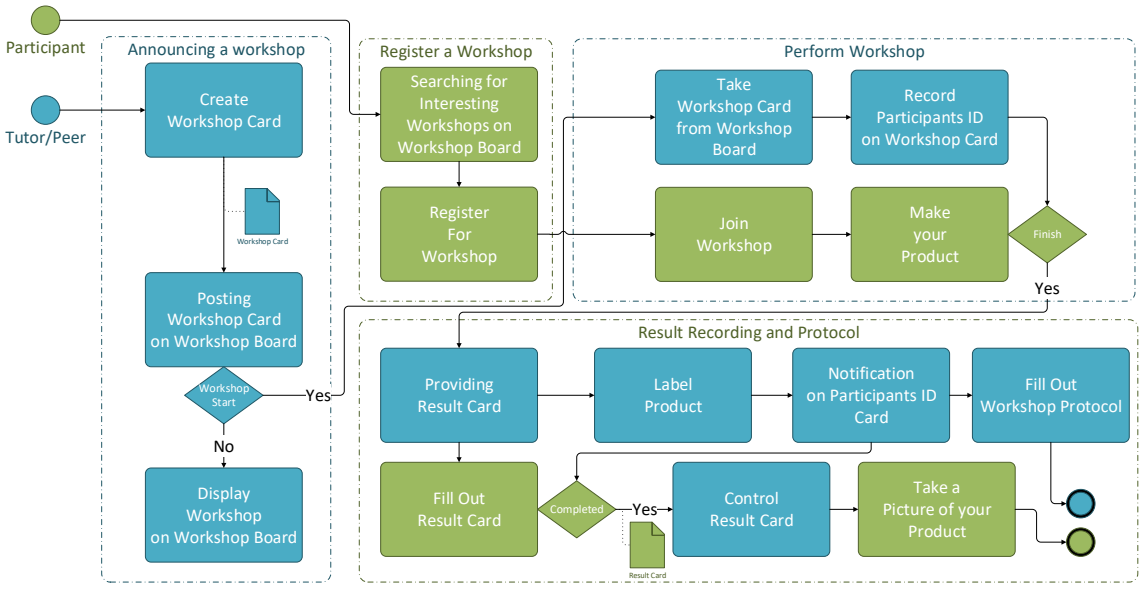

Figure 4.1: Evaluation Process overview containing tutor/peer and participant steps.

In Figure 4.1 on page 41, the evaluation process of the Maker Days for kids event in Graz can be seen. The whole process needs action from tutors/peers and the participants and can be separated in the following parts:

1. **Announcing a Workshop**
   This step is triggered by tutor or peer and is about defining a workshop and advertising the workshop on the magnetic black board. For this purpose, a workshop card is created, as seen in Figure 3.5 on page 18, with a title of the intended workshop, the tutor/peer that is giving the workshop, time and station information as well as a description of the workshop.

2. **Register a Workshop**
   This step is performed by the participants and includes the provision of workshop information from the magnetic black board where all offered workshops are placed. Participants have the possibility to get information about specific workshops and can register themselves by filling-in their participant ID in the workshop card.

3. **Perform Workshop**
   After reaching the specific start time of the workshop the workshop will be started at the specific station. For this purpose, the tutor/peer is collecting their specific workshop card from the magnetic black board. The participants are joining the station and are starting with their projects in collaboration with their tutor or peer. For evaluation purpose, the tutor/peer is recording all participants IDs on the backside of the workshop card, as seen in Figure 4.2 on page 43.

4. **Result Recording and Protocol**
   The last step of the evaluation process is about recording and protocolling the results of this workshop. When a participant is done with their product, the tutor/peer is handing over a product card to the participant. The product card, as seen in Figure 4.3 on page 44, offers a reflection of the workshop from participant view. For this purpose, the participants are describing their product in their own words including the used tools and materials and what they learned during this workshop. Furthermore, participants also provide information about duration and possible support by other participants or tutor/peer. The tutor/peer is also reflecting the workshop by describing positive and negative occurrences as well as methods and tools that were used during the workshop. Another interesting overview about the workshop provides the

competences section. In this section, different competences fields are listed such as Computational Thinking or Media Design. These fields gives a better overview about the competences that were trained with the specific workshop.

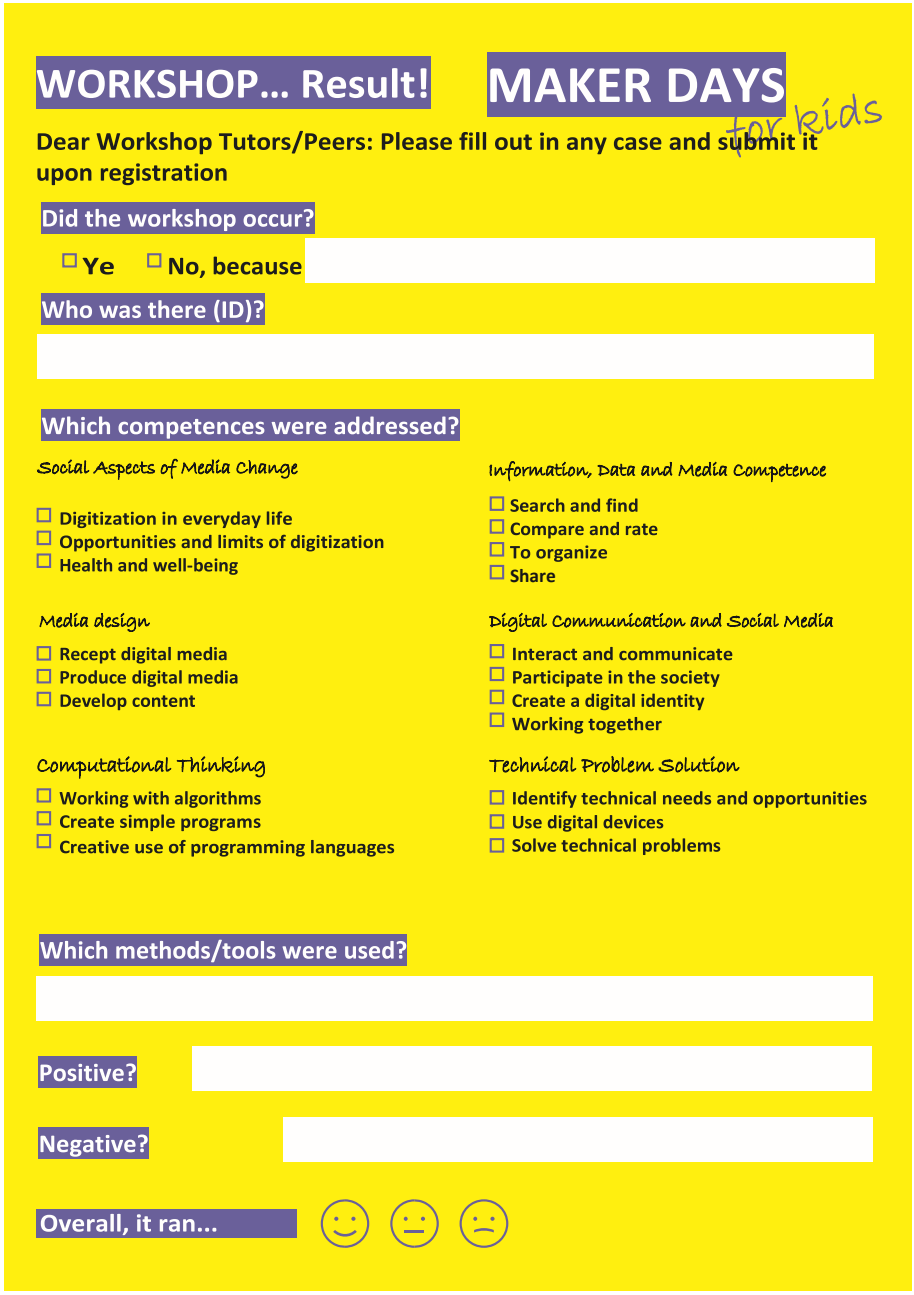

Figure 4.2: Example of the backside of an empty workshop card that is used for evaluating the workshop (Source: [ESG18]).

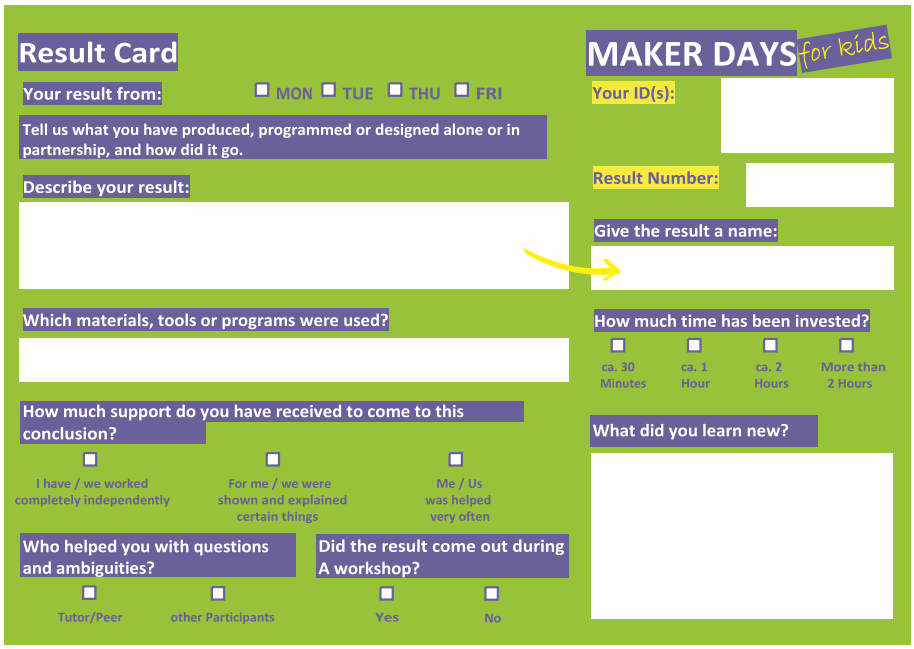

Figure 4.3: Example of an empty product card that is used by participants to describe their products (Source: [ESG18]).

4.2 General Statistics

The General Statistics subsection describes the whole Maker Days for kids event with all participants and all workshops. The general facts of the event were:

- 18 Stations
- 119 Attendees
- 126 Workshops
- 4 Days

The duration of the event was about four days from Monday to Friday, including a free Wednesday. In total there were 119 attendees that had the opportunity to participate in one or more of the 126 individual workshops at 18 different stations.

4.2.1 Participation

At the event were 119 attendees. In Figure 4.4 on page 45, the distribution between the ages can be depicted. In the age range between 10 and 13 it is almost uniformly distributed between 17-21%. The least attendees were below 10 years with 7% and 14 years with 3% old. There is also an amount of 13% where we have no data about

the age. The Distribution clearly shows, that we have reached our target groups of children between 10 and 14 years. Solely, the 14 years are underpresent with 3%. For future events, this should be considered.

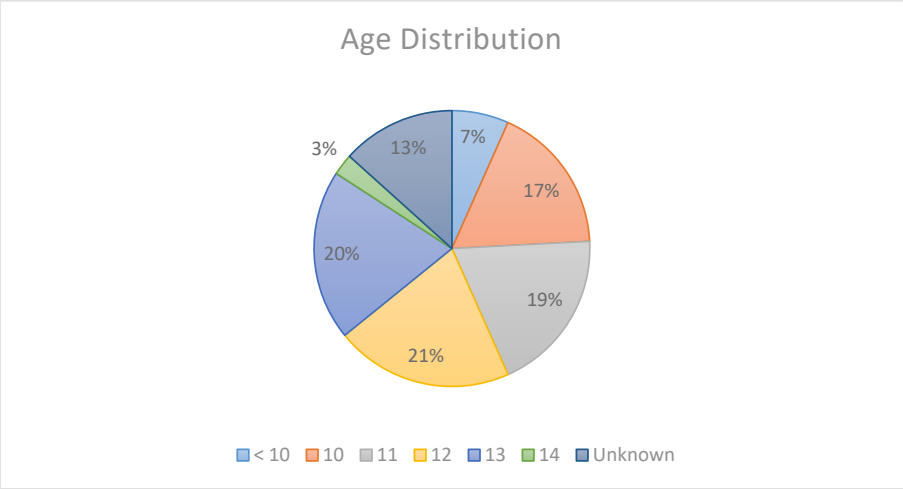

Figure 4.4: Statistical overview about the average age of the attendees.

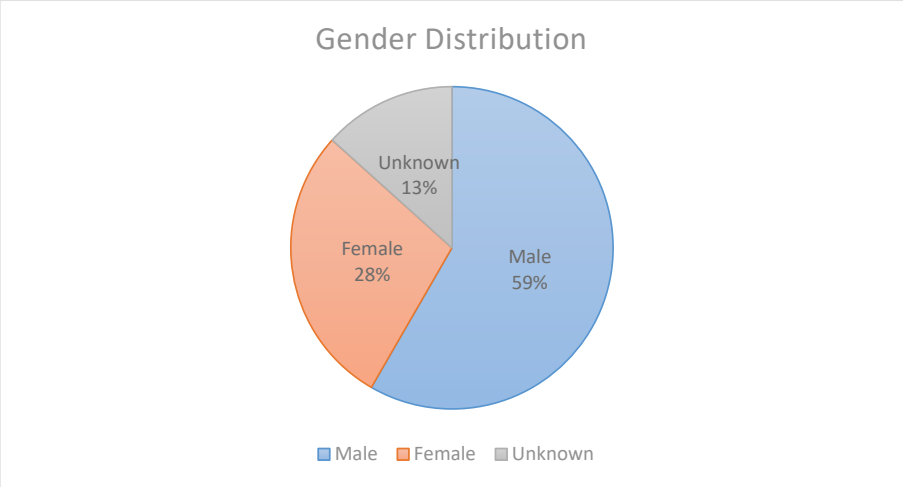

Figure 4.5: Statistical overview about the gender distribution at the event.

Most of the participants were boys with a rate of 59% and girls were presented with a rate of 28%. For the last 13%, we have no information about their gender, as seen in Figure 4.5 on page 45. Consequently, the current marketing did not reach girls that well and for future events this needs to be considered to attract more girls.

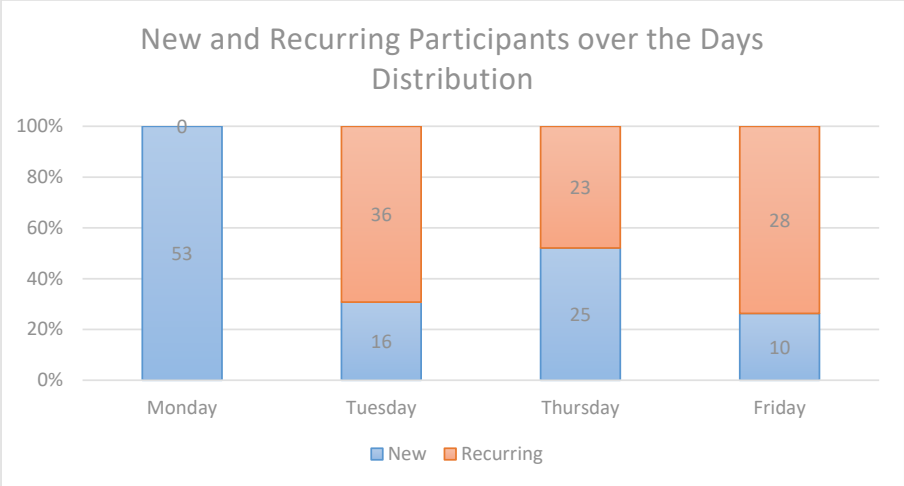

Figure 4.6: Statistical overview about new and recurring participants over the whole four days of the event.

Figure 4.6 shows that most of the following days consists of a high amount of recurring participants. Just on the third day there have been more new participants. This indicates that the offered workshops and stations attracted them to return.

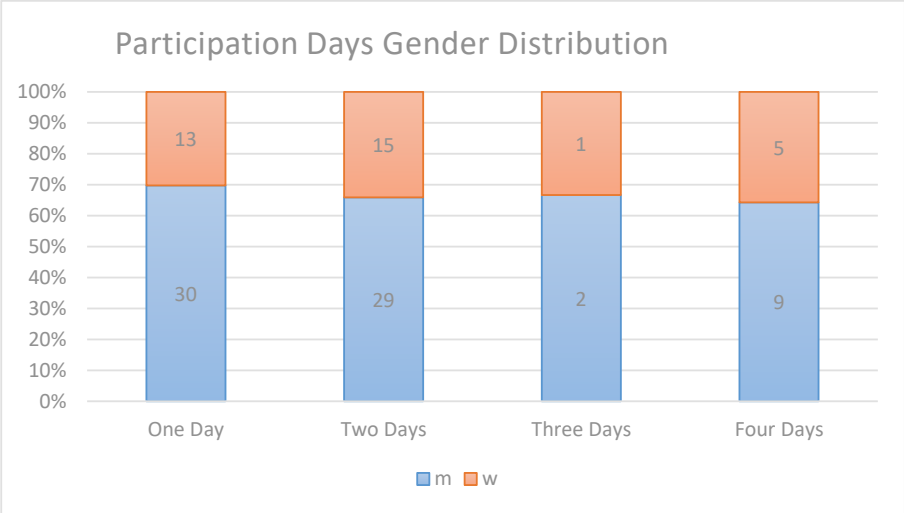

Figure 4.7: Statistical overview about the participation days gender distribution.

As seen in Figure 4.7 on page 46, considering the distribution between girls and boys in general, there is no significant difference on the amount of attandancy days between girls and boys.

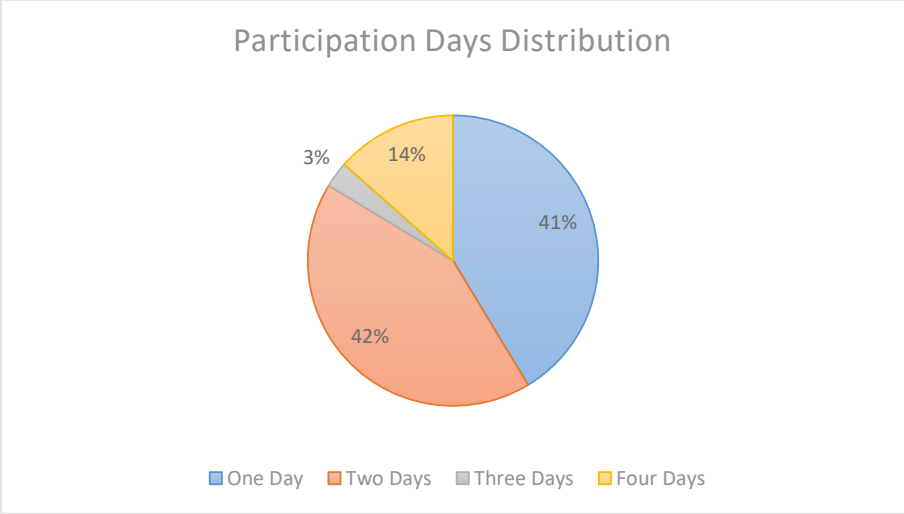

Figure 4.8: Statistical overview about the participation days distribution.

In Figure 4.8 on page 47, the amount of participation days of all attendees can be seen. Most of the attendees visited the event in one or two days. Just 3% make use of three days of attendancy. It could be that two days are for the most enough to try-out their field-of-interests.

4.2.2 Stations

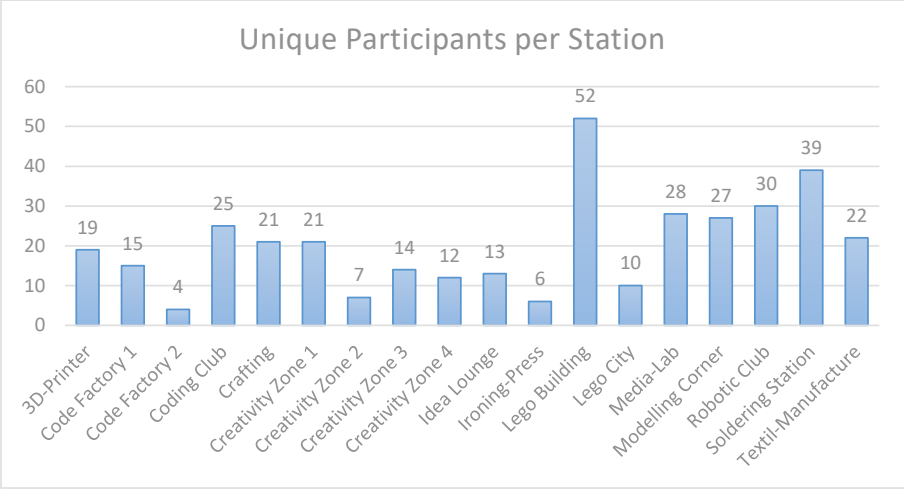

Figure 4.9: Statistical overview about the unique participants per station.

The event offered 18 different stations at all four days, but not every station were opened each day. As depicted in Figure 4.9 on page 47, the most attractive stations

were the Lego Building, Soldering Station and the Robotic Club. The least attractive stations were the Ironing-Press, if we are combining Code Factories and Creativity Zones together. All other stations have been accepted and visited by the participants equally.

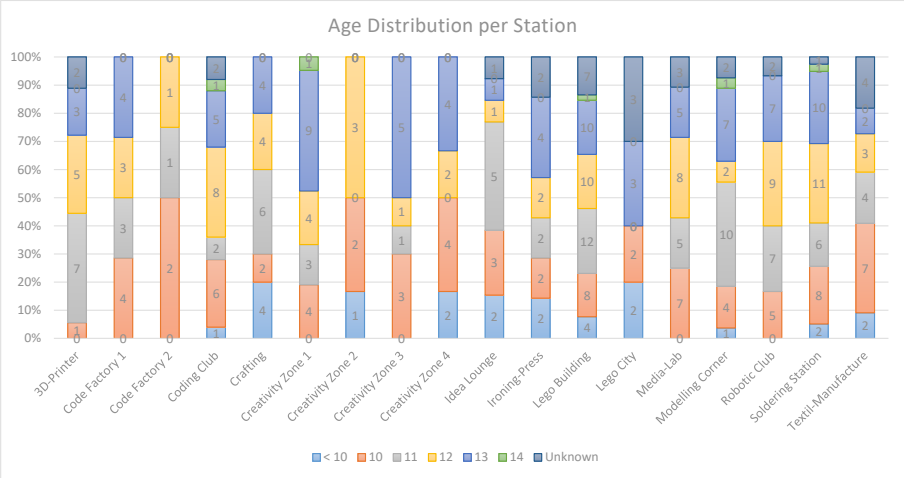

Figure 4.10: Statistical overview about the age distribution at the stations.

In Figure 4.10 on page 48, the age distribution between all stations can be depicted. The Lego Building, that was the most visited station at the event attracted all ages as well as other stations scuh as Modelling Corner and the Soldering Station. The Crafting station had the most attraction on participants between 10 and 12 years. The other stations attracted specific age ranges but mostly between 11 and 13 year old children.

Figures 4.11-?? on page 49-?? gives an overview about the most attractive stations for a specific age between below 10 years and 14 years. On the whole event was only a single station that attracted all ages and this were the Lego stations. The remaining results show, that the sphere of interest is changing during the ages.

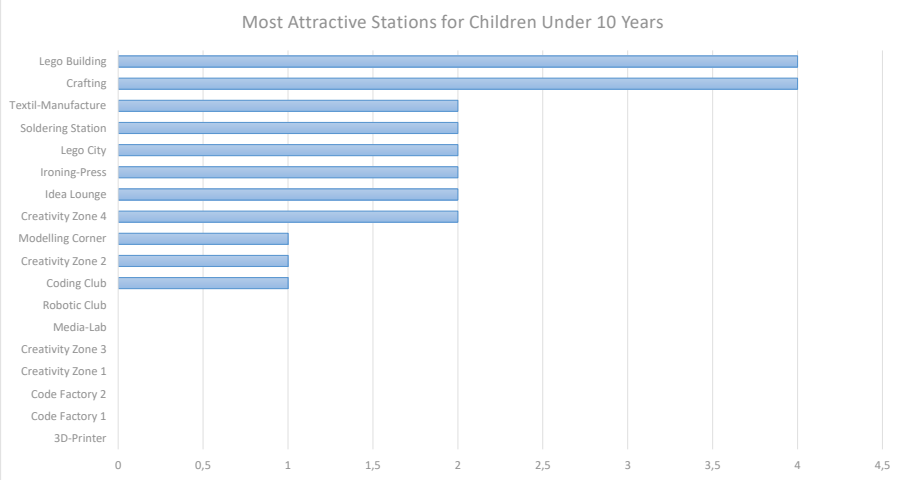

Figure 4.11: Statistical overview about the most attractive stations for participants that were younger than ten years old.

Figure 4.11 and 4.12 shows that young children at the age of below 10 and 10 years were most attracted by the Lego stations and handcrafting at the Crafting station.

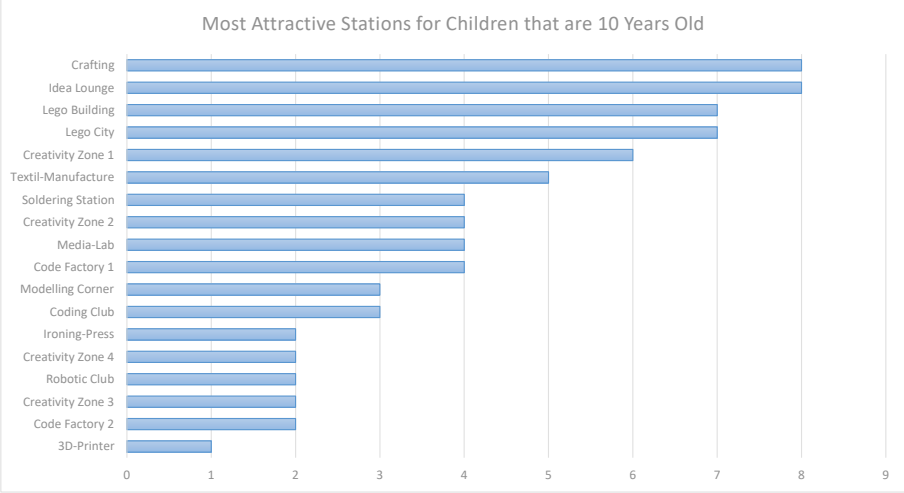

Figure 4.12: Statistical overview about the most attractive stations for participants that were ten years old.

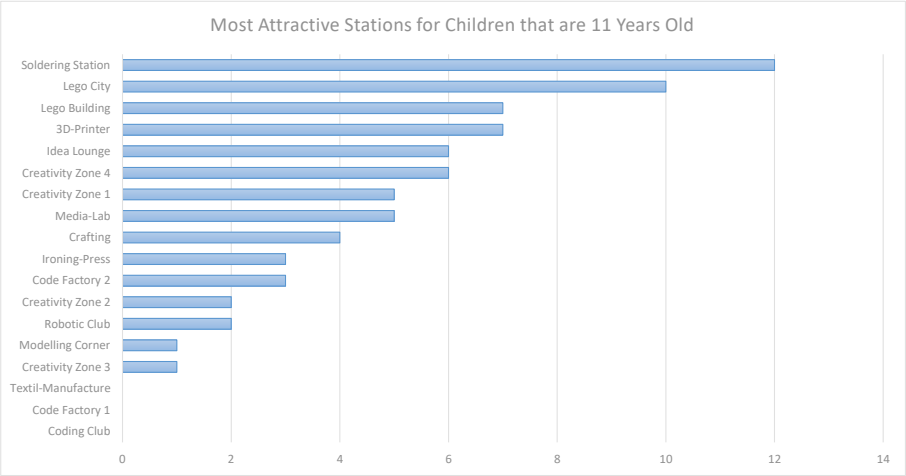

Figure 4.13: Statistical overview about the most attractive stations for participants that were eleven years old.

Figure 4.13 clearly shows, reaching the age of 11 years, the field of interest gets translocated to the Soldering Station and the 3D-Printer station.

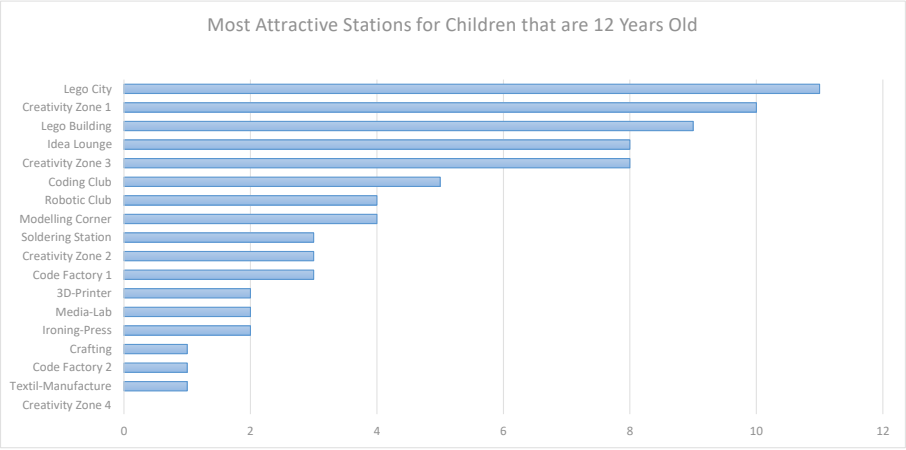

Figure 4.14: Statistical overview about the most attractive stations for participants that were twelve years old.

The elder participants with the age of 12 or higher were the most attracted by stations that had a focus on programming, as seen in Figure 4.14 on page 50 and 4.15 on page 51, such as Coding Club, Robotic Club and the Creativity Zones.

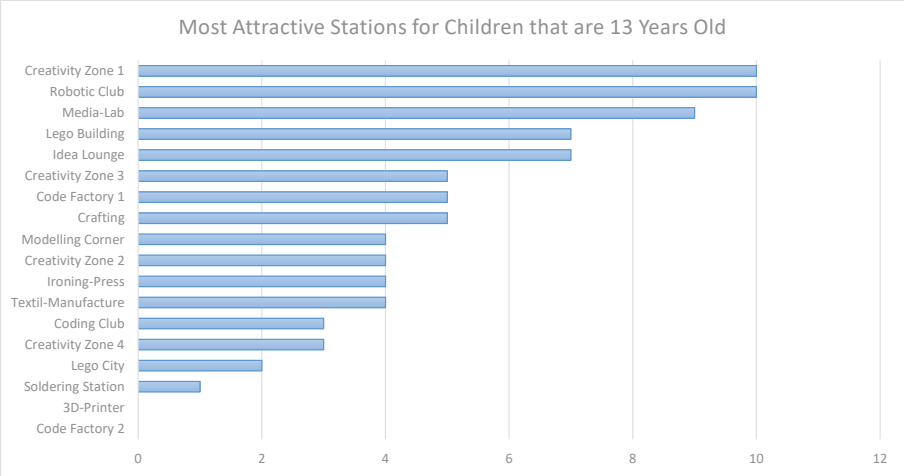

Figure 4.15: Statistical overview about the most attractive stations for participants that were thirteen years old.

For children of the age of 14 there is no possibility to make a statement because of the low number of participants at this age.

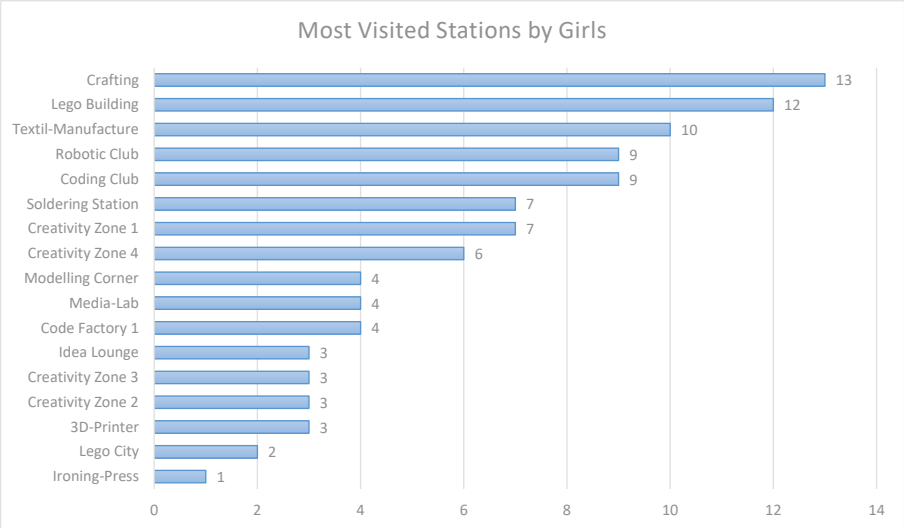

Figure 4.16: Statistical overview about the most attractive stations for girls.

As seen in Figure 4.16 on page 51, the Crafting station was the most attractive for girls closely followed by Lego Building and Textile-Manufacture, but girls were also attracted by pure technical and computer science related stations such as Soldering Station and Robotic Club or Coding Club.

4.2.3 Workshops

The stations have been classified in three different groups Digital Fabrication (Code Factory, Modelling Corner), Physical (Computing) (Coding Club, Robotic Club, Soldering Station, Lego Building, Media-Lab, Ironing-Press and Cut-Plotter, 3D-Printer, Textile Manufacture) and Supply Stations (Crafting, Idea Lounge). Figure 4.17 shows that most of the workshops have been carried out at Physical (Computing) stations with 85%. The least amount of workshops have been performed at the Supply Stations. This is caused by the different amount of stations in the different domains. Consequently, this data has no significance.

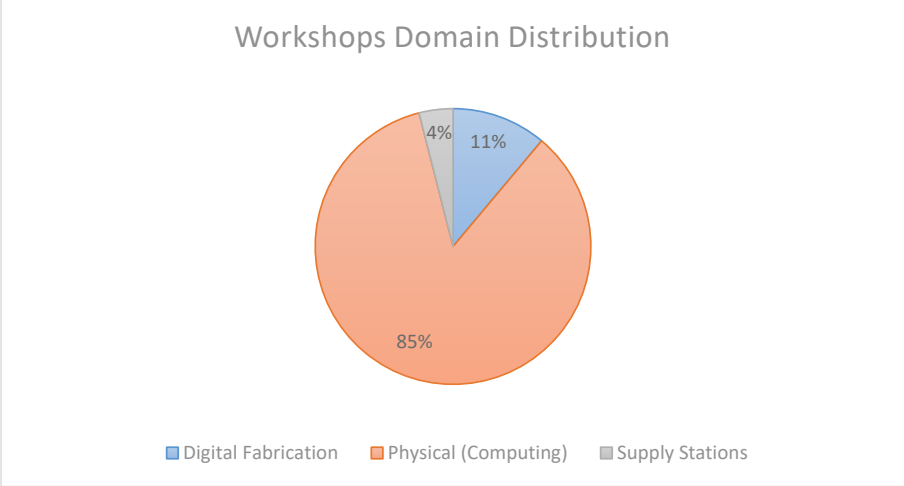

Figure 4.17: Statistical overview about the distribution of workshops per domain.

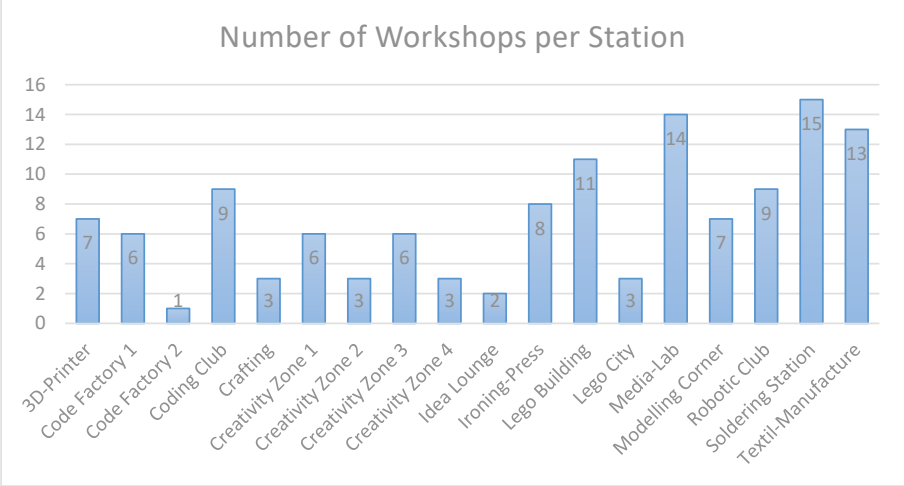

Figure 4.18: Statistical overview about the number of workshops per station.

Figure 4.17 gives an overview about the amount of workshops per station. The most workshops have been performed at the Creativity Zones, Lego Stations, Soldering Station and the Media Lab. The least workshops were at the Idea Lounge.

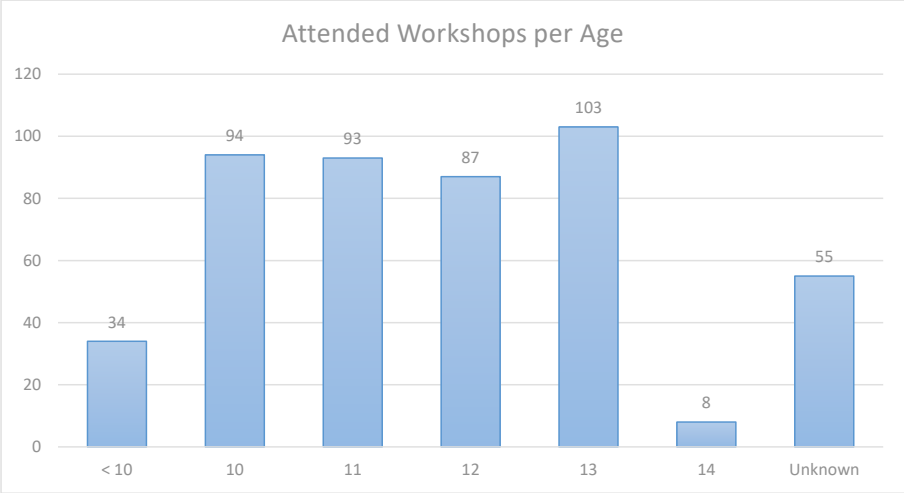

Figure 4.19: Statistical overview about the attended workshops per age.

In Figure 4.19 on page 53 and 4.20 on page 53 the statistical overview about the number of workshops per station can be depicted. Because of the different amount of participants per age these values have been normalized as seen in Figure 4.20 on page 53. Children below 10 years, 10 years olds and 13 years old had the same average value about 4,3 workshops. During the age range between 11 and 12 years there were less participated workshops. For the age of 14 we can make no statement because there were too less participants at this age.

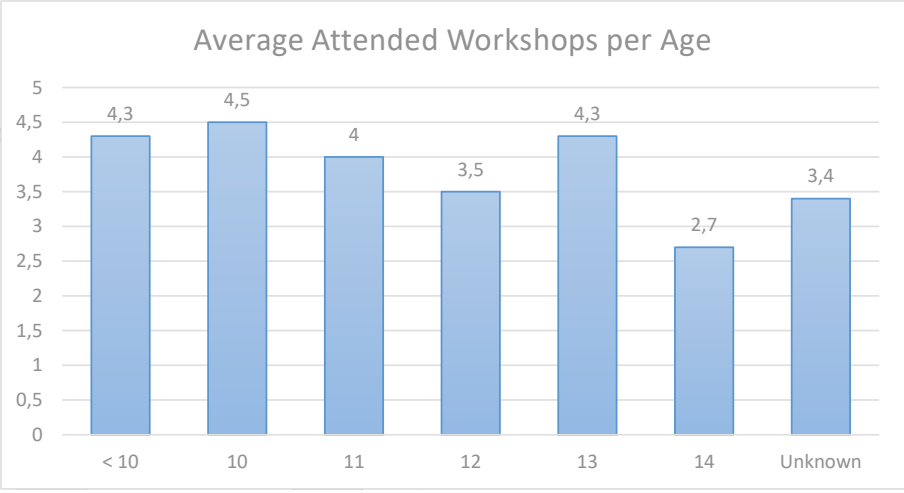

Figure 4.20: Statistical overview about the average attended workshops per age.

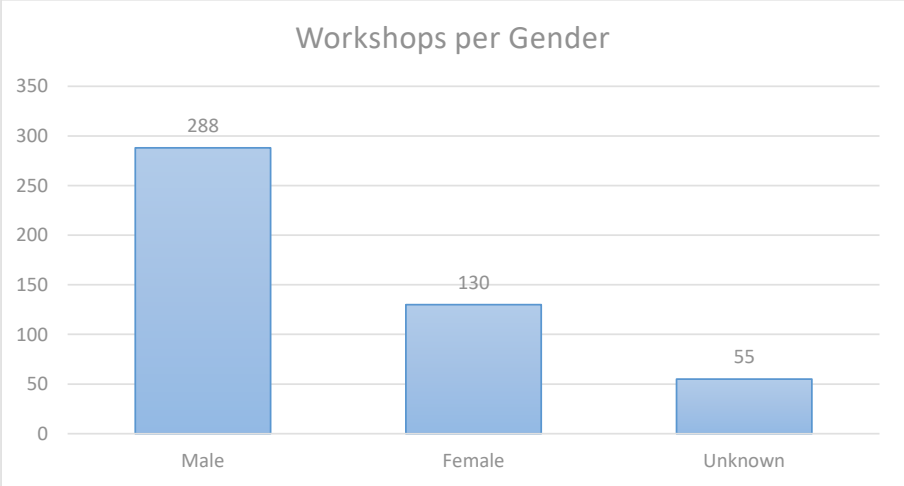

Figure 4.21: Statistical overview about the number of attended workshops per gender.

In Figure 4.21 on page 54 and 4.22 on page 54 the attended workshops per gender can be depicted. Here we need to consider the same situation as we had for the age distribution. The distribution between girls and boys vary and therefore we are normalizing these values. In Figure 4.22 on page 54 we see no significant differences between the average attended workshops per gender.

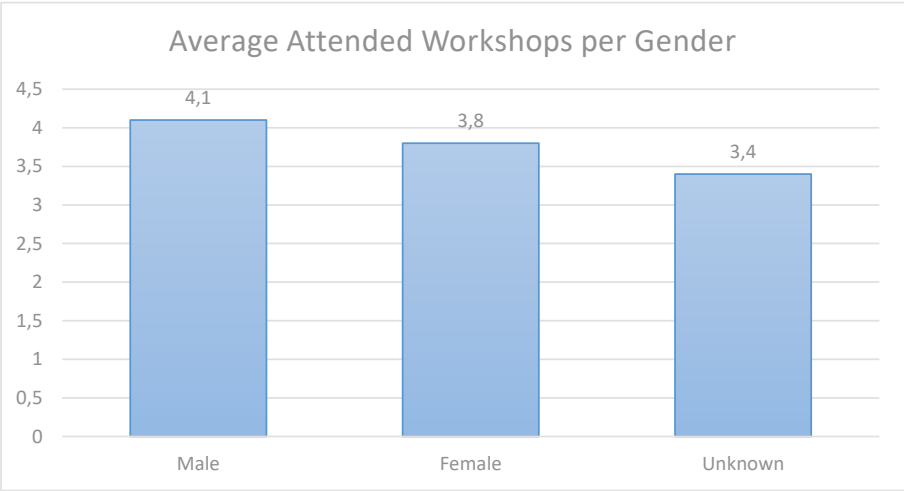

Figure 4.22: Statistical overview about the average attended workshops per gender.

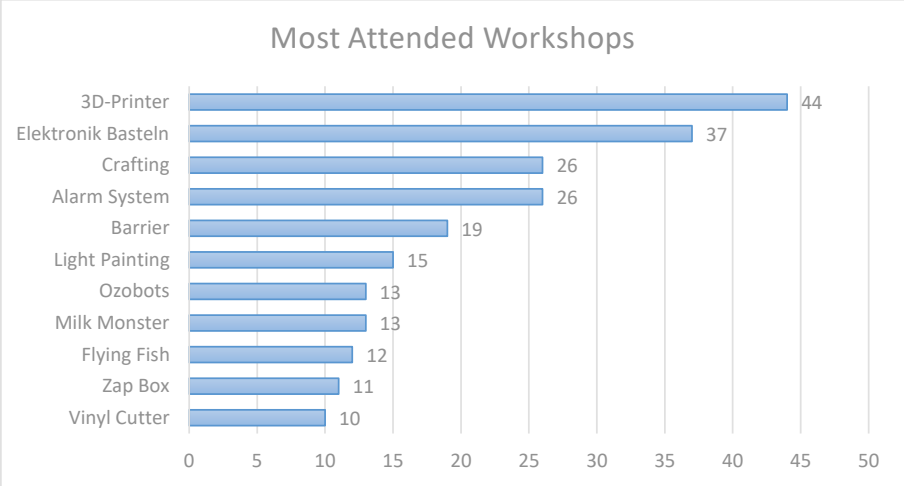

Figure 4.23: Statistical overview about the most attended workshops.

Figure 4.23 gives an overview about the most attended workshops. The most popular workshop was the 3D-Printer with 44 participants pulled tight of the Soldering Station with 37 participants. Most of the other popular workshops had a focus on programming. Consequently, it seems that programming workshops have a special attraction on children between 10 and 14 years.

4.2.4 Movement Profile

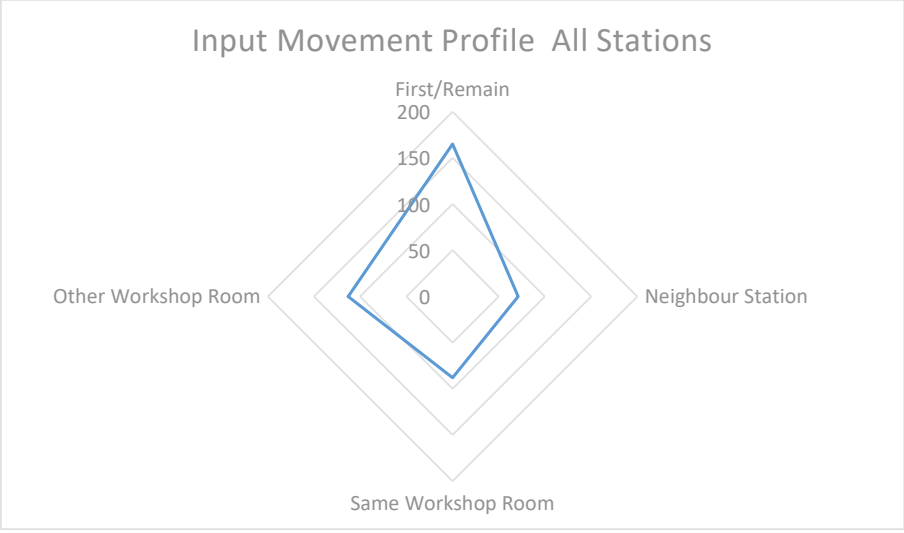

Figure 4.24: Overview of the input movement profile of all stations.

Figure 4.24 on page 55 and Figure 4.25 on page 56, depicts the input and output of the participants of all stations of the Maker Days for Kids event in Graz. It can be seen, that most of the participants have consciously chosen their workshops. This can be seen through the high amount of participants that changed the workshop room instead of changing workshops to adjacent stations.

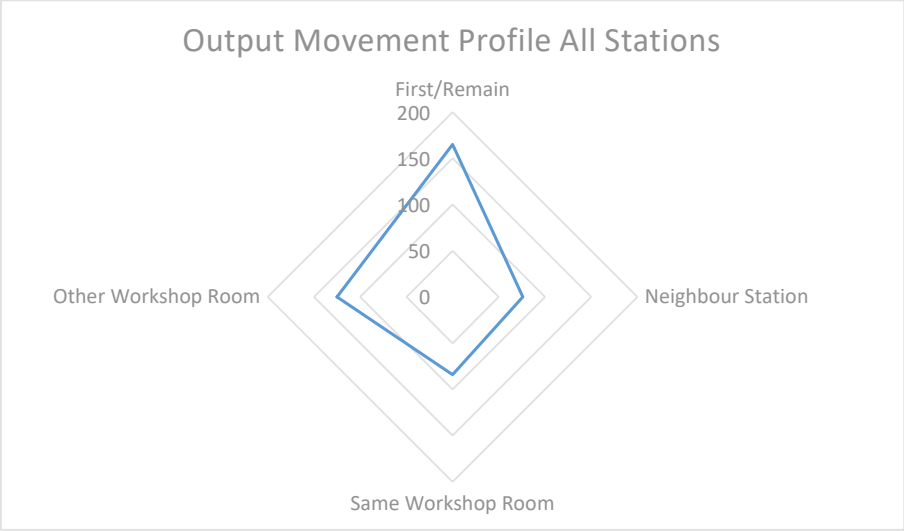

Figure 4.25: Overview of the output movement profile of all stations.

4.3 Digital Fabrication Stations

4.3.1 Code Factory

Participants

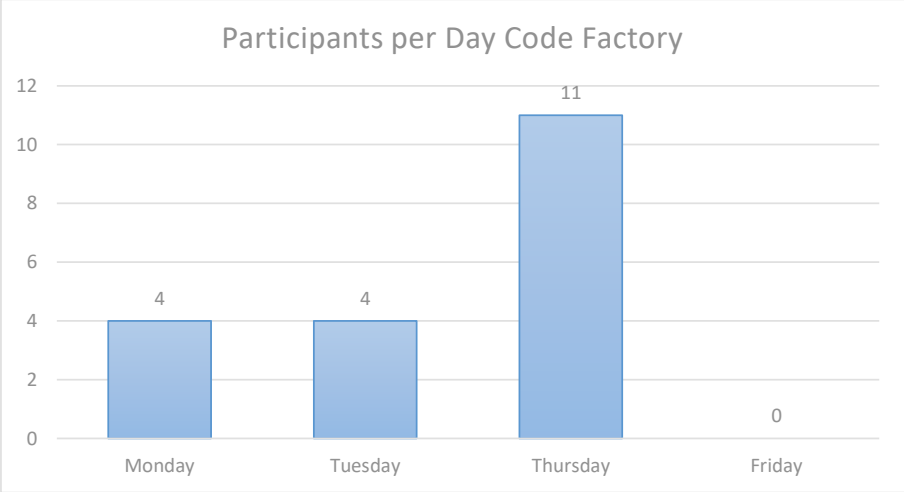

Figure 4.26: Statistical overview about the participants per day of the Code Factory.

In Figure 4.26 on page 57 the participants per day can be seen. The most attractive day has been the Thursday with 11 participants. On friday, these stations did not offer any workshop and on the first two days there were about four participants on each day.

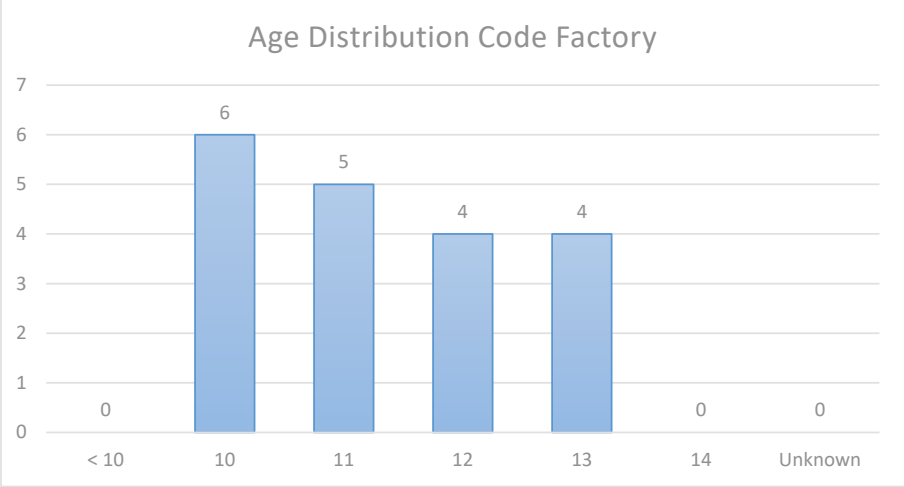

Figure 4.27: Statistical overview about the age distribution of the Code Factory.

Figure 4.27 represents the age distribution of the Code Factory. The diagram showas that the most attracted attendees were about 10 years old and with increasing age the station were less attractive.

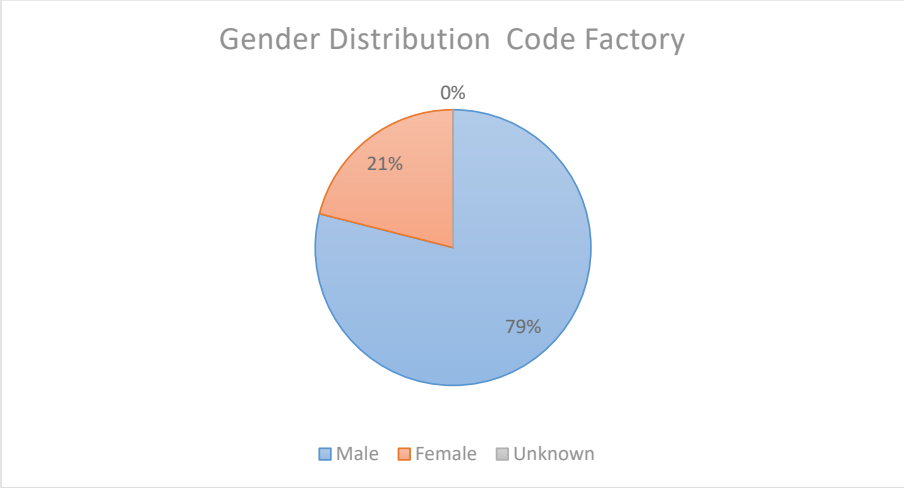

Figure 4.28: Statistical overview about the gender distribution of the Code Factory.

Figure 4.28 clearly shows that the station had about 79% boys and 21% girls.

Workshops

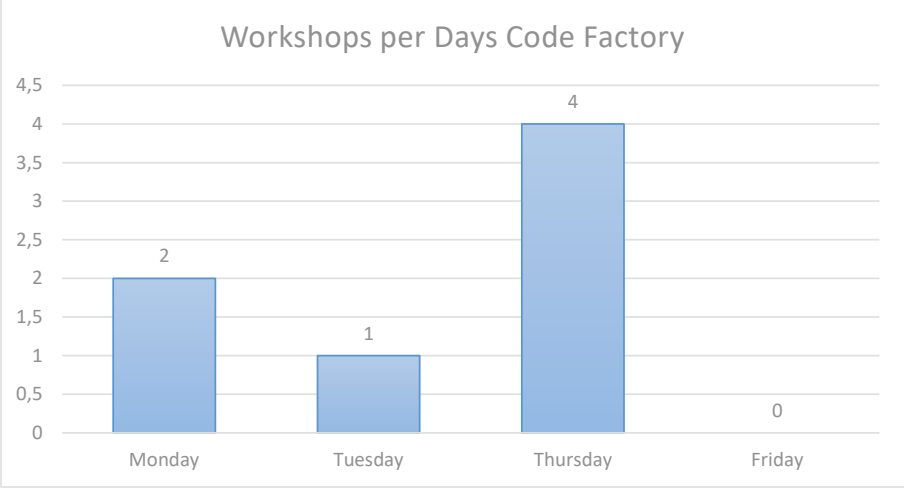

Figure 4.29: Statistical overview about the workshops per day of the Code Factory.

Most of the workshops were offered on Thursday, this also explains the higher participants on that day, with 4 workshops overall. Monday and Tuesday offered half

of them with two on Monday and a single one on Tusday, as seen in Figure 4.29 on page 58.

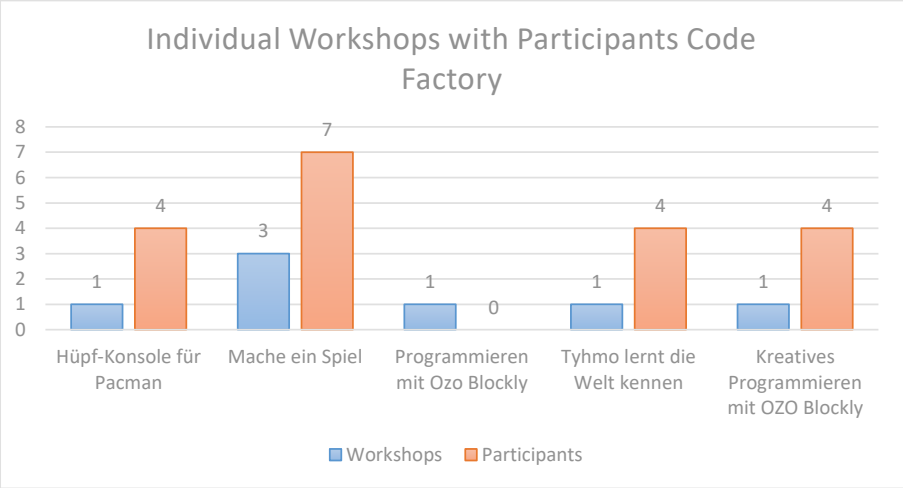

Figure 4.30: Statistical overview about the individual workshops with participants of the Code Factory.

As Figure 4.30 shows, the most attractive course was the "Mache ein Spiel" workshop with 7 participants. This workshop was realised by a peer and clearly shows that also peers within the same age region are able to offer successfully their own workshops. The high amount of participants show the acceptance of this kind of workshops and depicts that peer-learning is an important method for attracting children. Beside the "Programmieren mit Ozo Blockly" workshop that had zero participants had the other workshops around four attendees.

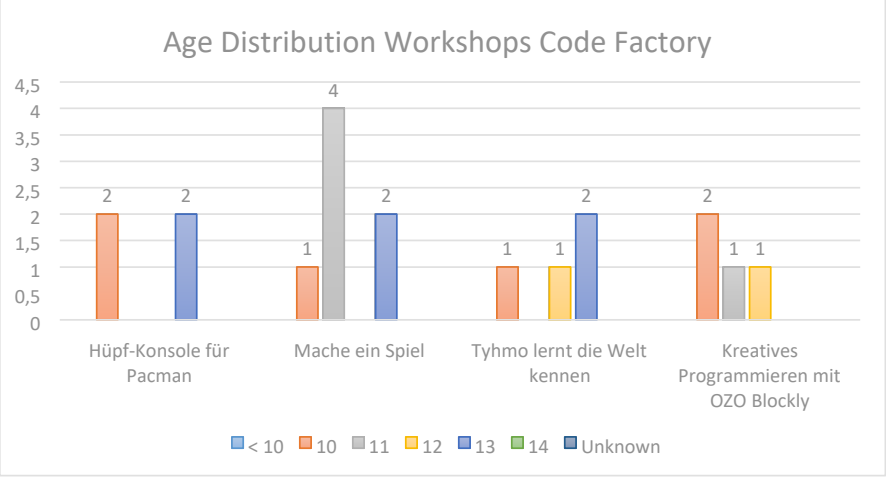

Figure 4.31: Statistical overview about the age distribution of the individual workshops of the Code Factory.

Figure 4.31 shows that the station attracted participants in the age range of attendees that are between 10 and 13 years old.

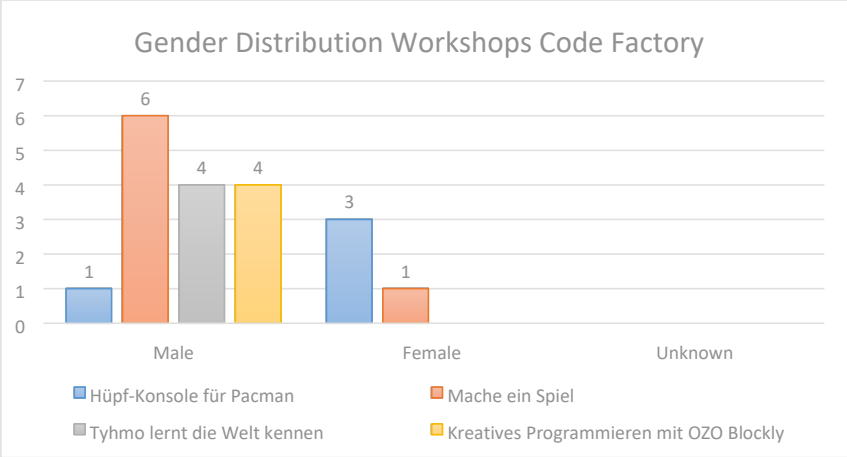

Figure 4.32: Statistical overview about the gender distribution of the individual workshops of the Code Factory.

Most participants were boys and were most attracted by the ”Mache ein Spiel“ workshop. Girls were the most attracted by the Hüpf-Konsole für Pacman workshop, as seen in Figure 4.32 on page 60. In future events, this workshop could be extended to attract more girls for this station.

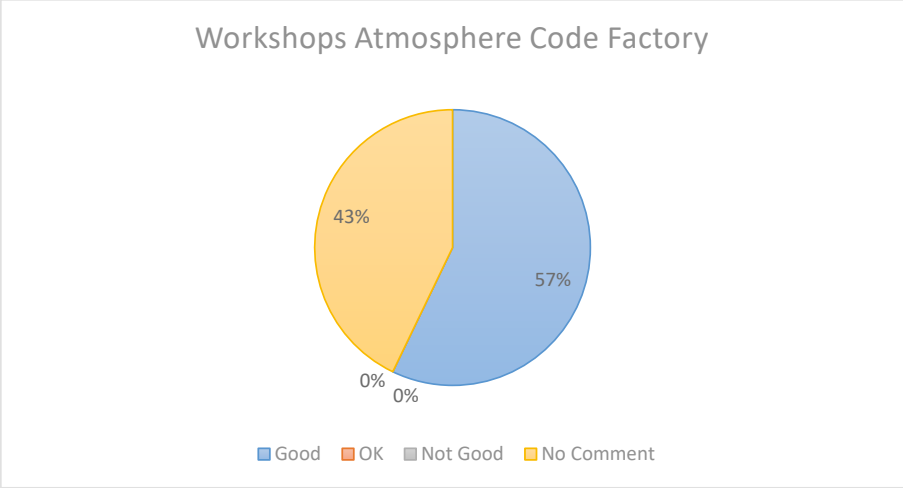

Figure 4.33: Statistical overview about the athmosphere at the individual workshops of the Code Factory.

Figure 4.33 shows that 57% of all workshops had a good atmosphere and for the remaining share of 43% are no comments available.

Movement Profile

Code Factory 1

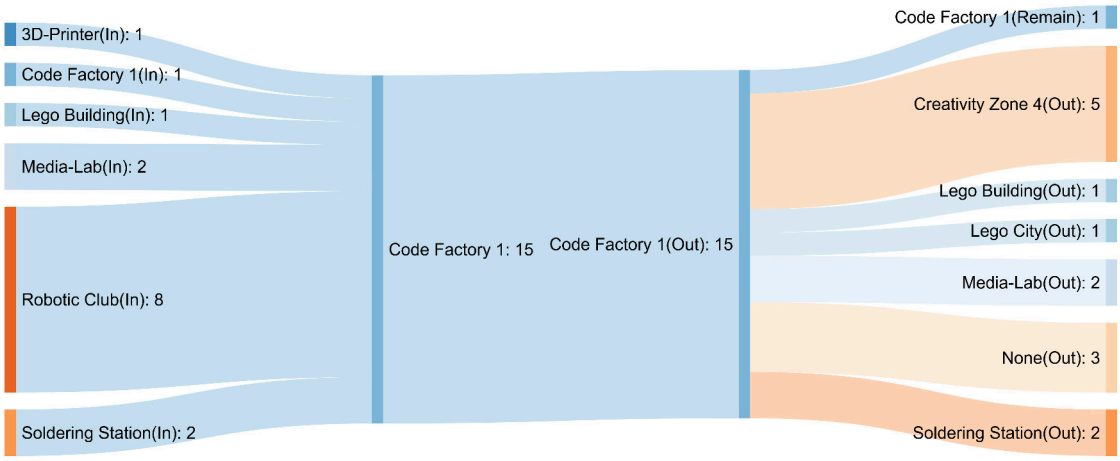

Figure 4.34: Overview of the input and output movement profile of the Code Factory 1 station.

In Figure 4.34 on page 61, the input and output movement of the Code Factorycan be seen. Most of the participants joined from the Robotic Club to this station and afterwards most of them joined the Creativity Zone 4. In general, most of the participants joined this station from a neighbouring station, as seen in Figure 4.35 on page 61, but afterwards there were more stations in the other workshop room that were joined, as seen in Figure 4.36 on page 4.36.

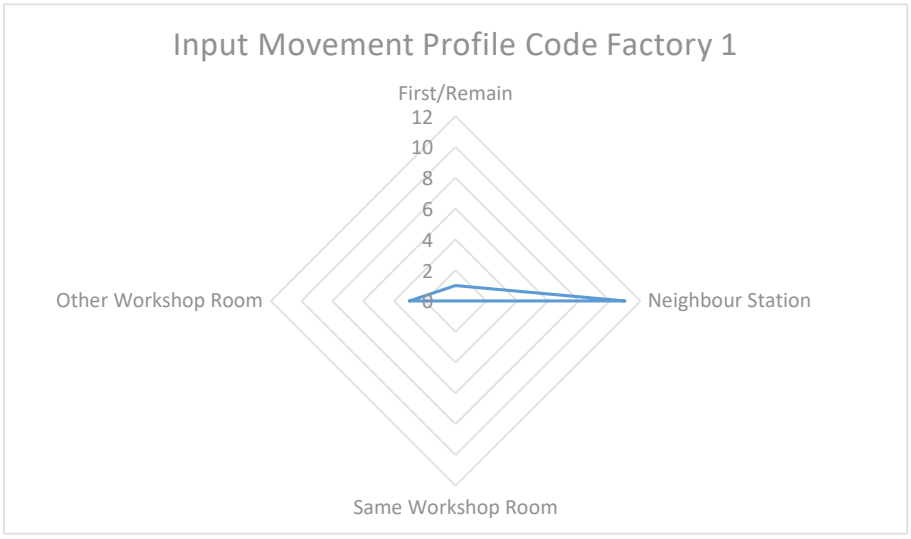

Figure 4.35: Overview of the input movement profile of the Code Factory 1 station.

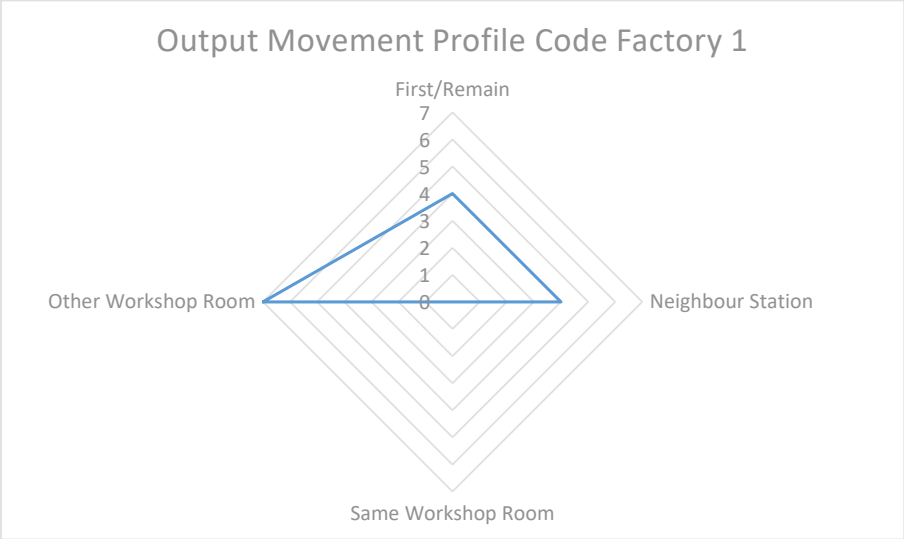

Figure 4.36: Overview of the output movement profile of the Code Factory 1 station.

Code Factory 2

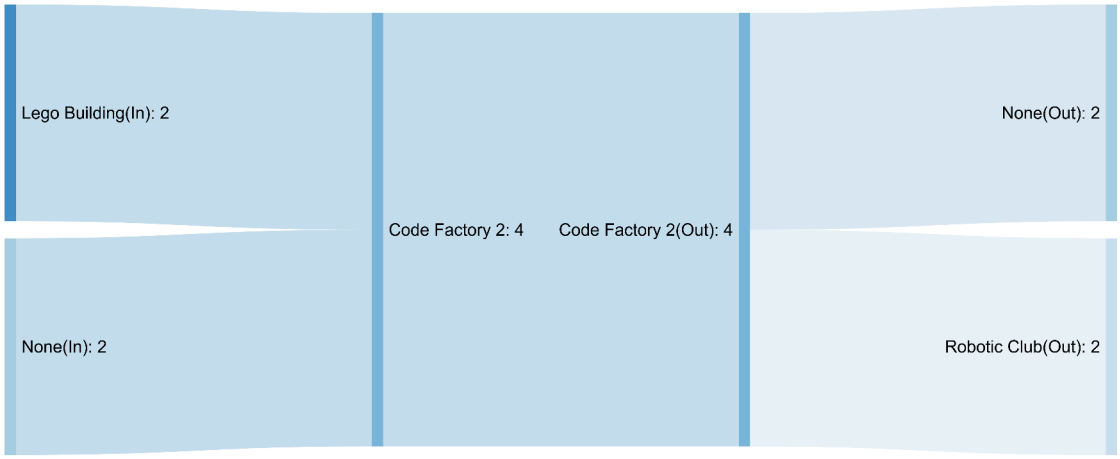

Figure 4.37: Overview of the input and output movement profile of the Code Factory 2 station.

Most of the participants of the Code Factory 2 station were joining the station from the Lego Building and left the station for the Robotic Club, as seen in Figure 4.37 on page 62. The Lego Building station is adjacent to the Code Factory 2 and therefore participants came from neighbouring station, as seen in Figure 4.38 on page 63. The participants that left this station changed to other stations that were in the same workshop room, as seen in Figure 4.39 on page 63.

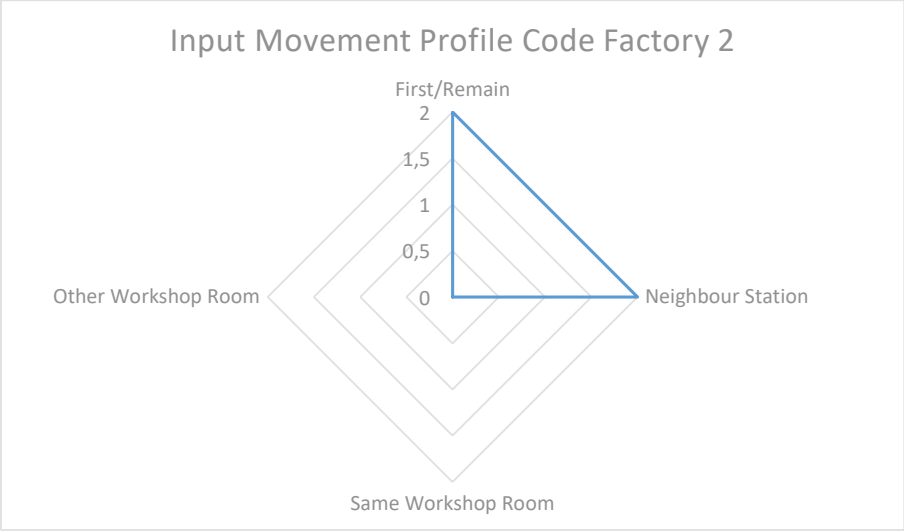

Figure 4.38: Overview of the input movement profile of the Code Factory 2 station.

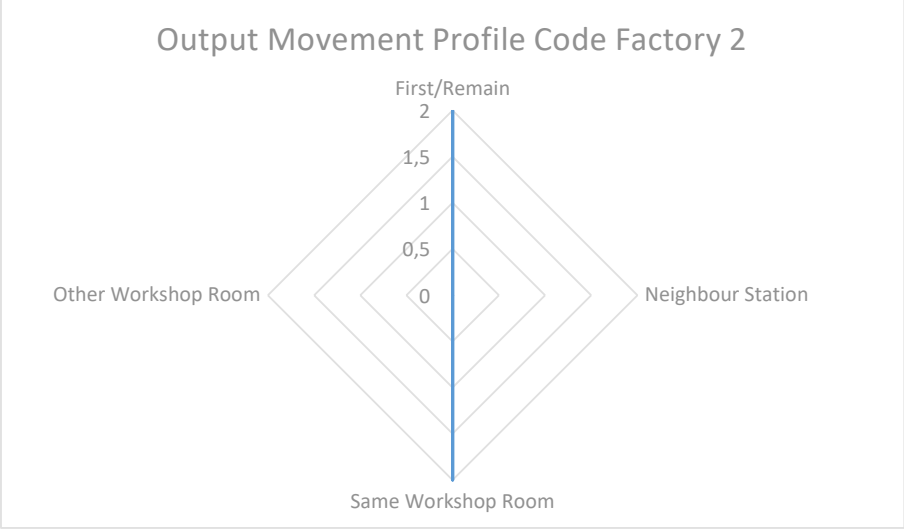

Figure 4.39: Overview of the output movement profile of the Code Factory 2 station.

4.3.2 Modelling Corner

Participants

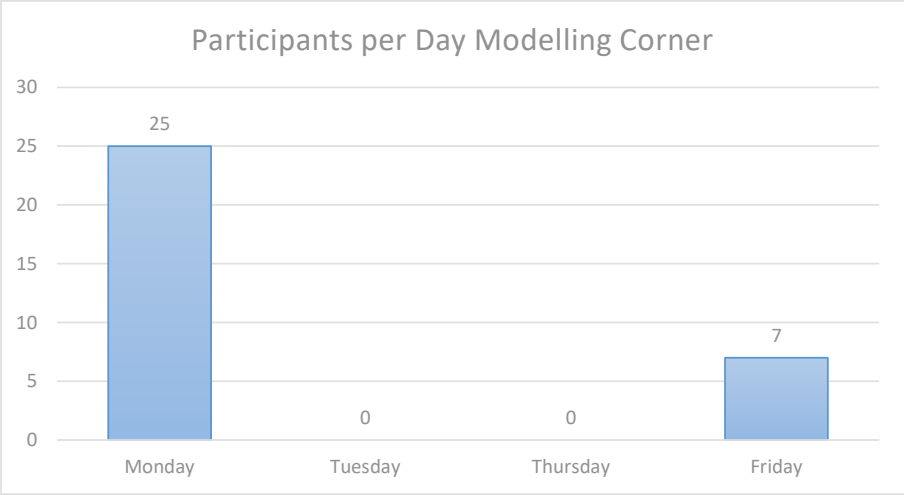

Figure 4.40: Statistical overview about the participants per day of the Modelling Corner.

Figure 4.40 shows that on Monday the most attendees of 25 individuals on Monday and on Friday about 7. On Tuesday and Thursday there was no recorded data of this station, but we know that there were workshops because of recorded product cards.

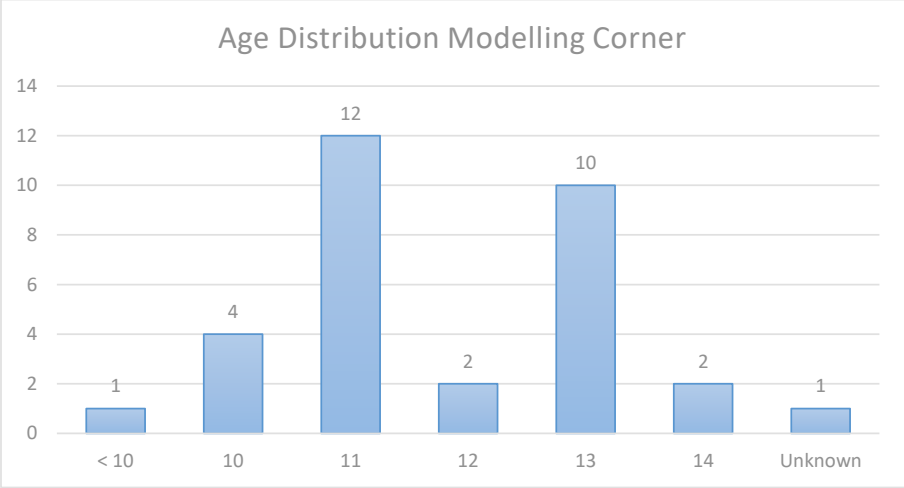

Figure 4.41: Statistical overview about the age distribution of the Modelling Corner.

In Figure 4.41 on page 64 the age distribution of the participants can be depicted.

Most of the participants were 12 years or 13 years old. The least participants age group were about 12 years old with an amount of 2 individuals.

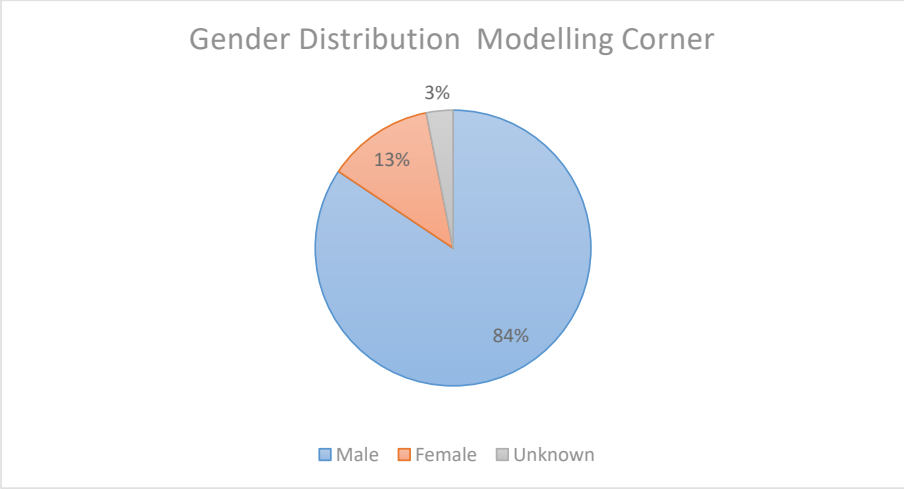

Figure 4.42: Statistical overview about the gender distribution of the Modelling Corner.

Most of the attendees were boys with a share of 84%. This result shows that this station needs to increase the attractiveness for girls.

Workshops

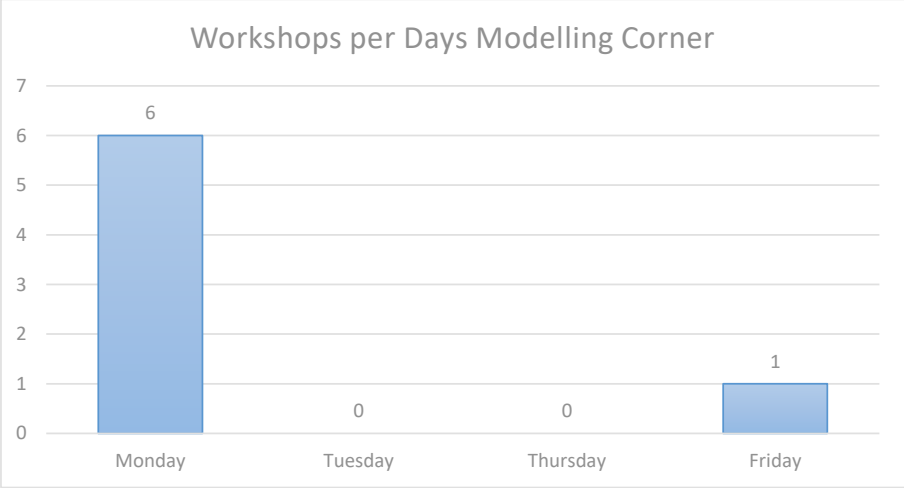

Figure 4.43: Statistical overview about the workshops per day of the Modelling Corner.

On Monday the Modelling Corner station offered about 6 workshops and on Friday one, as seen in Figure 4.43 on page 65. For Tuesday and Thursday we have no recorded data from the workshop cards but we know that there was at least one workshop because of filled product cards.

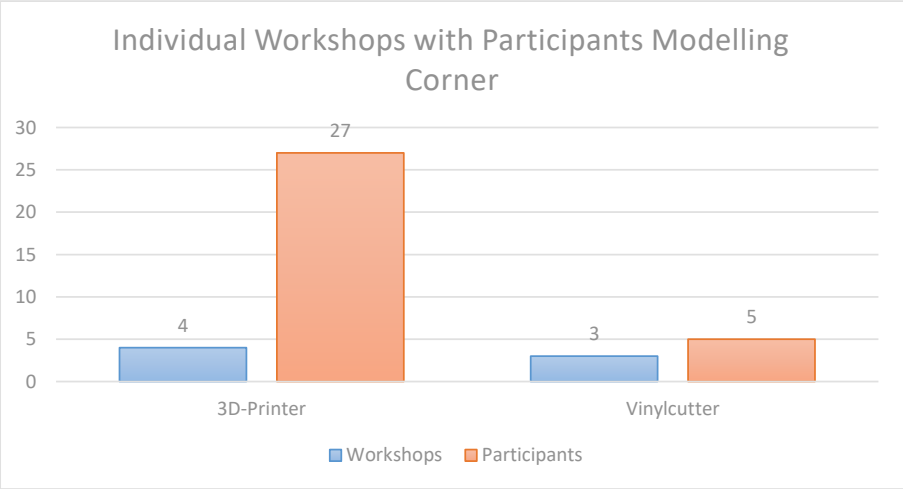

Figure 4.44: Statistical overview about the individual workshops with participants of the Modelling Corner.

The 3D-Printer had the most attendees with 27 participants. The Vinyl-Cutter instead had just 5 individuals, as seen in Figure 4.44 on page 66.

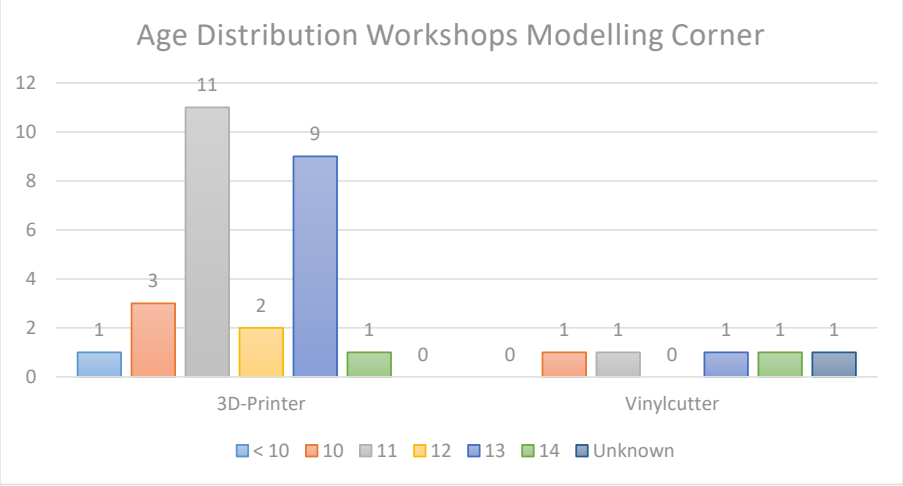

Figure 4.45: Statistical overview about the age distribution of the individual workshops of the Modelling Corner.

As seen in Figure 4.45 on page 66, the station attracted with the 3D-Printer work-

shops the complete age range of children that are between below 10 years and 14 years old.

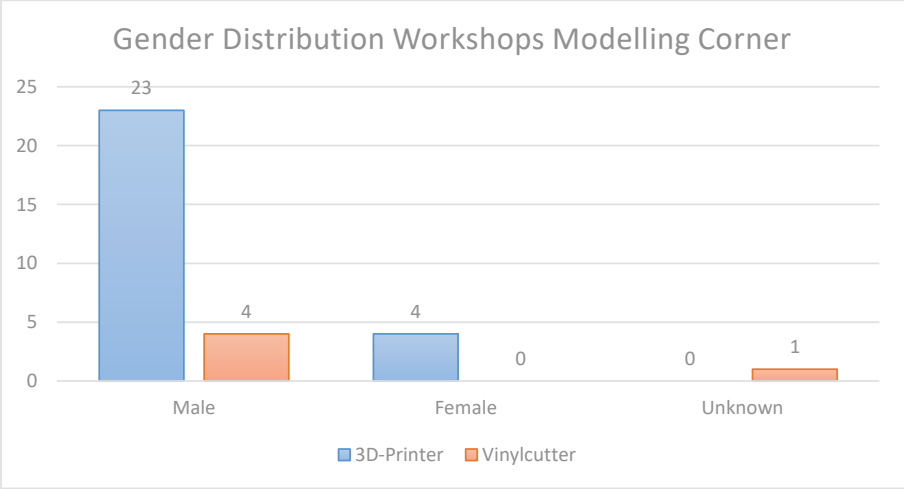

Figure 4.46: Statistical overview about the gender distribution of the individual workshops of the Modelling Corner.

Figure 4.46 clearly shows that the Vinyl-Cutter workshop was very successful.

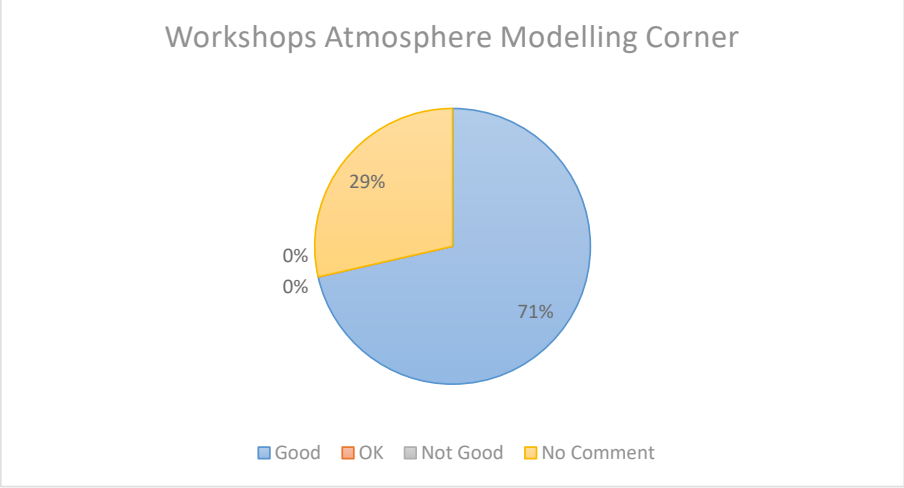

Figure 4.47: Statistical overview about the athmosphere at the individual workshops of the Modelling Corner.

About two out of three workshops had a good atmosphere and about the rest are no comments available, as seen in Figure 4.47 on page 67.

Movement Profile

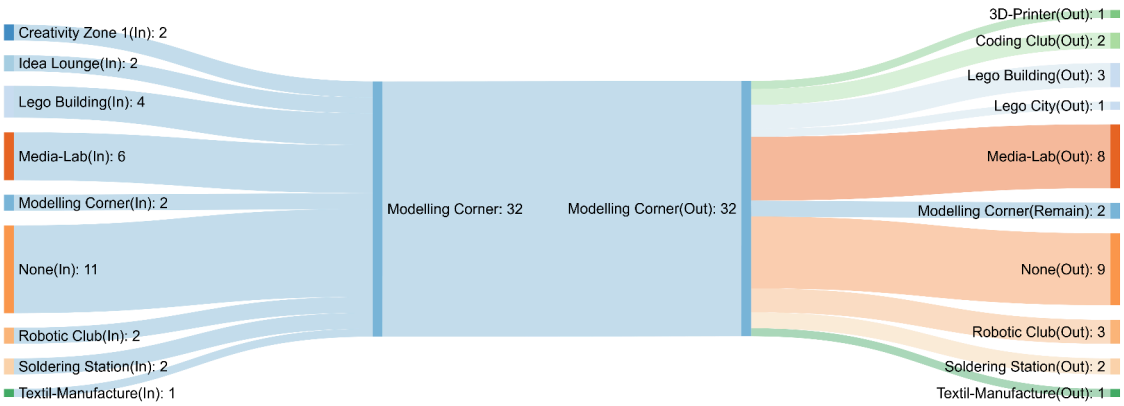

Figure 4.48: Overview of the input and output movement profile of the Modelling Cornerstation.

Most of the participants have consciously chosen the Modelling Corner, as seen in Figure 4.48 on page 68, and also most of the participants remained at this station. In general, the participants came from stations of the other workshop room, as seen in Figure 4.49 on page 68 and also switched to stations in the other workshop room, as seen in Figure 4.50 on page 69.

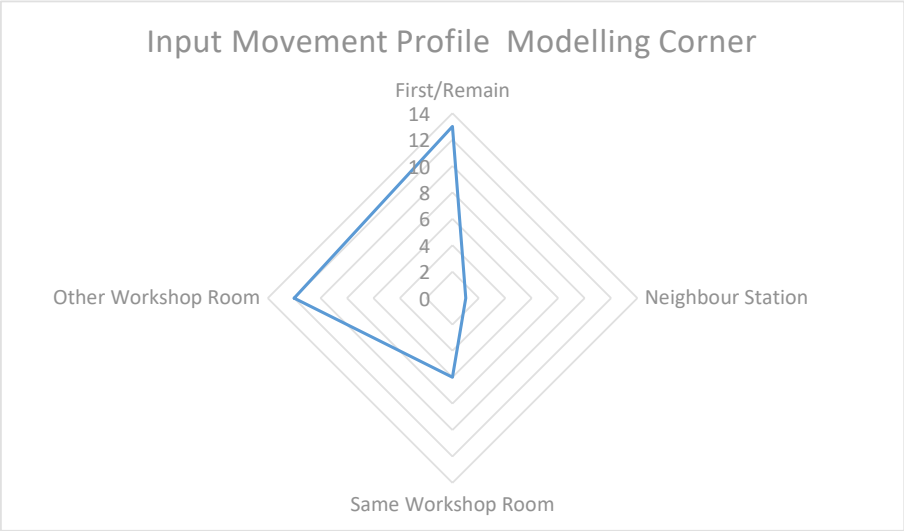

Figure 4.49: Overview of the input movement profile of the Modelling Cornerstation.

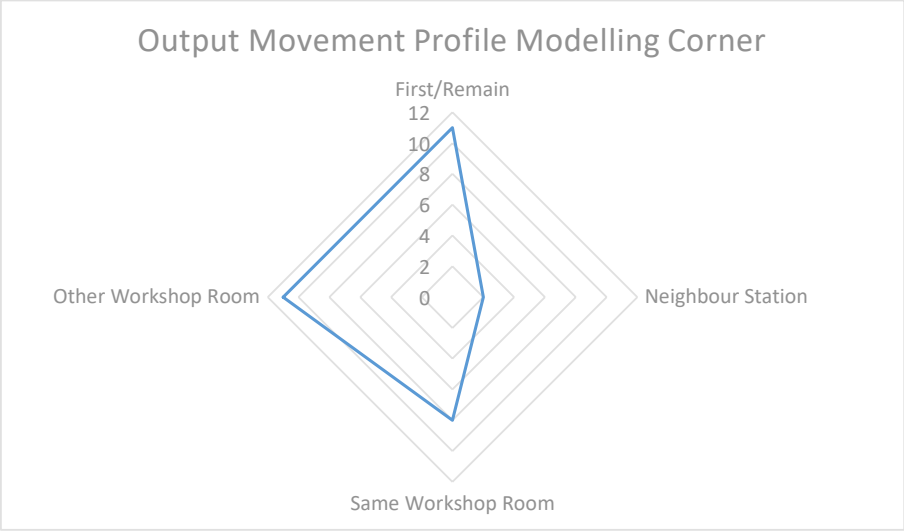

Figure 4.50: Overview of the output movement profile of the Modelling Cornerstation.

4.4 Physical (Computing) Stations

4.4.1 Coding Club

Participants

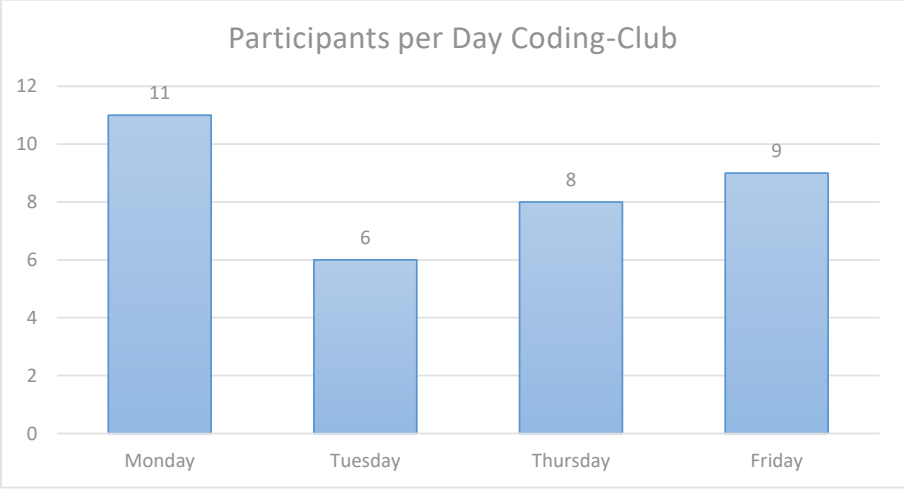

Figure 4.51: Statistical overview about the participants per day of the Coding Club.

Figure 4.51 shows the statistical overview about the participants per day of the Coding Club. The most participants have been on Monday by 11 individuals. The next day, the number decreased to six and the last days it steadily increased to 9 on the last day.

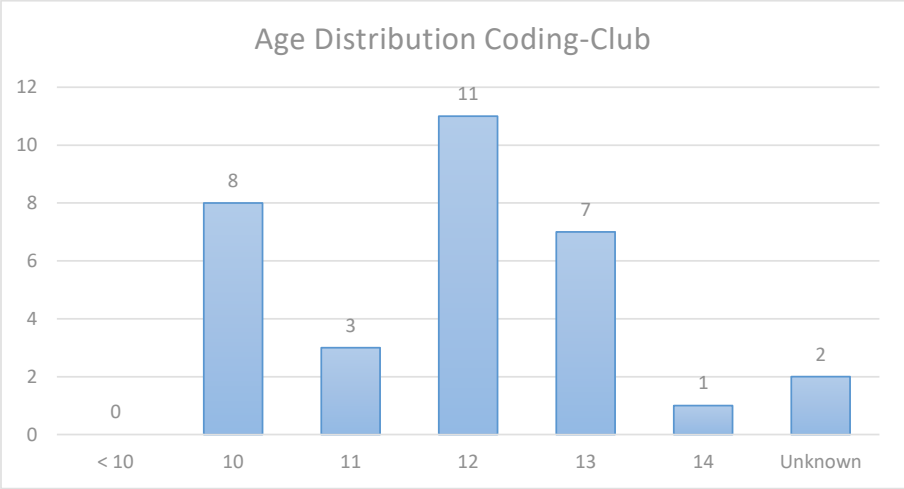

Figure 4.52: Statistical overview about the age distribution of the Coding Club.

Figure 4.52 clearly shows that the group of children of the age of 12 years were most attracted by this station closely followed by the 10 years old. The least group were children at the age of 11.

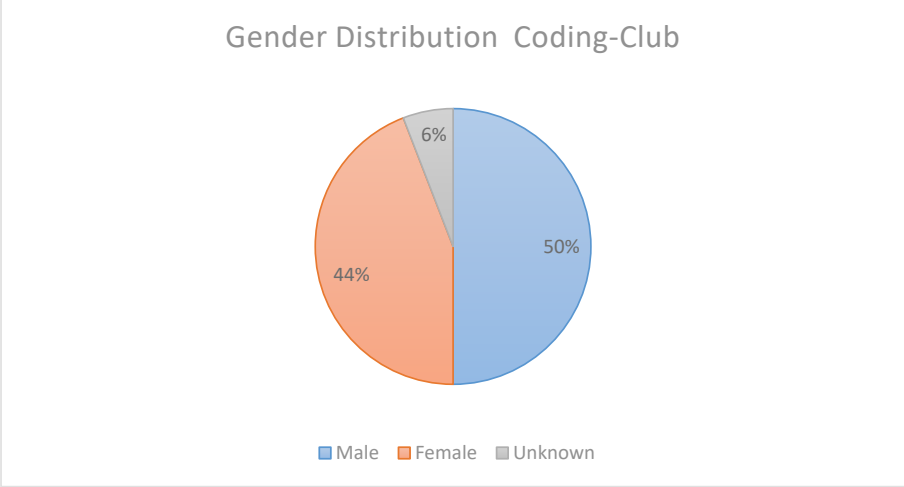

Figure 4.53: Statistical overview about the gender distribution of the Coding Club.

At this station, the gender gap between boys and girls were pretty close between 44% girls and 50% boys, as seen in Figure 4.53 on page 70. Consequently, this station

offered specific attractions to them. One of the reasons could be the strong connection combining programming microcontrollers with handcrafting such as building a Milk Monster.

Workshops

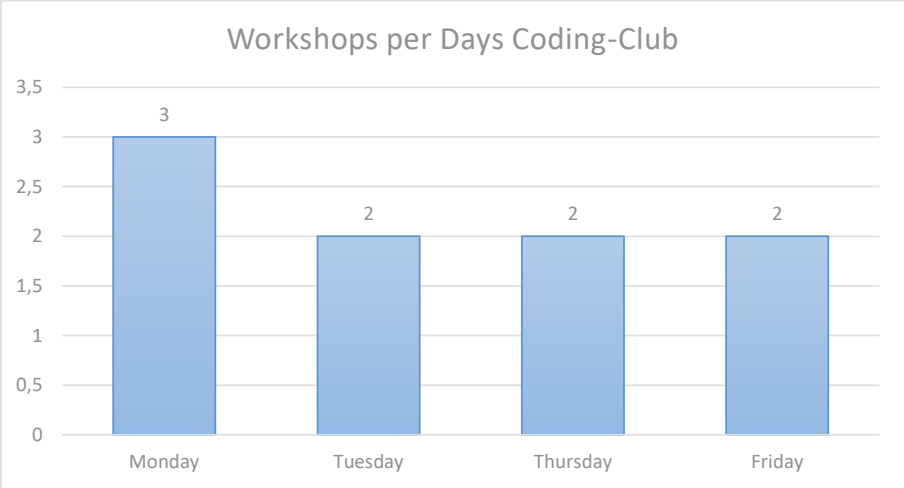

Figure 4.54: Statistical overview about the workshops per day of the Coding Club.

Figure 4.54 shows that the number of workshops were almost steady over all four days.

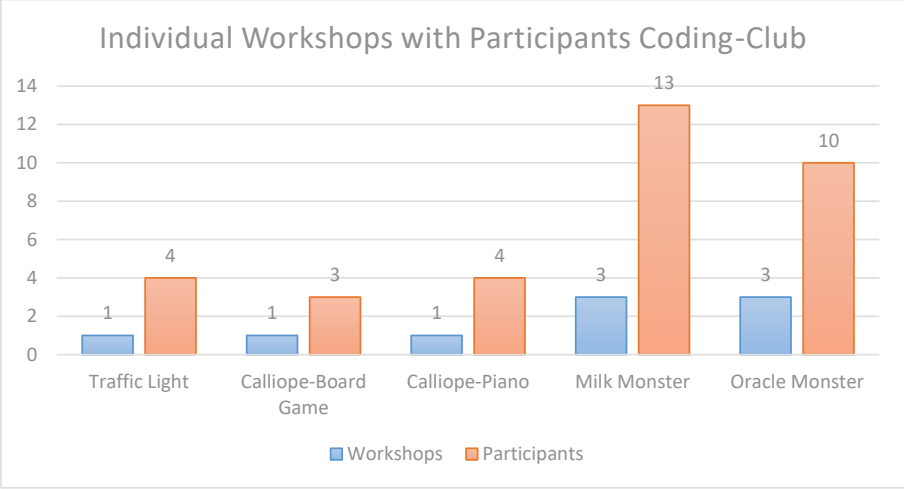

Figure 4.55: Statistical overview about the individual workshops with participants of the Coding Club.

Figure 4.55 provides an overview of the individual workshops, the number of offerings and the total number of participants. The most attractive workshop was the Milk Monster with 13 participants, closely followed by the Orace Monster and the least attractive the Calliope-Board-Game with 3 participants.

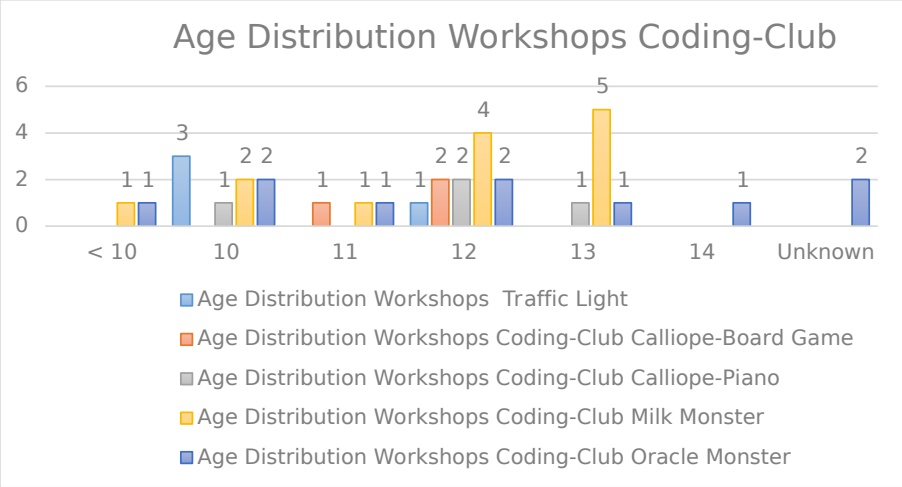

Figure 4.56: Statistical overview about the age distribution of the individual workshops of the Coding Club.

The Milk Monster and the Oracle Monster were most attractive to children between 12 and 13 years, as seen in Figure 4.56 on page 72. The Traffic-Light was the most attractive to children with an age of 10 years. In future events, the Traffic-Light project can become a basic workshop that could to attract them for more advanced workshops such as the Milk Monster.

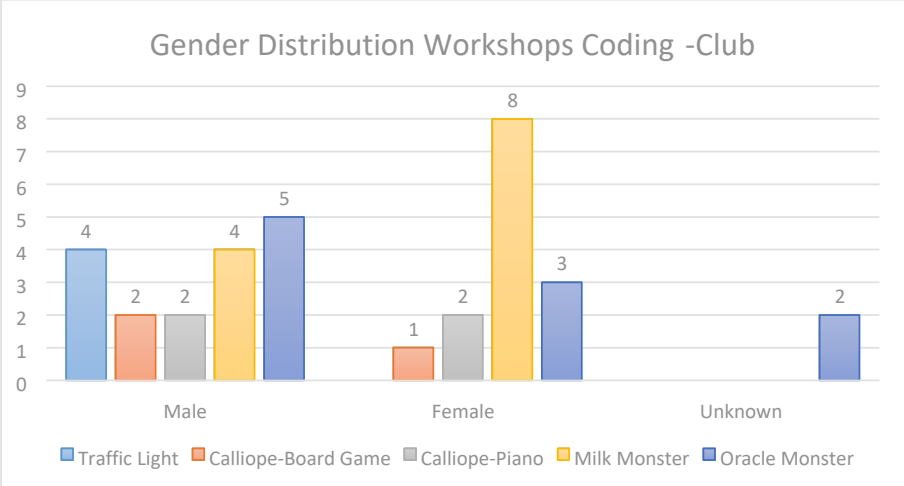

Figure 4.57: Statistical overview about the gender distribution of the individual workshops of the Coding Club.

Figure 4.57 clearly shows, that the most girls were attracted by the Milk Monster. For boys there is no significance visible. In future events, the Milk Monster should be retained to keep the high attraction to the girls.

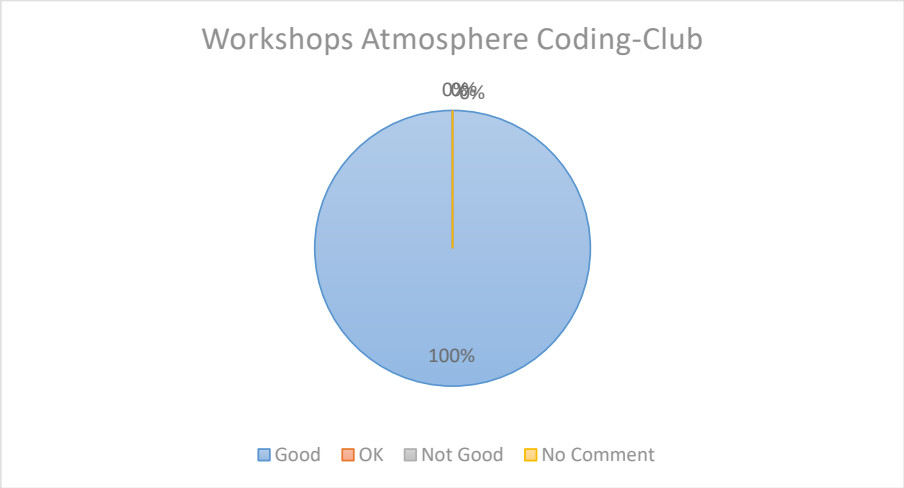

Figure 4.58: Statistical overview about the athmosphere at the individual workshops of the Coding Club.

Figure 4.58 shows that the atmosphere during the workshops were good without any problems.

Movement Profile

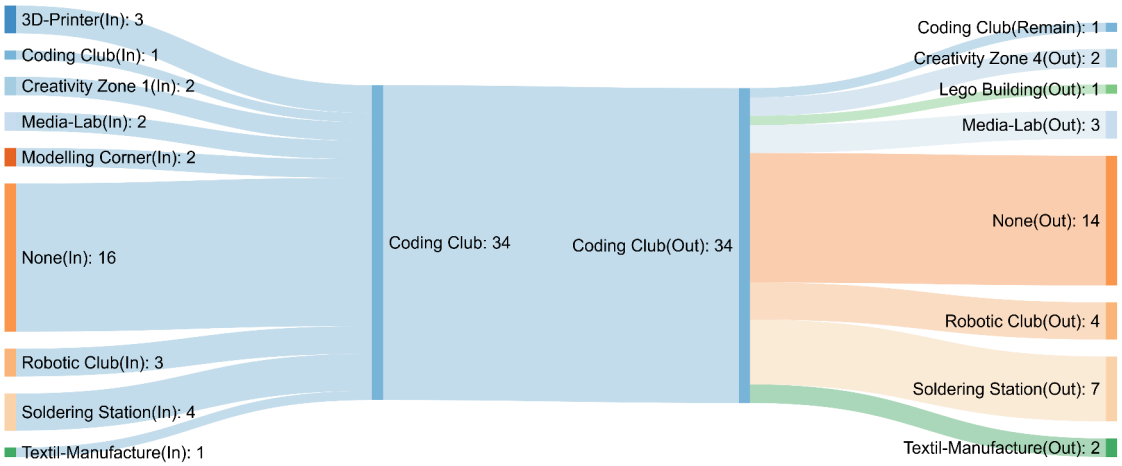

Figure 4.59: Overview of the input and output movement profile of the Coding Clubstation.

In Figure 4.59 on page 74 it can be seen that the most participants had chosen this station as their starting station and most of the also retained at this station. The input and output of this station clearly show that most of the participants remained at this station and others joined stations in the other workshop room, as seen in Figure 4.60 on page 74 as well as in Figure 4.61 on page 75.

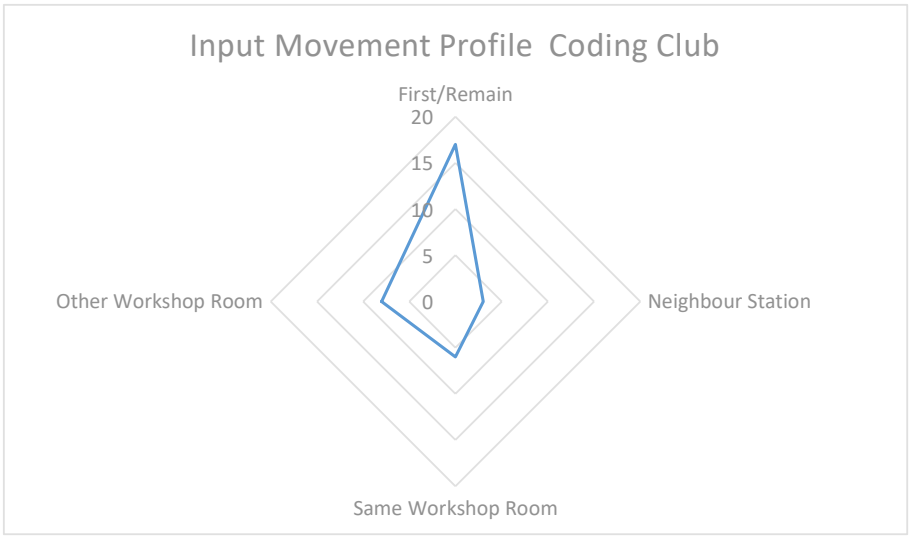

Figure 4.60: Overview of the input movement profile of the Coding Clubstation.

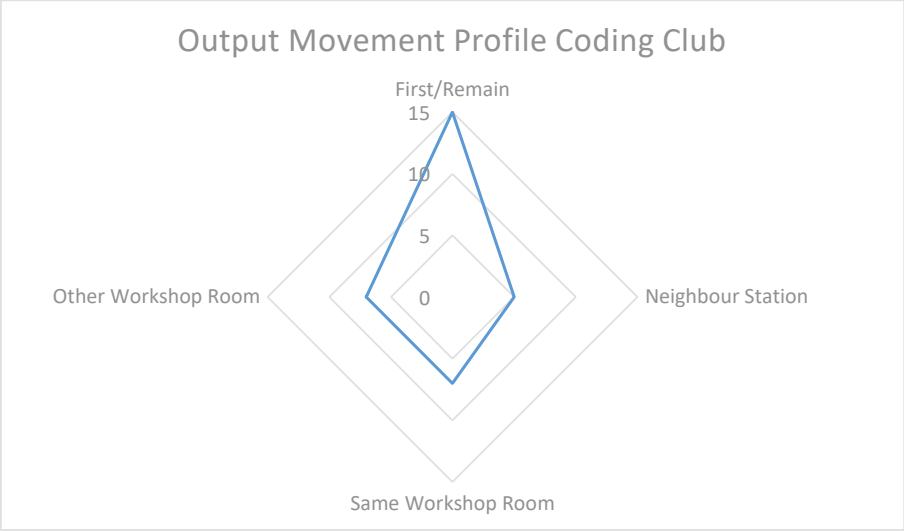

Figure 4.61: Overview of the output movement profile of the Coding Clubstation.

4.4.2 Robotic Club

Participants

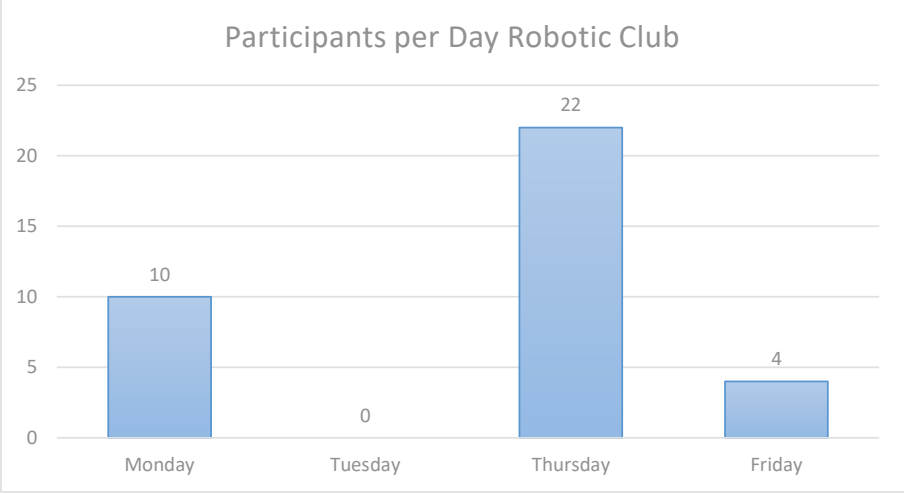

Figure 4.62: Statistical overview about the participants per day of the Robotic Club.

Figure 4.62 shows that Thursday was the most tempting day with 22 participants, Monday were about 10 individuals and on Friday there were just 4 participants. On Tuesday, the Robotic Club workshops were temporary moved to the Code Factory 2 station thats why this day is represented with zero in the diagram.

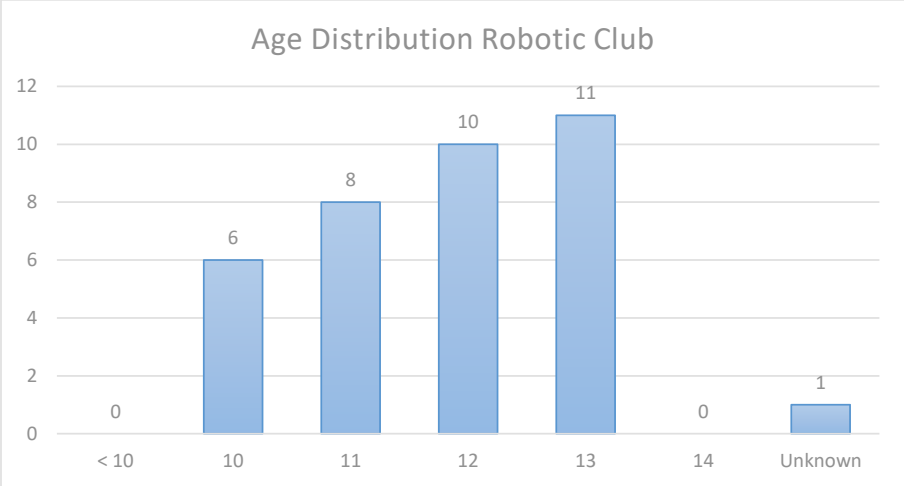

Figure 4.63: Statistical overview about the age distribution of the Robotic Club.

As seen in Figure 4.63 on page 76, the Robotic Club workshops attracted all ages and with increasing age the station became more attractive. About 11 participants were about 13 years old and represent the most attended age group at this station.

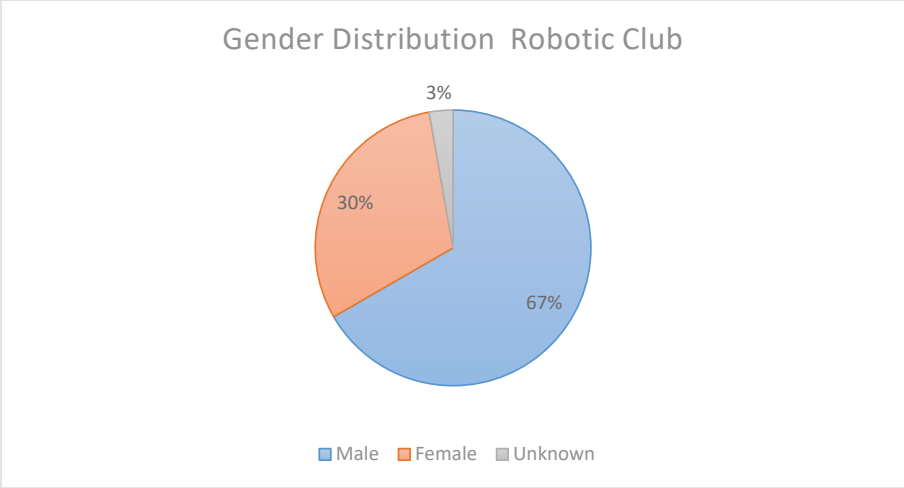

Figure 4.64: Statistical overview about the gender distribution of the Robotic Club.

This station attracted some more girls than other station such as the Coding Factory. Girls were represented with a share of 30% and as the Figure 4.64 depicts, boys were presented as 67%.

Workshops

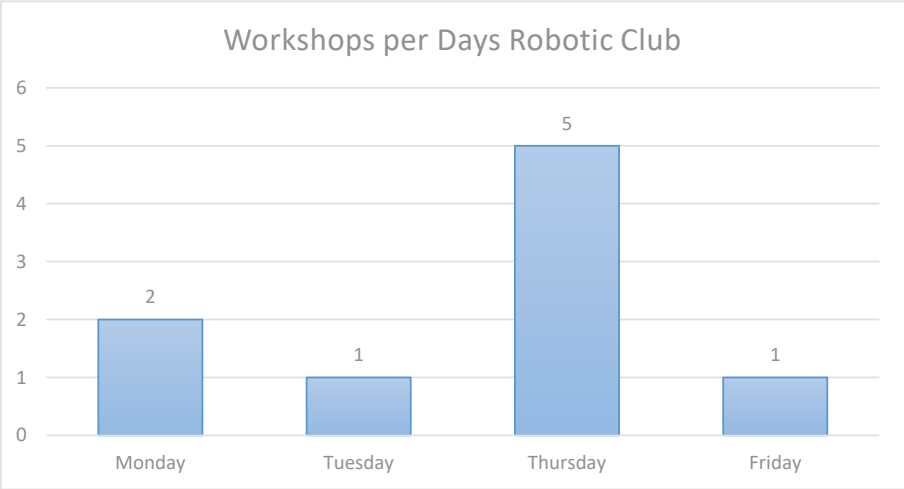

Figure 4.65: Statistical overview about the workshops per day of the Robotic Club.

Most of the workshops have been offered on Thursday with a total amount of 5. The other three days had about the same amount of 1-2 workshops per day, as seen in Figure 4.65 on page 77.

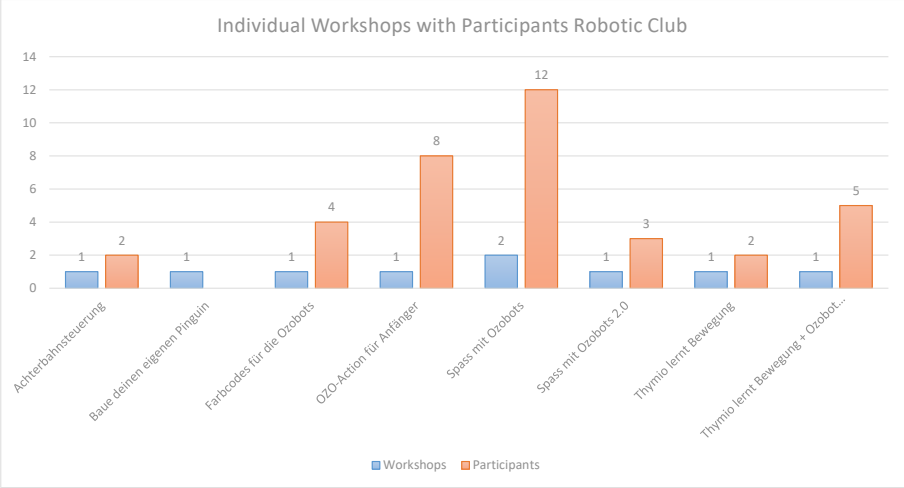

Figure 4.66: Statistical overview about the individual workshops with participants of the Robotic Club.

Figure 4.66 gives an overview of the participants at the individual workshops. The station had their focus on working with Ozobots. The most attractive workshop also contains projects with the Ozobot and is called ”Spass with Ozobots“ and had

about 12 participants. The least visited workshop was the ”Achterbahnsteuerung“ with 2 participants, but this workshop was just offered on friday; the ”Baue deinen eigenen Pinguin“ workshop had no attendees at all.

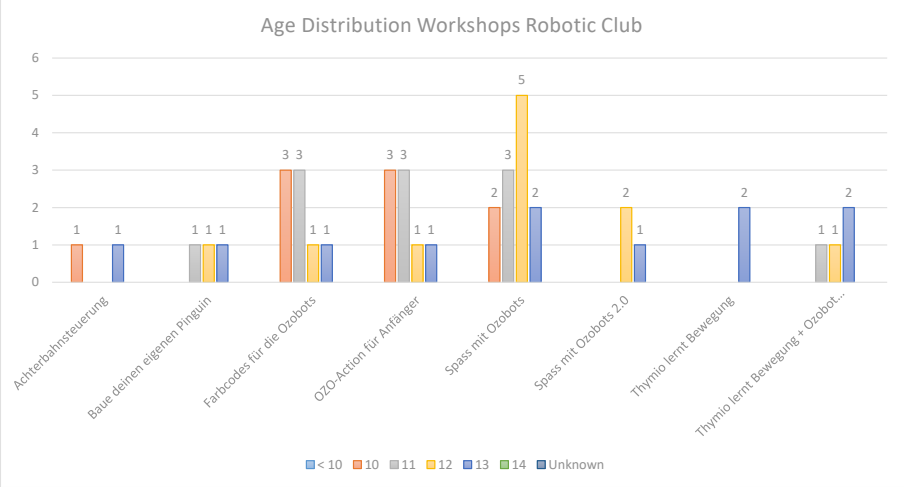

Figure 4.67: Statistical overview about the age distribution of the individual workshops of the Robotic Club.

The station attracted all ages equally, especially the Ozobots workshops, as seen in Figure 4.67 on page 78.

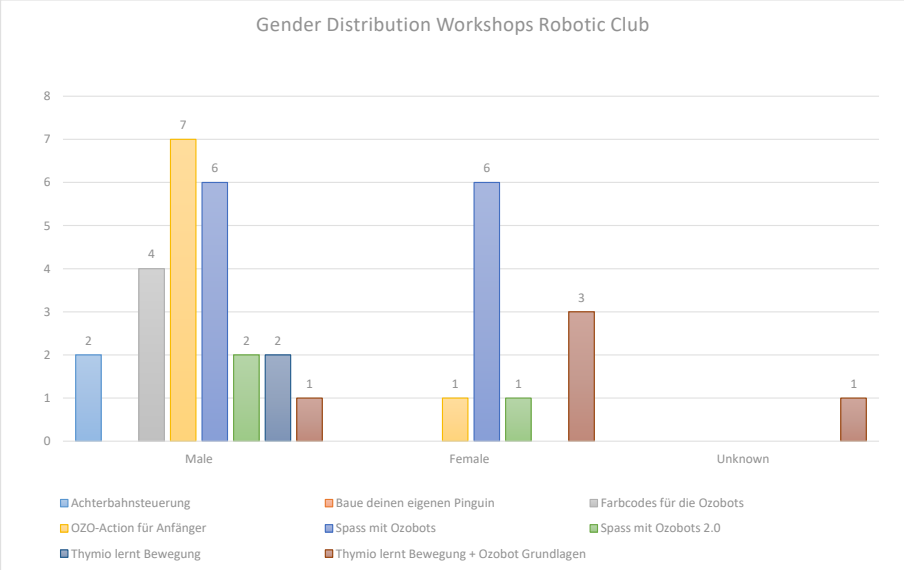

Figure 4.68: Statistical overview about the gender distribution of the individual workshops of the Robotic Club.

Figure 4.68 gives an overview of the gender distribution of the individual workshops. The girls were mostly attracted by the "Spass mit Ozobots" workshop with 6 participants that is equally to the boys, they have also about 6 participants. The males were attracted by all of the workshops from the station, except the Baue deinen eigenen Pinguin workshop.

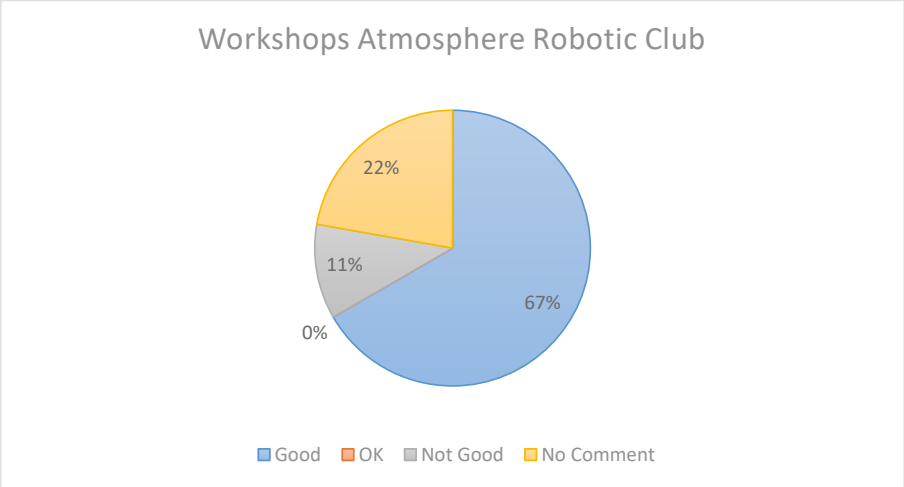

Figure 4.69: Statistical overview about the athmosphere at the individual workshops of the Robotic Club.

About 67% of all workshops at the Robotic Club station had a good atmosphere and about 11% had no good atmosphere. For the remaining share we had no data available.

Movement Profile

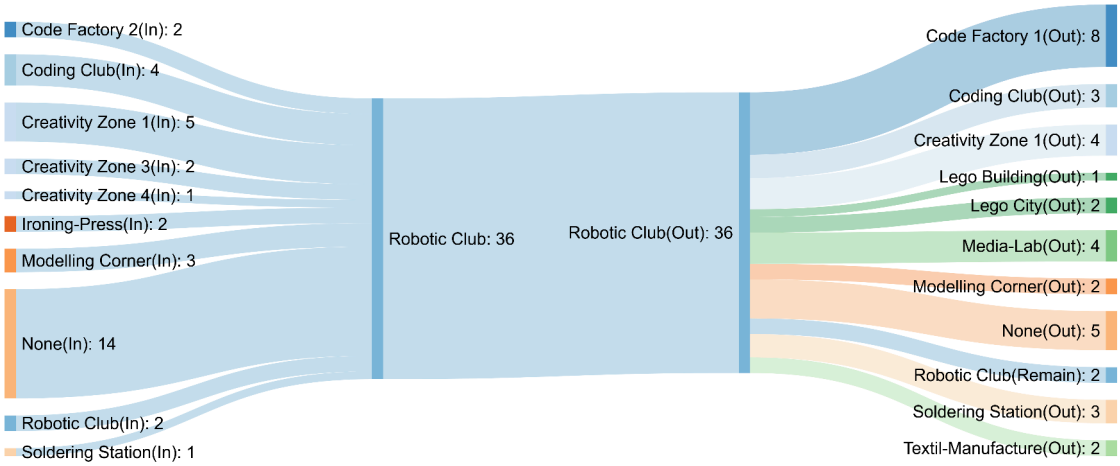

Figure 4.70: Overview of the input and output movement profile of the Robotic Clubstation.

In Figure 4.70 on page 80 the input and output can be seen. Most of the participants have consciously chosen this station, as seen in Figure 4.71 on page 80. The output movement, as seen in Figure 4.72 on page 81, clearly shows that most of the participants joined neighbouring stations.

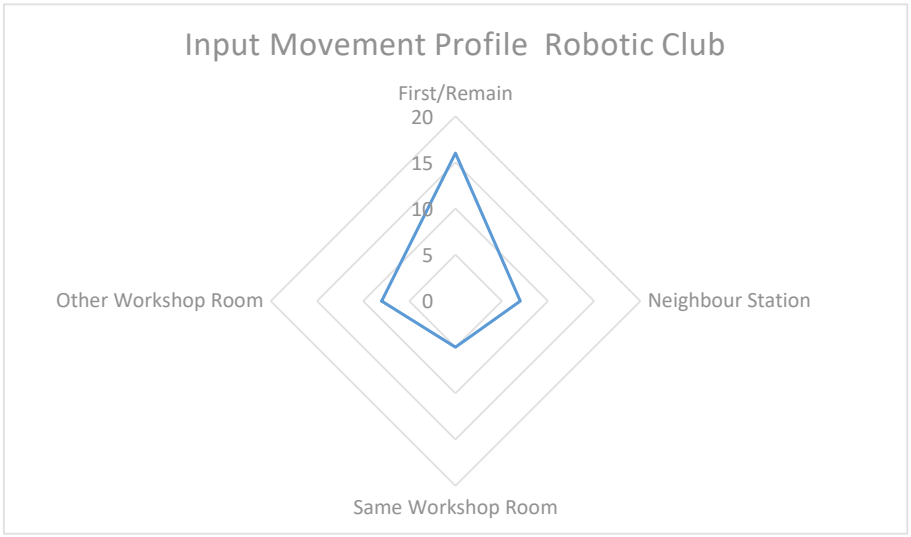

Figure 4.71: Overview of the input movement profile of the Robotic Clubstation.

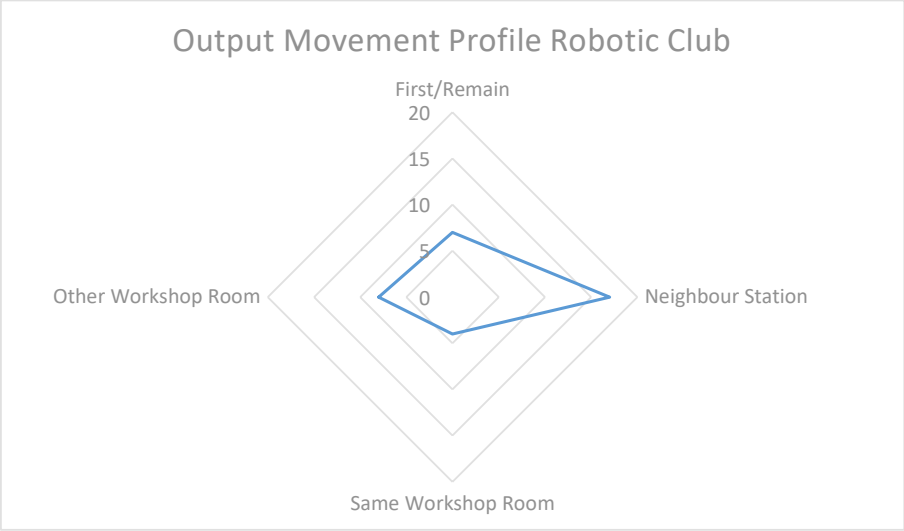

Figure 4.72: Overview of the output movement profile of the Robotic Clubstation.

4.4.3 Soldering Station

Participants

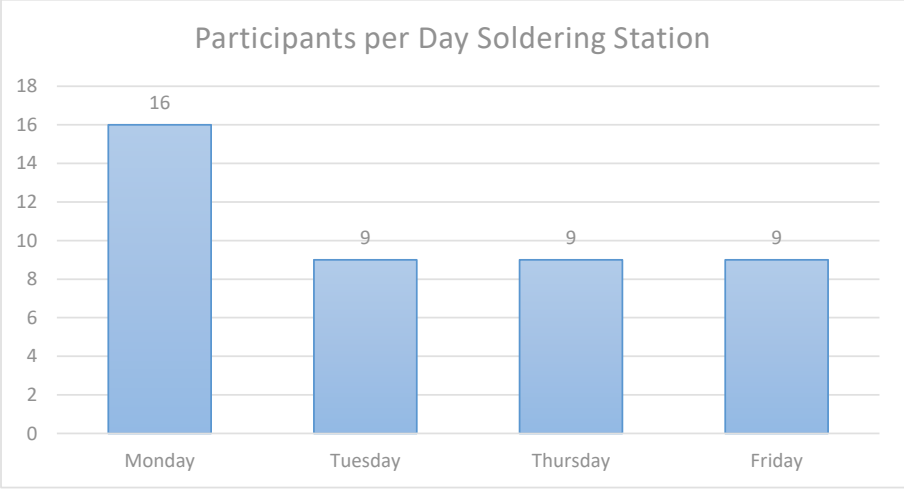

Figure 4.73: Statistical overview about the participants per day of the Soldering Station.

The most attractive day for the Soldering Station was Monday with 16 participants, as seen in Figure 4.73 on page 81. The other days had a steady number of 9 participants.

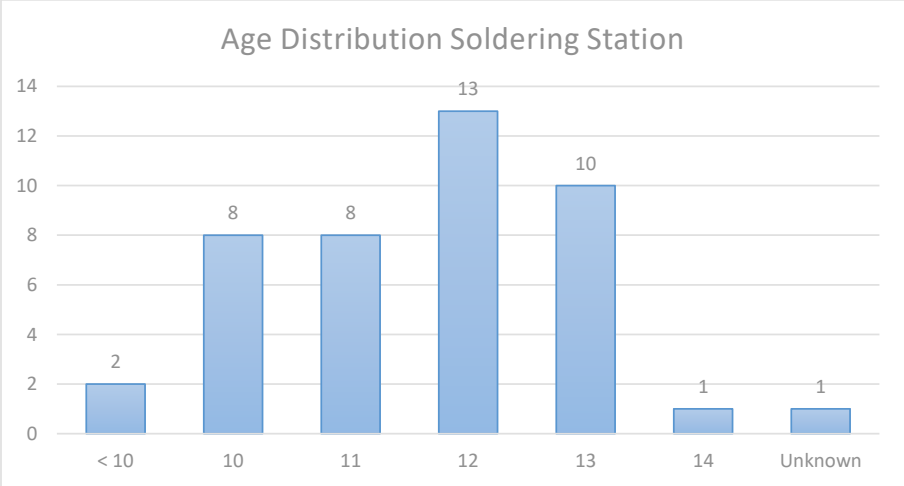

Figure 4.74: Statistical overview about the age distribution of the Soldering Station.

Figure 4.74 shows that the station was the most attractive to the age between 12 and 13 but also before we can depict that there is an interest in soldering electronic components.

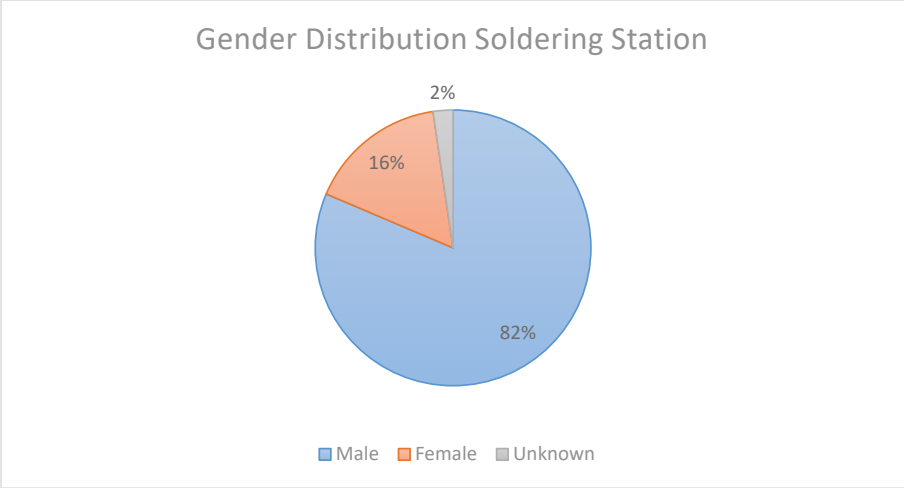

Figure 4.75: Statistical overview about the gender distribution of the Soldering Station.

Most of the attendees were boys with a share of 82% but there were also girls that participated at this station, as seen in Figure 4.75 on page 82. For future events, the low share of girls should be considered. One of the possibilities to increase this amount could be to combine the electrical engineering with handcrafting or textile projects.

Workshops

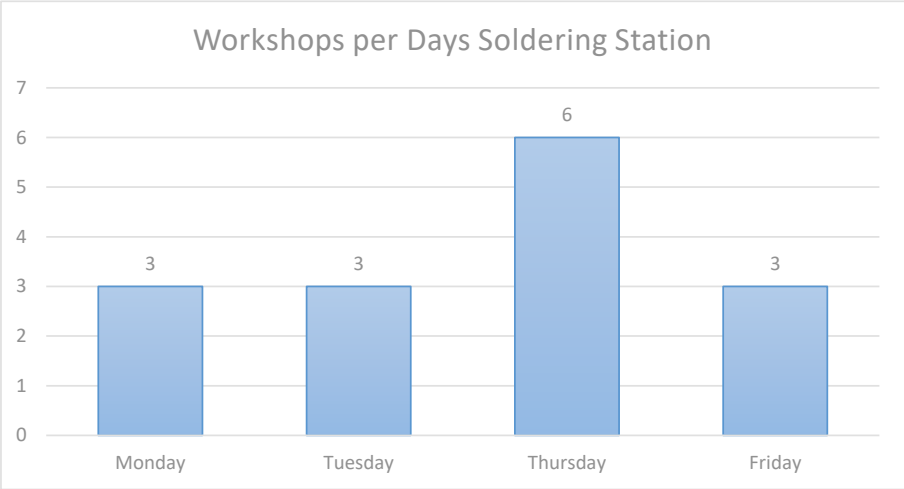

Figure 4.76: Statistical overview about the workshops per day of the Soldering Station.

The most workshops have been offered on Thursday, as seen in Figure 4.76 on page 83. The reason for this increase was the focus of basic workshops on the first days and introducing more advanced workshops on the last days.

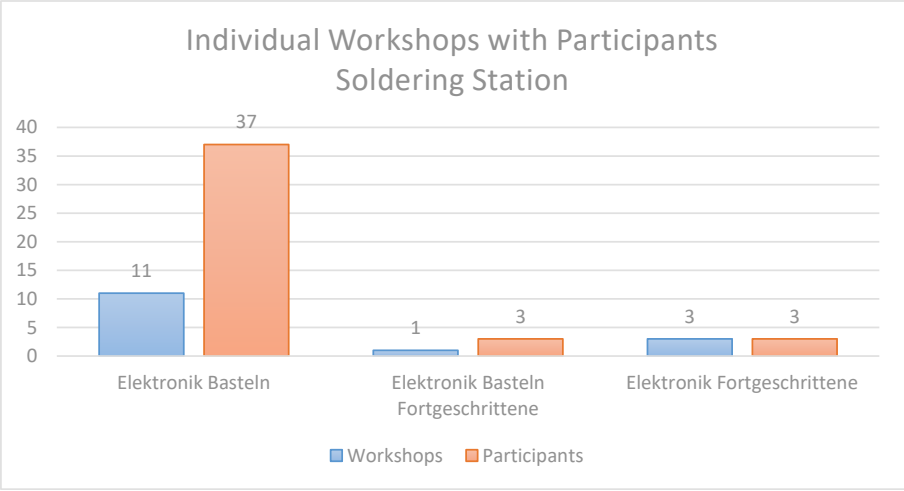

Figure 4.77: Statistical overview about the individual workshops with participants of the Soldering Station.

Figure 4.77 gives an overview about the participants of the individual workshops. The most attractive workshop was the ”Elektronik Basteln“ where they were able

to build a Vibrobot toy. The more advanced workshops had low participation. One of the reasons could be that the advanced workshops were too difficult for most of the participants.

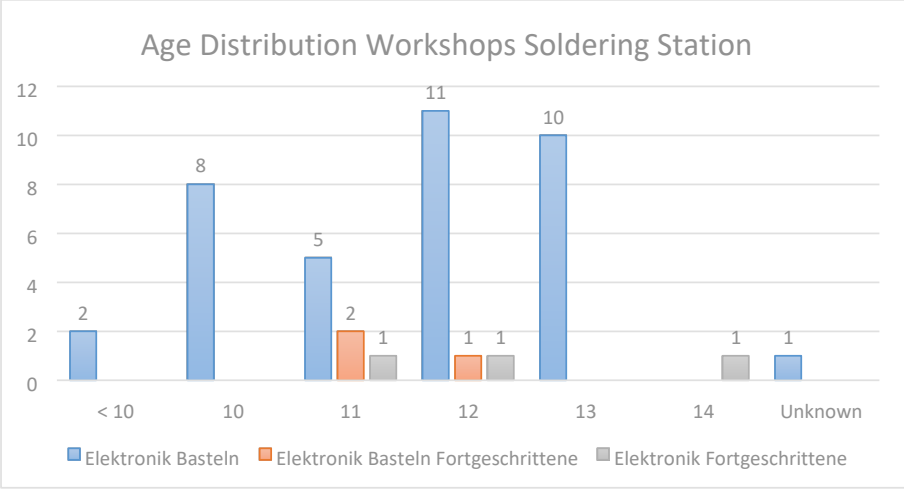

Figure 4.78: Statistical overview about the age distribution of the individual workshops of the Soldering Station.

Figure 4.78 shows that the ”Elektronik Basteln“ workshop reached the whole age region. The more advanced workshops instead, were participated by 11 and 12 years old children.

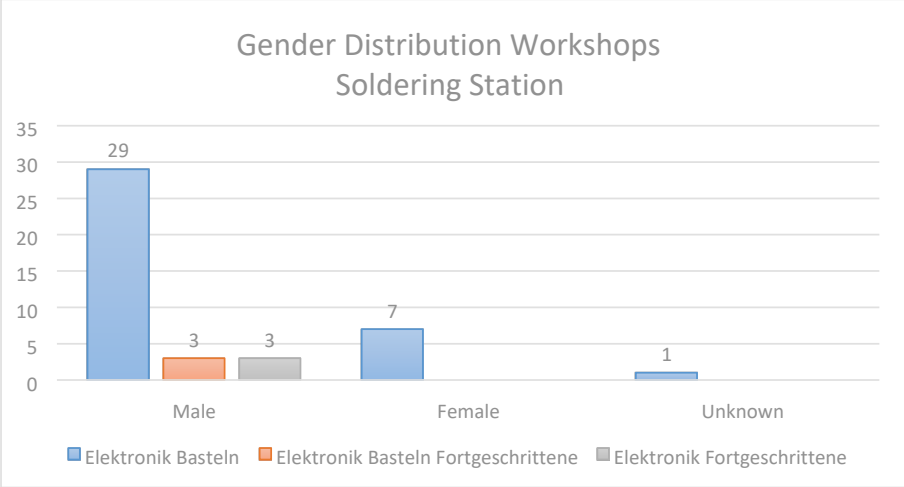

Figure 4.79: Statistical overview about the gender distribution of the individual workshops of the Soldering Station.

In Figure 4.79 on page 84 the gender distribution of the individual workshops can

be seen. It clearly shows that girls did not get attracted by the advanced electronic workshops. For future events, advanced workshops should be more aligned to the interests of girls to attract them more for this field.

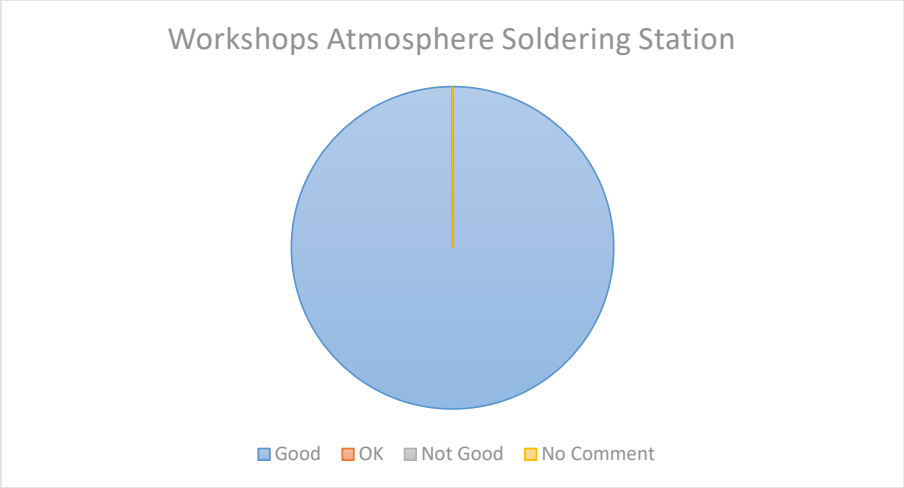

Figure 4.80: Statistical overview about the athmosphere at the individual workshops of the Soldering Station.

Figure 4.80 shows that all the workshops had a good atmosphere without any problems.

Movement Profile

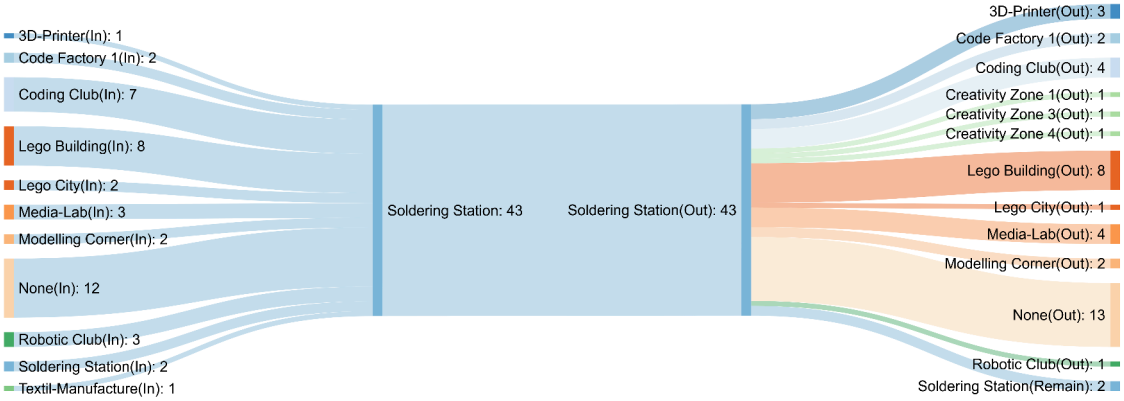

Figure 4.81: Overview of the input and output movement profile of the Soldering Stationstation.

In Figure 4.81 on page 85 the input and output movement profile of the Soldering Station can be seen. Most of the participants consciously chosen this station as

well as joined from the Lego Building station. Most of the participants joined the station from stations at the same workshop room, as seen in Figure 4.82 on page 86. Outgoing participants joined stations in the same as well as in the other workshop room, as seen in Figure 4.83 on page 86.

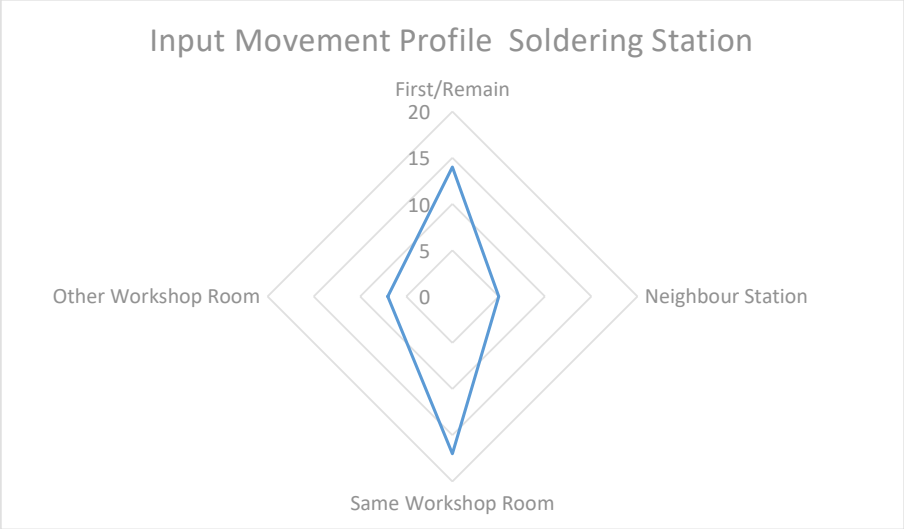

Figure 4.82: Overview of the input movement profile of the Soldering Stationstation.

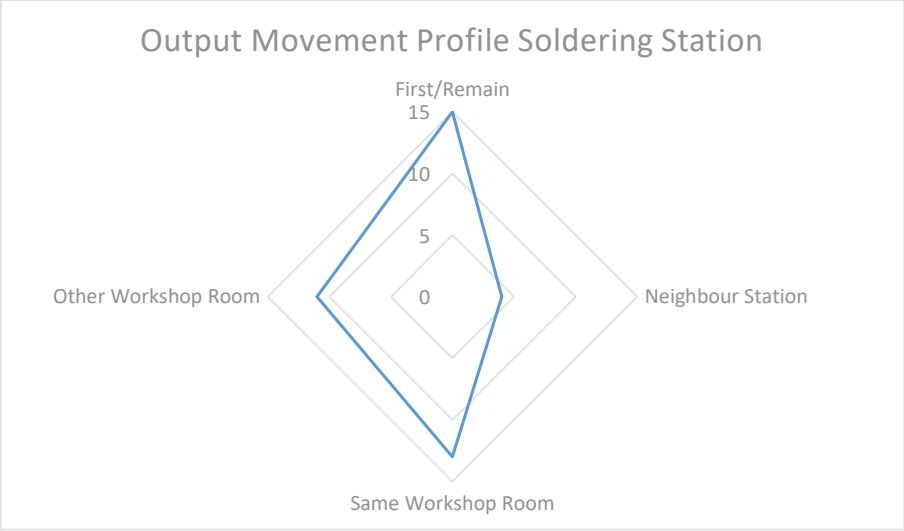

Figure 4.83: Overview of the output movement profile of the Soldering Stationstation.

4.4.4 Lego Building

Participants

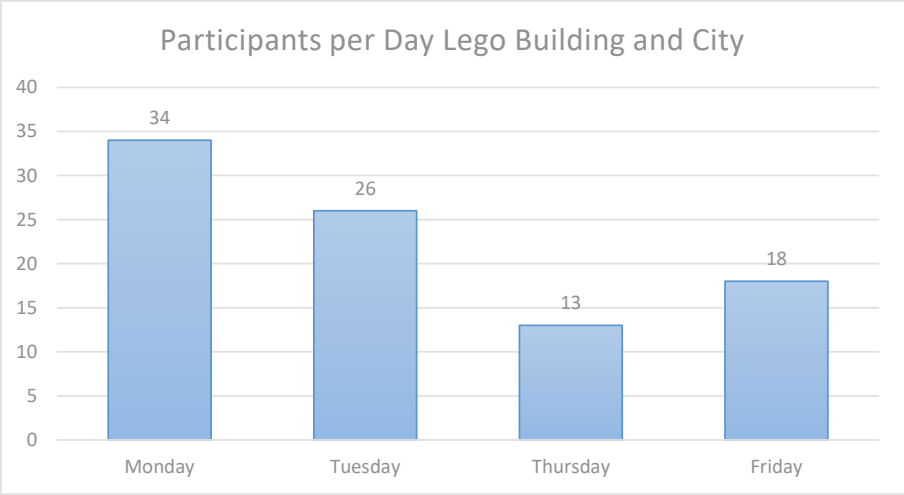

Figure 4.84: Statistical overview about the participants per day of the Lego Building and City.

Figure 4.84 shows the distribution of the participants of the four days. The most participants visited the station on monday and the following days the amount steadily decreased. One of the reasons for this trend could be that the Lego block variation steadily decreased and that the participants could not build with them.

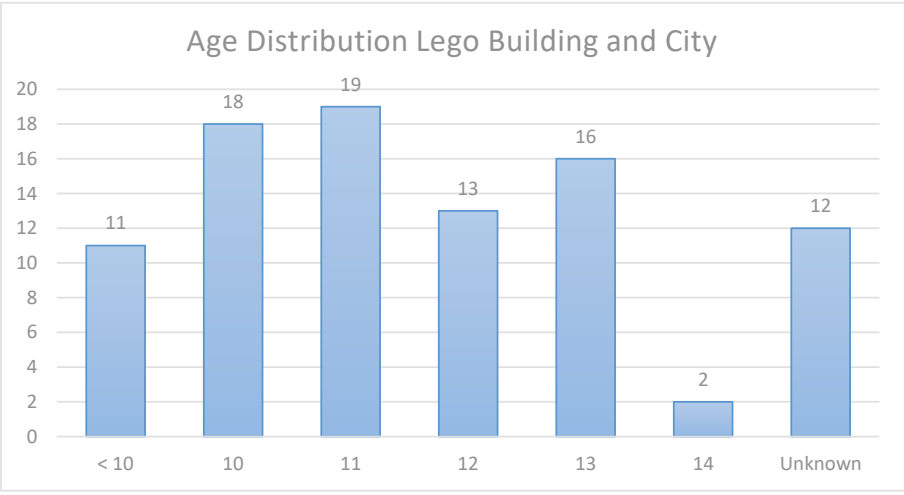

Figure 4.85: Statistical overview about the age distribution of the Lego Building and City.

The age distribution, as seen in Figure 4.85 on page 87 shows that the station attracted all ages without any significances.

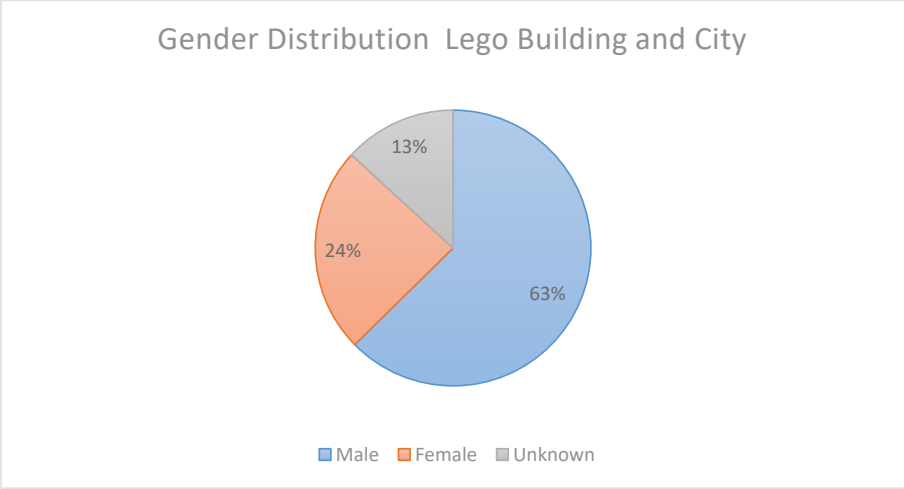

Figure 4.86: Statistical overview about the gender distribution of the Lego Building and City.

Most of attendees were males with a share of 63% and 24% girls, as seen in Figure 4.86 on page 88. Because of the high variation of Lego blocks and the high creativitiy potential it seems that boys are more attracted by Lego.

Workshops

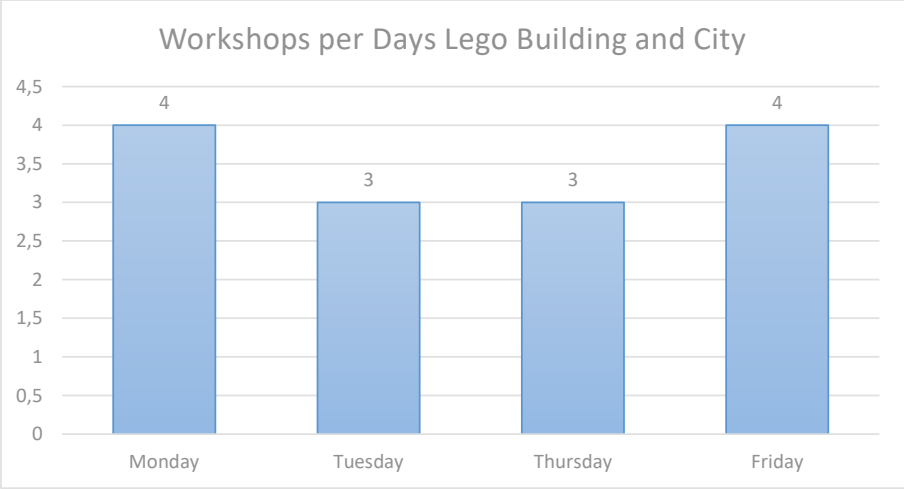

Figure 4.87: Statistical overview about the workshops per day of the Lego Building and City.

Figure 4.87 gives an overview about the workshops per day. The workshops were shared equally to all four days by about 3-4 workshops per day.

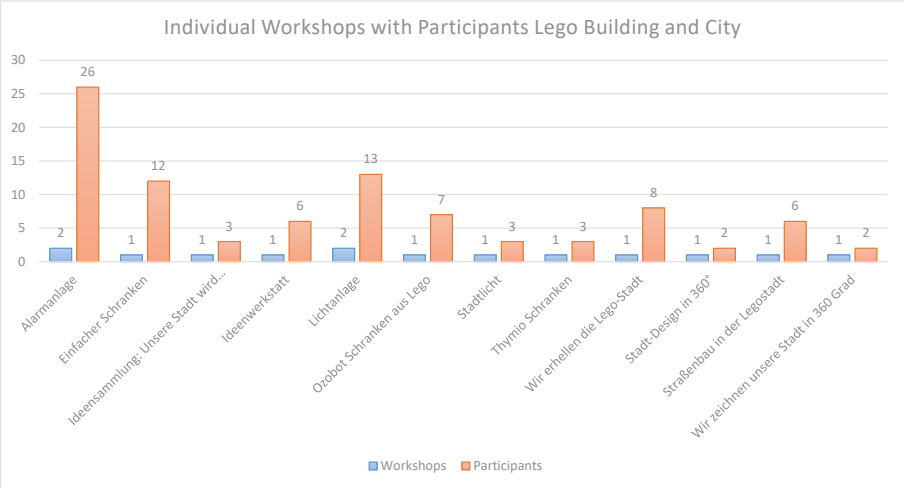

Figure 4.88: Statistical overview about the individual workshops with participants of the Lego Building and City.

The Alarmanlage workshop was the most attractive workshop with overall 26 participants, as seen in Figure 4.88 on page 89, closely followed by ”Einfacher Schranken und Lichtanlage“. The least interests were at finding ideas how the city should evolve at ”Ideensammlung“ as well as ”Stadt-Design“.

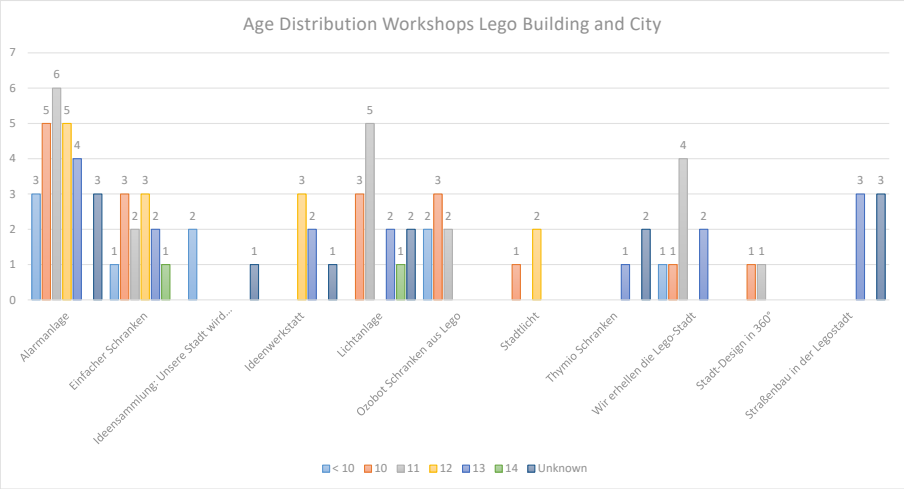

Figure 4.89: Statistical overview about the age distribution of the individual workshops of the Lego Building and City.

In Figure 4.89 on page 89 it can be seen, that the ”Alarmanlage“ and the ”Einfacher

Schranken“ were the only workshop that attracted children of all ages.

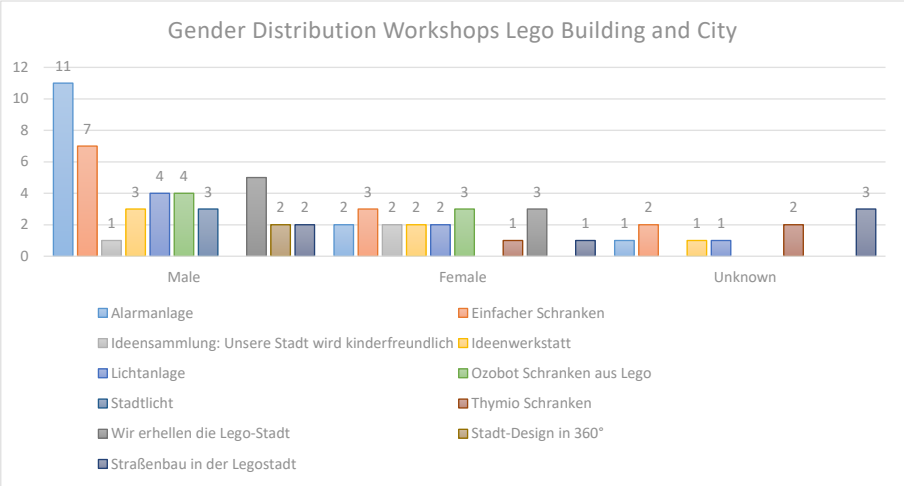

Figure 4.90: Statistical overview about the gender distribution of the individual workshops of the Lego Building and City.

Figure 4.90 shows that girls and boys visited all offered workshops. This indicates that the combination of Lego and programming attracts children and future events should consider this fact.

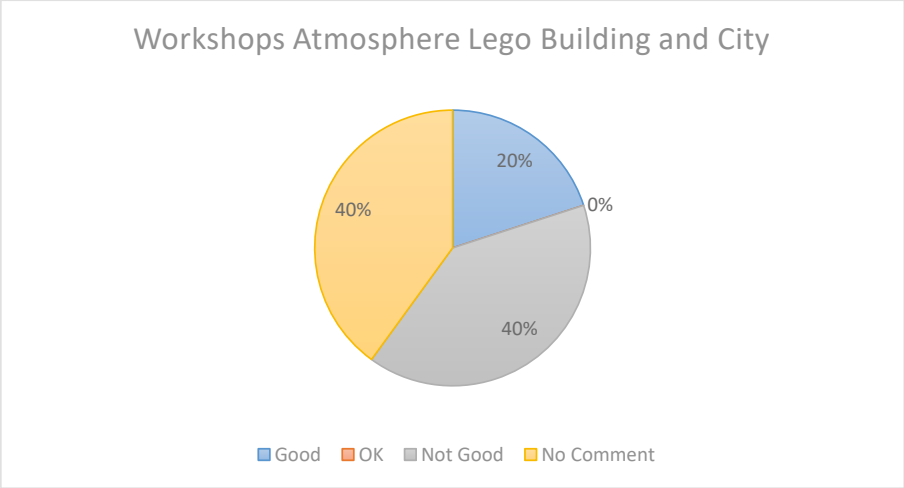

Figure 4.91: Statistical overview about the athmosphere at the individual workshops of the Lego Building and City.

The atmosphere at the station was not allways that good. About 40% of all workshops were Not Good and future events should improve this by adding more professionals or by introducing rules.

Movement Profile

Lego Building

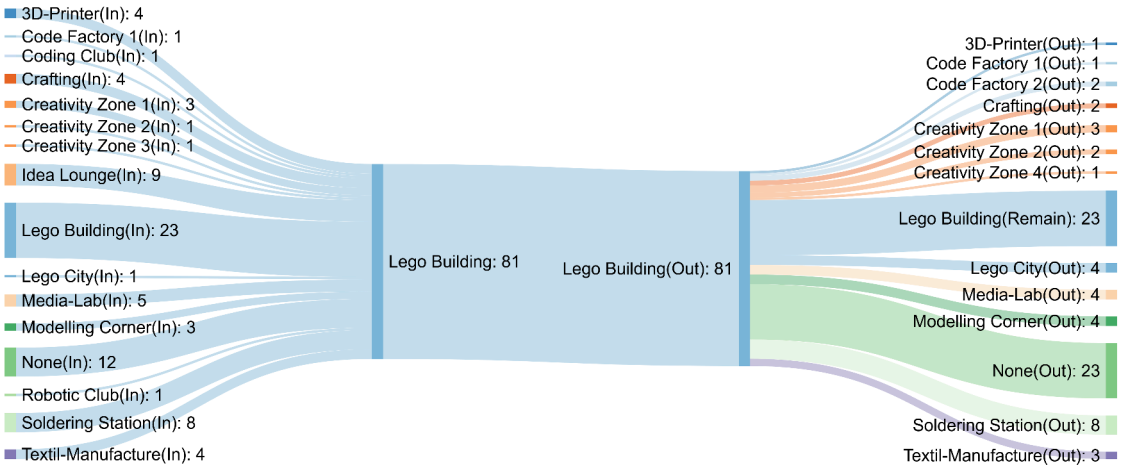

Figure 4.92: Overview of the input and output movement profile of the Lego Buildingstation.

In Figure 4.92 on page 91 it can be seen, that the Lego Building station has attracted participants from different stations at the whole Maker Days for Kids event. Furthermore, 23 participants remained at this station, as seen in Figure 4.94 on page 92. Most of the participants joined this station from the same as well as from the other workshop room, as seen in Figure 4.93 on page 91.

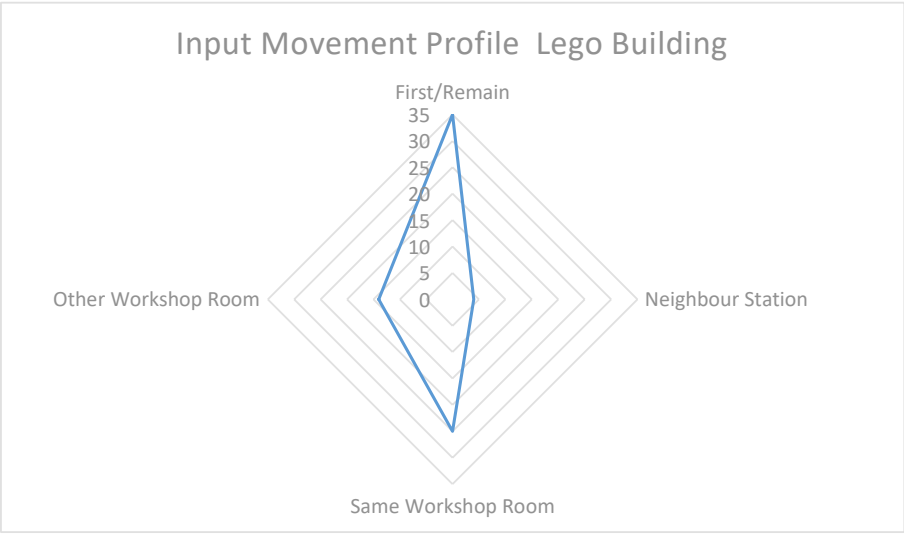

Figure 4.93: Overview of the input movement profile of the Lego Buildingstation.

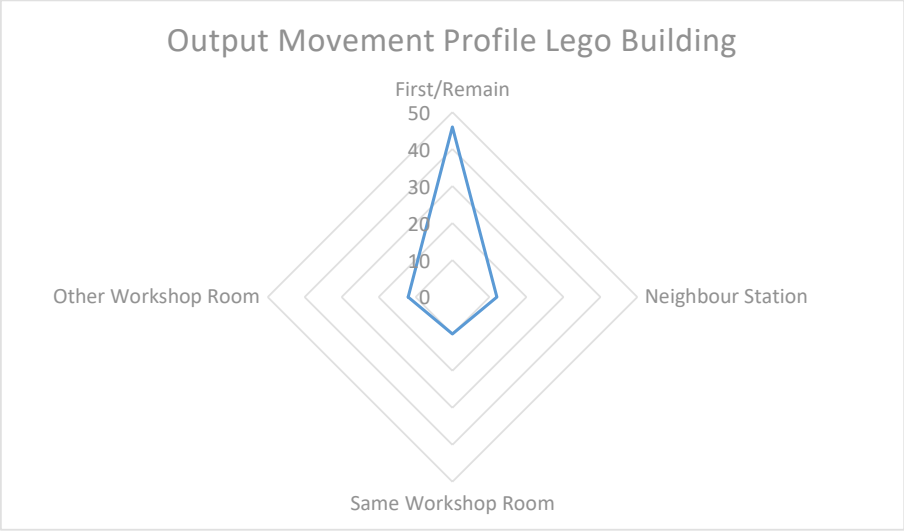

Figure 4.94: Overview of the output movement profile of the Lego Buildingstation.

4.4.5 Media-Lab

Participants

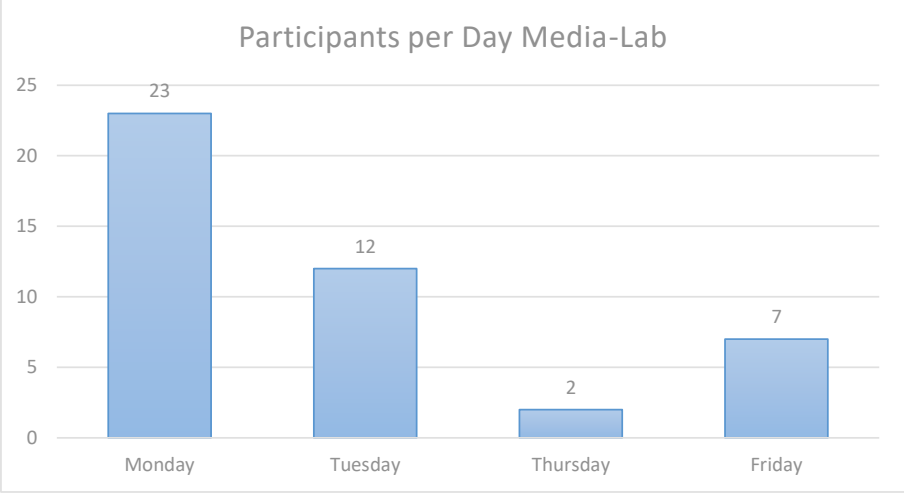

Figure 4.95: Statistical overview about the participants per day of the Media-Lab.

23 participants visited the station on Monday and this is also the biggest amount of the whole week, as seen in Figure 4.95 on page 92. The weakest day was Thursday with 2 participants.

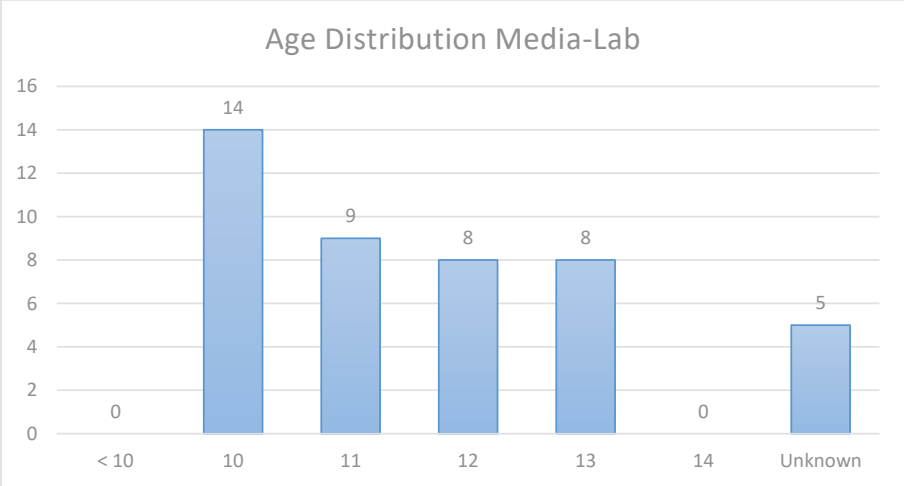

Figure 4.96: Statistical overview about the age distribution of the Media-Lab.

Figure 4.96 shows that the station attracted the most children at the age of 10 years and steadily decreased with elder ages.

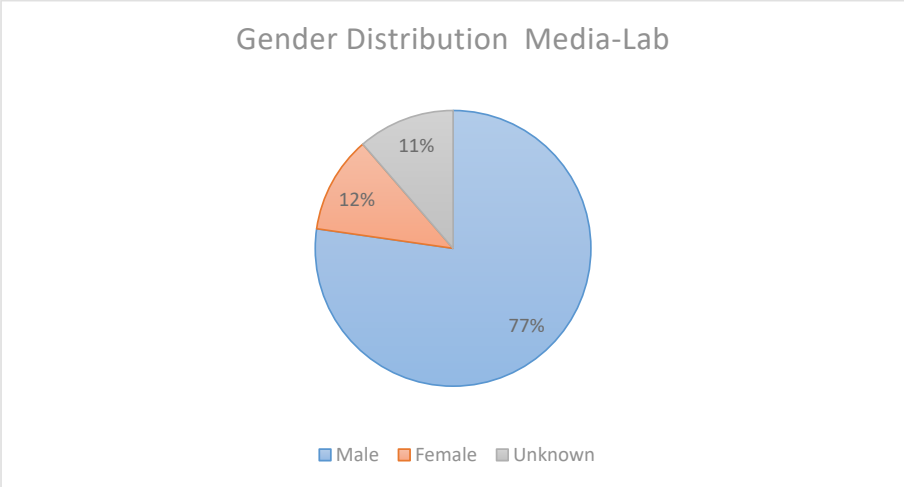

Figure 4.97: Statistical overview about the gender distribution of the Media-Lab.

About 77% of all participants were boys and girls had a share of 12% and were obviously underpresent. Future events should try to attract more girls for this station.

Workshops

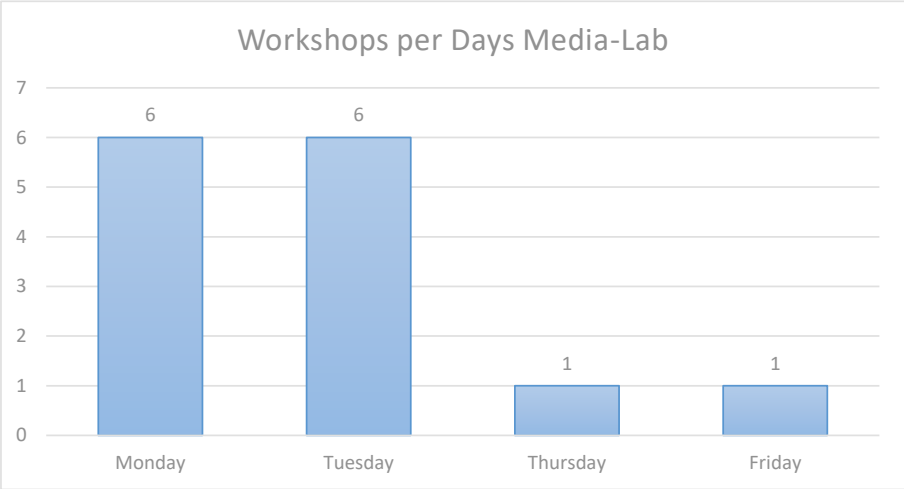

Figure 4.98: Statistical overview about the workshops per day of the Media-Lab.

As depicted in Figure 4.98 on page 94, on Monday and Tuesday about 6 workshops wer offered. In the last two days of the event this number decreased to just a single workshop per day.

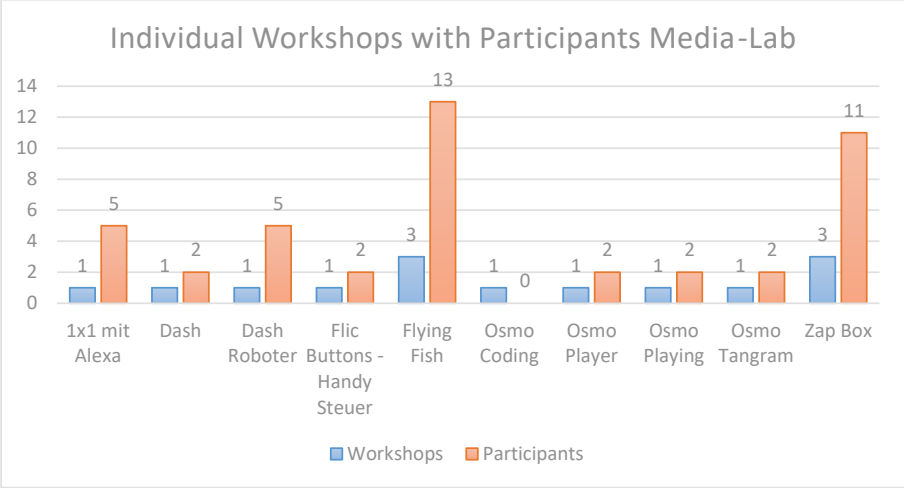

Figure 4.99: Statistical overview about the individual workshops with participants of the Media-Lab.

Figure 4.99 gives an overview about the most attractive individual workshops of this station. The Flying Fish attracted 13 participants, closely followed by the Zap Box. The least attractive workshop was the Flic Buttons.

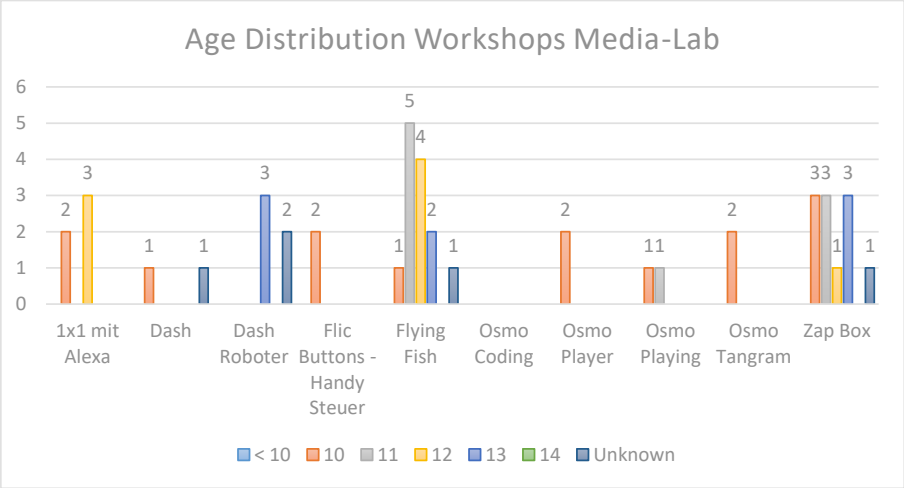

Figure 4.100: Statistical overview about the age distribution of the individual workshops of the Media-Lab.

The Flying Fish workshop attracted participants at the whole age region as well as the Zap Box. The other stations vary in their attractiveness for specific age groups but it clearly shows that this station, with all provided workshops, attracted all ages, as seen in Figure 4.100 on page 95.

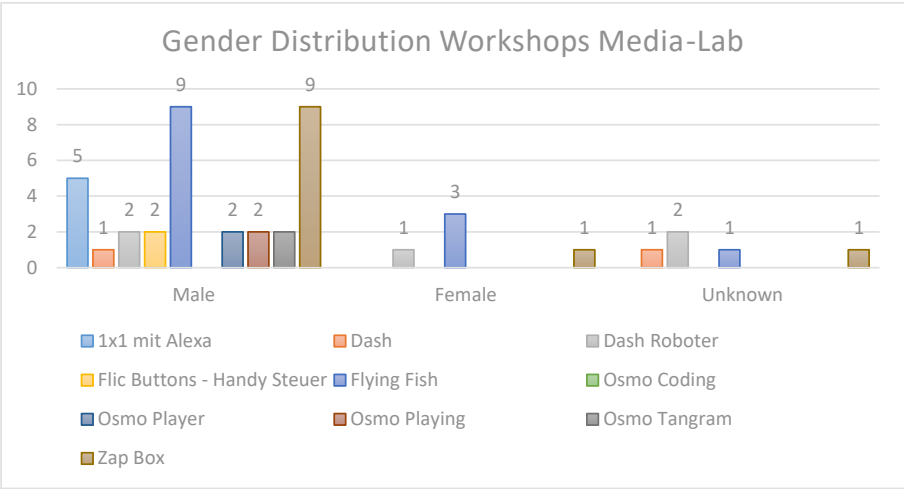

Figure 4.101: Statistical overview about the gender distribution of the individual workshops of the Media-Lab.

Figure 4.101 clearly shows that the station was more attracted to boys and they visited the most the Zap Box and the Flying Fish, but the Flying Fish also attracted girls.

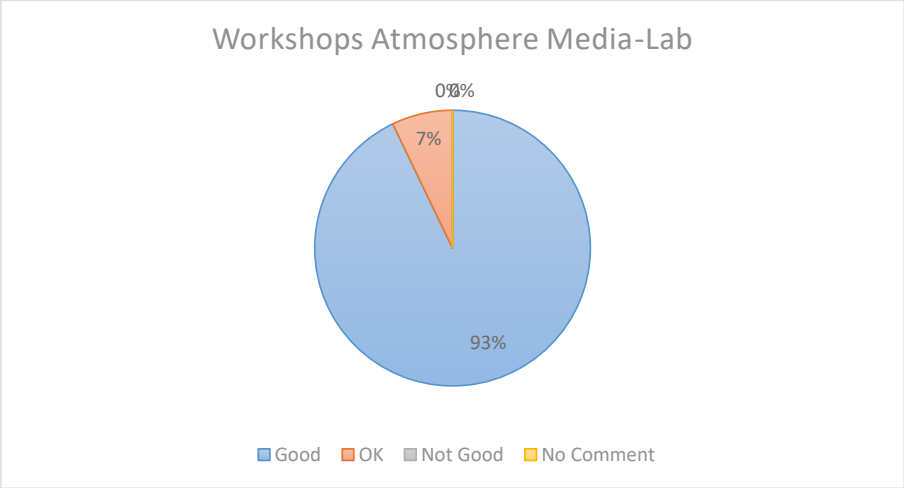

Figure 4.102: Statistical overview about the athmosphere at the individual workshops of the Media-Lab.

As seen in Figure 4.102 on page 96 most of the workshops had a good atmosphere with little exceptions.

Movement Profile

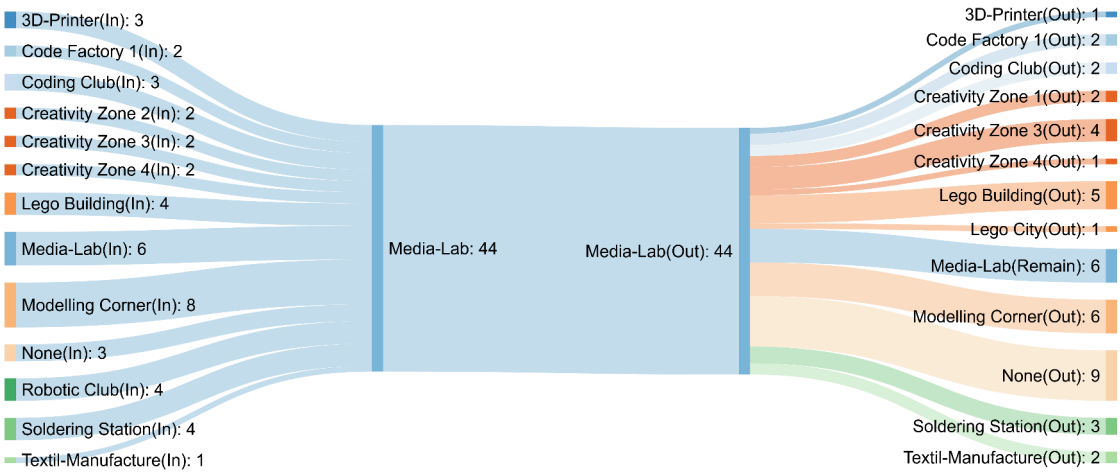

Figure 4.103: Overview of the input and output movement profile of the Media-Labstation.

The Media-Lab station attracted participants from different stations, as seen in Figure 4.103 on page 96, but most of them joined from the Modelling Corner that is in the same workshop room. Figure 4.105 on page 97 clearly depicts that most of

the participants changed to the other workshop room. Moreover, Figure 4.104 on page 97 also shows that participants also joined this station from the other workshop room.

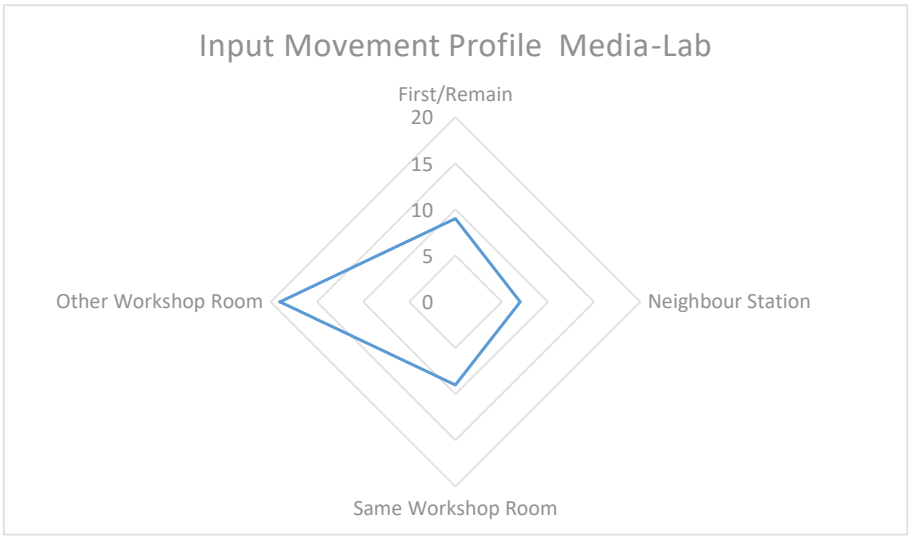

Figure 4.104: Overview of the input movement profile of the Media-Labstation.

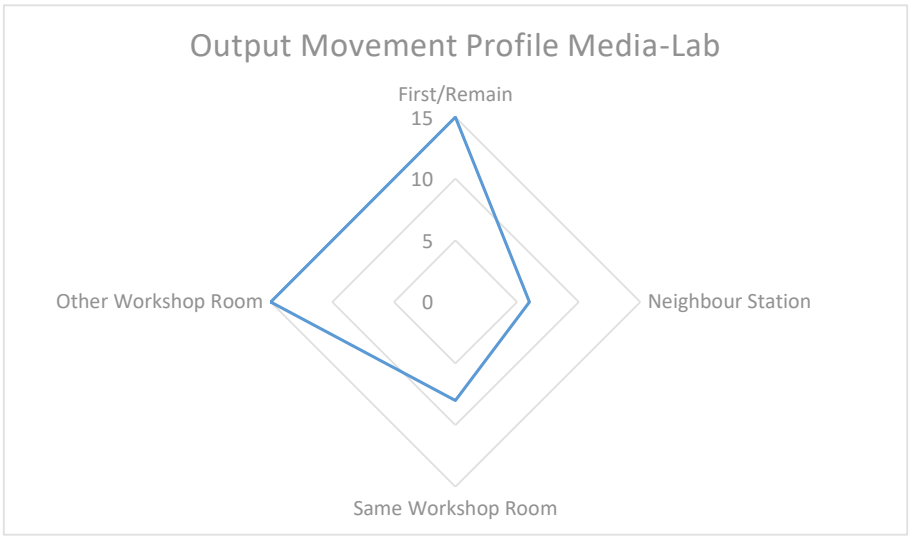

Figure 4.105: Overview of the output movement profile of the Media-Labstation.

4.4.6 Ironing-Press and Cut-Plotter

Participants

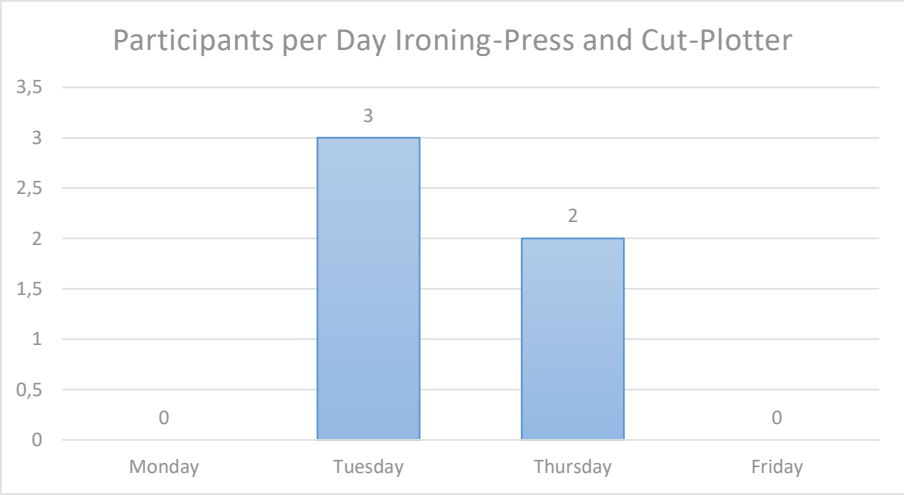

Figure 4.106: Statistical overview about the participants per day of the Iron Press and Cut Plotter.

The Iron Press and Cut Plotteroffered on Tuesday 3 workshops and on Thursday 2 workshops, the other two days there are no recorded data available, as seen in Figure 4.106 on page 98; But we know that there were at least one workshop because of recorded product cards from participants.

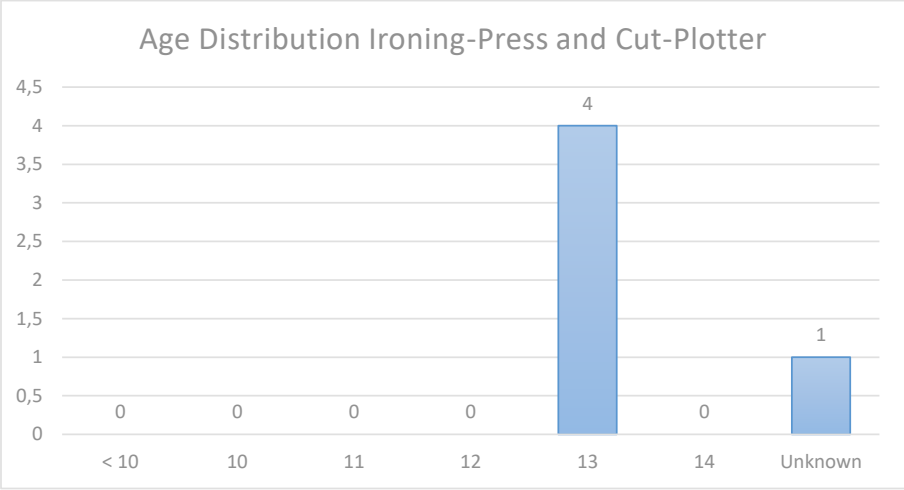

Figure 4.107: Statistical overview about the age distribution of the Iron Press and Cut Plotter.

Figure 4.107 clearly shows that the workshops have attracted children that were 13 years old.

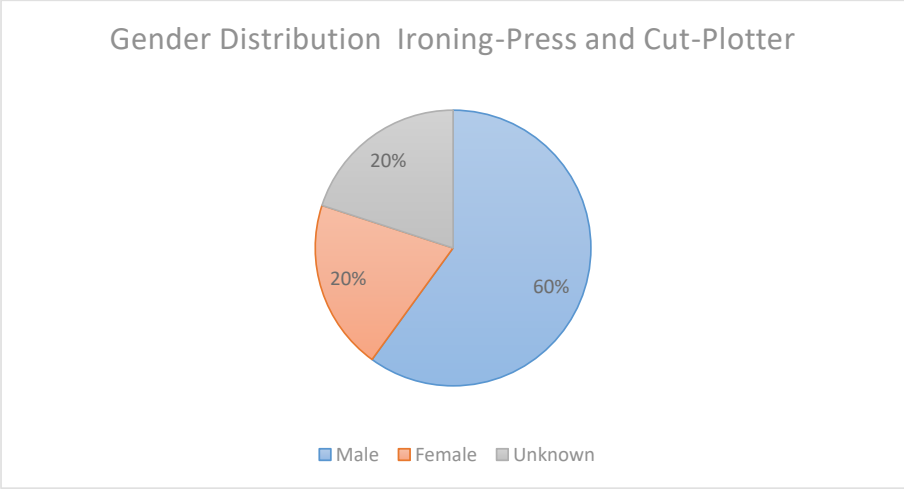

Figure 4.108: Statistical overview about the gender distribution of the Iron Press and Cut Plotter.

The distribution between girls and boys show that about 60% of all attenedees were boys and 20% were girls, as seen in Figure 4.108 on page 99. For the remaining share we have no data available for identifying the gender.

Workshops

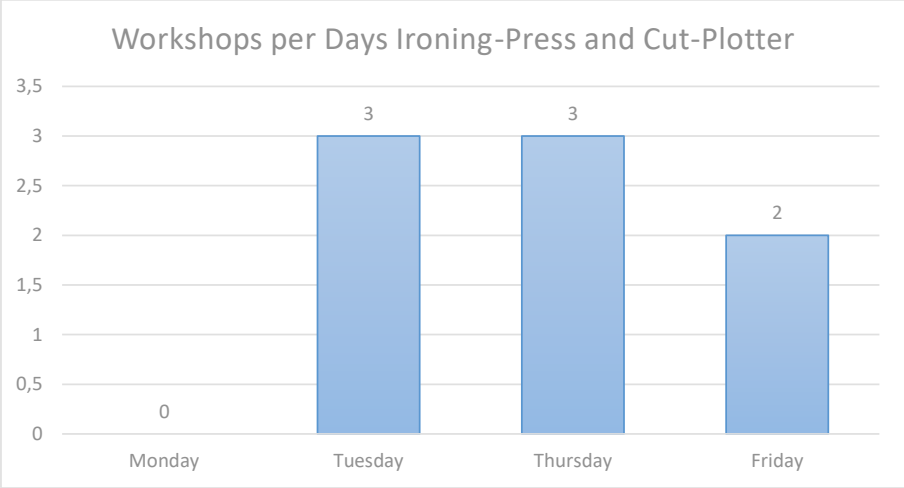

Figure 4.109: Statistical overview about the workshops per day of the Iron Press and Cut Plotter.

Figure 4.109 depicts that between Tuesday and Friday the station offered 8 workshops where 2 were offered on Friday and on the other two days on each day 3 workshops have been performed.

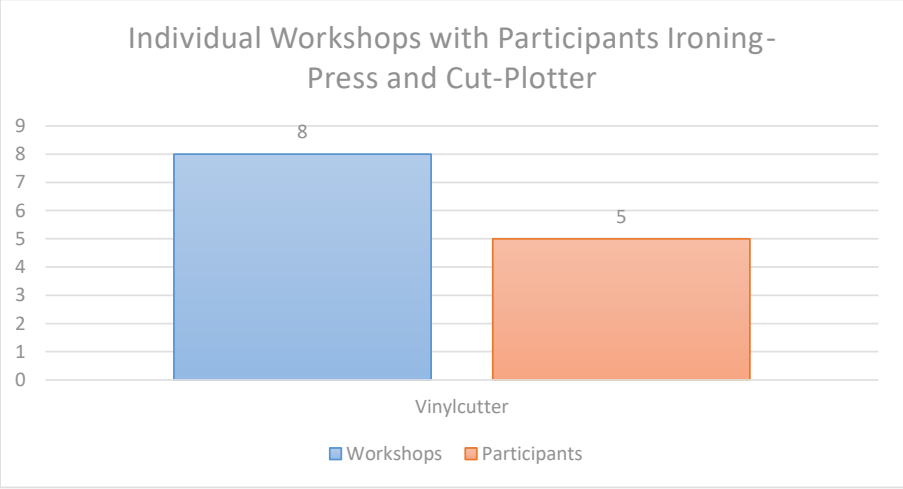

Figure 4.110: Statistical overview about the individual workshops with participants of the Iron Press and Cut Plotter.

The Vinyl-Cutter workshop was the only workshop that were offered in the Iron Press and Cut Plotterstation. Overall, there were 8 workshops offered with 5 participants, as seen in Figure 4.110 on page 100.

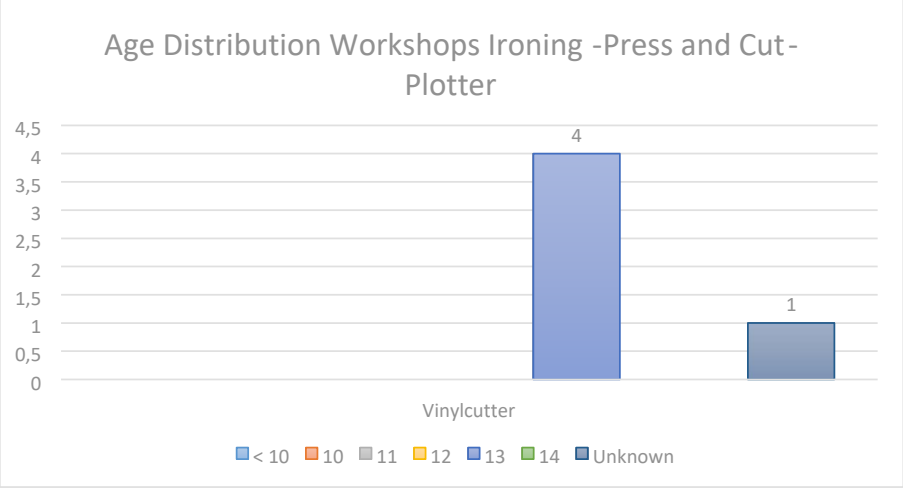

Figure 4.111: Statistical overview about the age distribution of the individual workshops of the Iron Press and Cut Plotter.

Figure 4.111 clearly shows that the Vinyl-Cutter workshops have attracted only

children that are 13 years old.

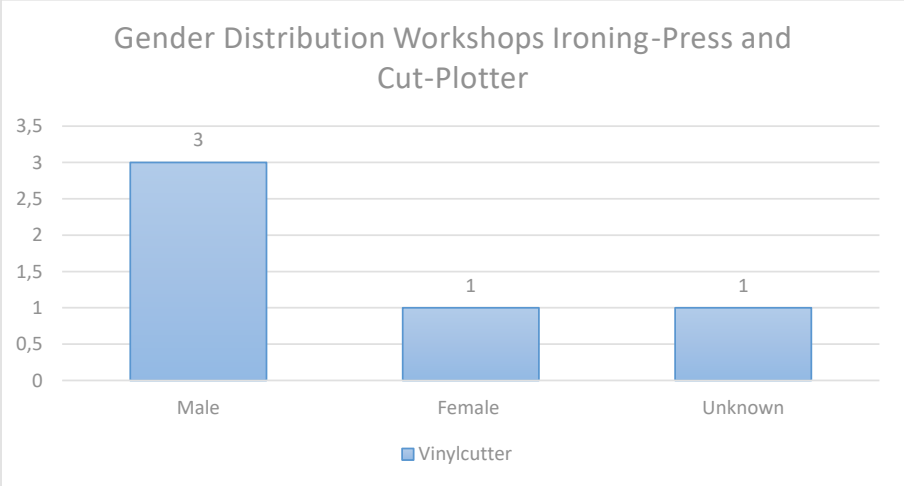

Figure 4.112: Statistical overview about the gender distribution of the individual workshops of the Iron Press and Cut Plotter.

Most of the participants were boys and a single participant were a girl, as seen in Figure 4.112 on page 101.

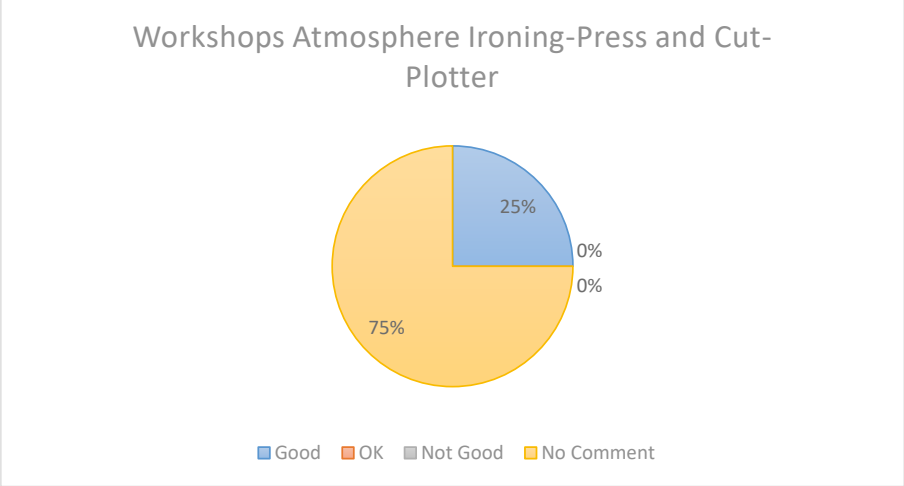

Figure 4.113: Statistical overview about the athmosphere at the individual workshops of the Iron Press and Cut Plotter.

As Figure 4.113 shows, for most of the workshops there are no comments about the atmosphere but 25% of all workshops the atmosphere were good.

Movement Profile

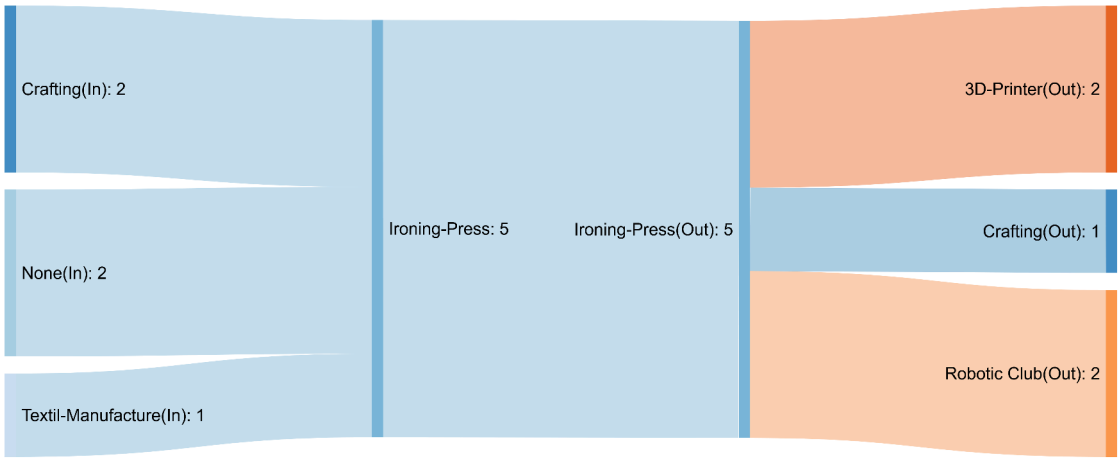

Figure 4.114: Overview of the input and output movement profile of the Iron Press and Cut Plotterstation.

Figure 4.114 on page 102, Figure 4.115 on page 102 and Figure 4.116 on page 103 clearly shows that most of the participants joined this station from the other workshop room and also left the station to the other room.

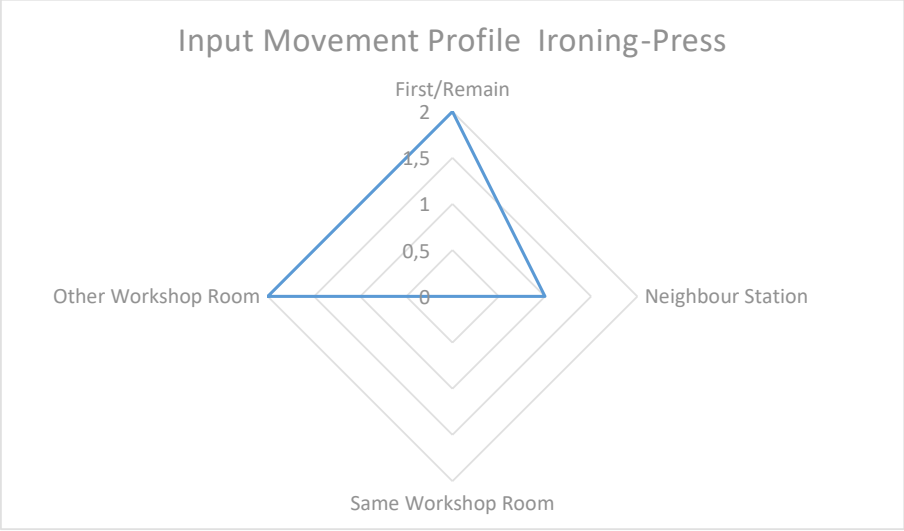

Figure 4.115: Overview of the input movement profile of the Iron Press and Cut Plotterstation.

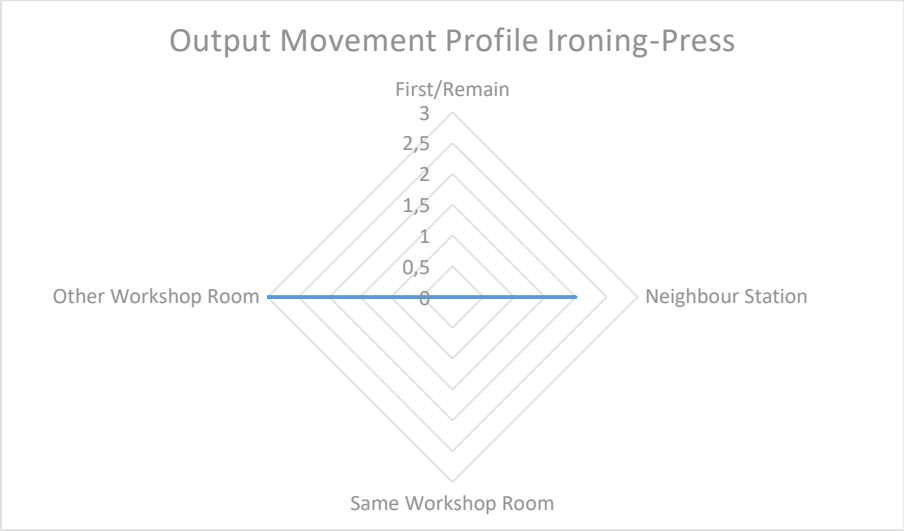

Figure 4.116: Overview of the output movement profile of the Iron Press and Cut Plotterstation.

4.4.7 Textile-Manufacture

Participants

Figure 4.117: Statistical overview about the participants per day of the Textile-Manufacture.

Figure 4.117 gives an overview about the participants per day of the Textile-Manufacture station. This station had all the week participants that are equally shared between Monday and Thursday with 7-8 participants.

Figure 4.118: Statistical overview about the age distribution of the Textile-Manufacture.

The station attracted the most children at the age of 10 years and steadily droppend with increased age such as just 2 participants with an age of 13 years, as seen in Figure 4.118 on page 104.

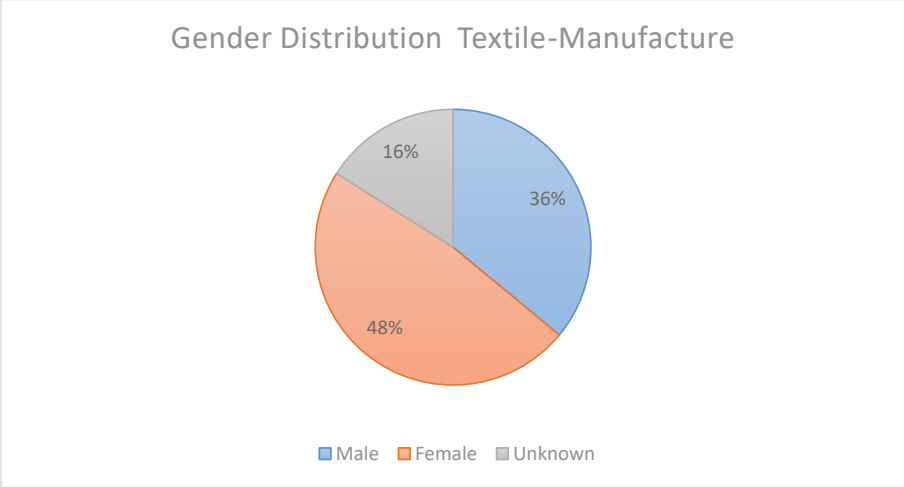

Figure 4.119: Statistical overview about the gender distribution of the Textile-Manufacture.

This station is the only station that attracted more girls than boys, as seen in Figure 4.119 on page 104. Girls had an overall share of 48% and boys are underpresent with 36%.

Workshops

Figure 4.120: Statistical overview about the workshops per day of the Textile-Manufacture.

Figure 4.120 clearly shows that there have been workshops on all four days of the event. Monday had about 3 workshops and on Tuesday and Thursday the amount were increased to 4 workshops and dropped down to 2 on the last day.

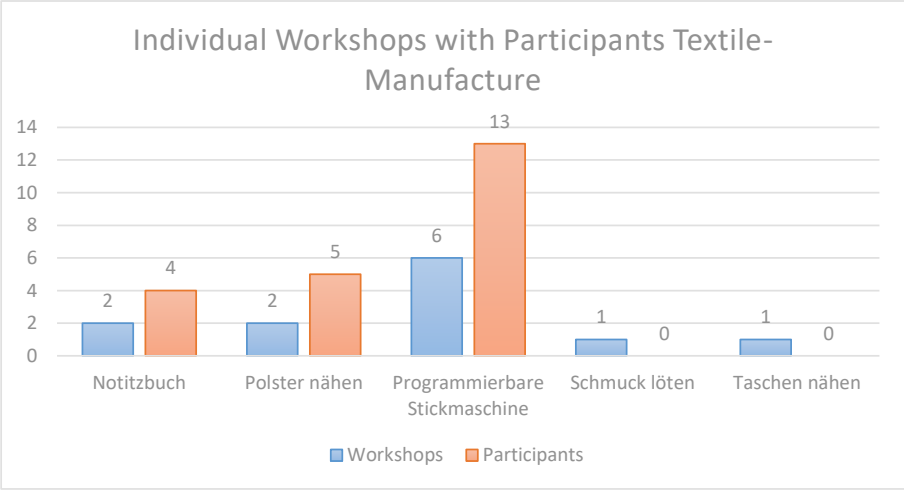

Figure 4.121: Statistical overview about the individual workshops with participants of the Textile-Manufacture.

The most attractive individual workshop at the Textile-Manufacturestation was the programmable stitch machine. This workshop had about 13 participants and was

offered 6 times, as seen in Figure 4.121 on page 105. For the workshops ”Schmuck löten“ and ”Taschen nähen“ are no data available.

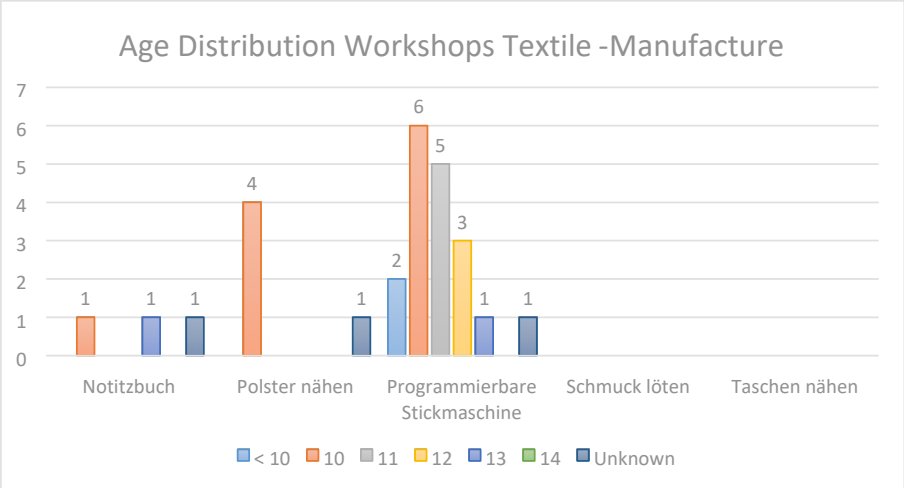

Figure 4.122: Statistical overview about the age distribution of the individual workshops of the Textile-Manufacture.

The programming stitch machine attracted participants at all ages, the other workshops attracted more younger children at the age of 10 years, as seen in Figure 4.122 on page 106.

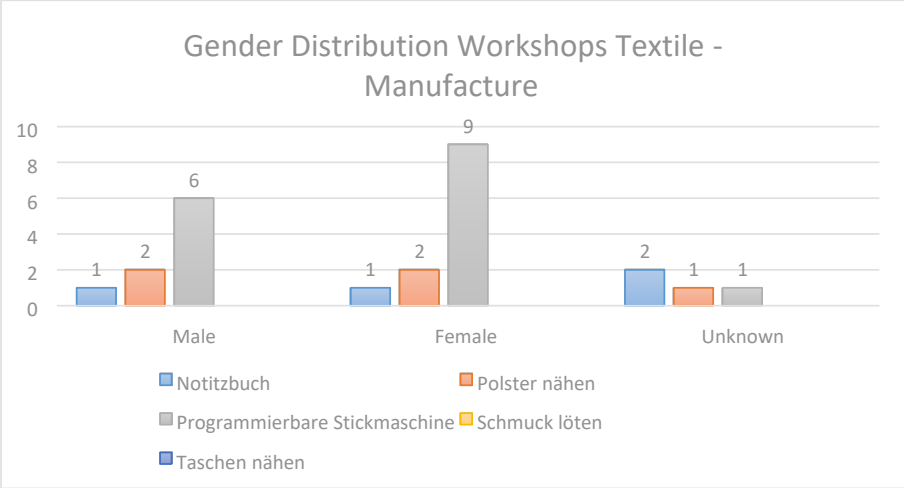

Figure 4.123: Statistical overview about the gender distribution of the individual workshops of the Textile-Manufacture.

The gender distribution in Figure 4.123 on page 106 shows that the programming stitch machine were able to attract girls and boys. There were also two boys that

visited the ”Polster nähen“ workshop. For future events, the amount of boys at this station should be increased.

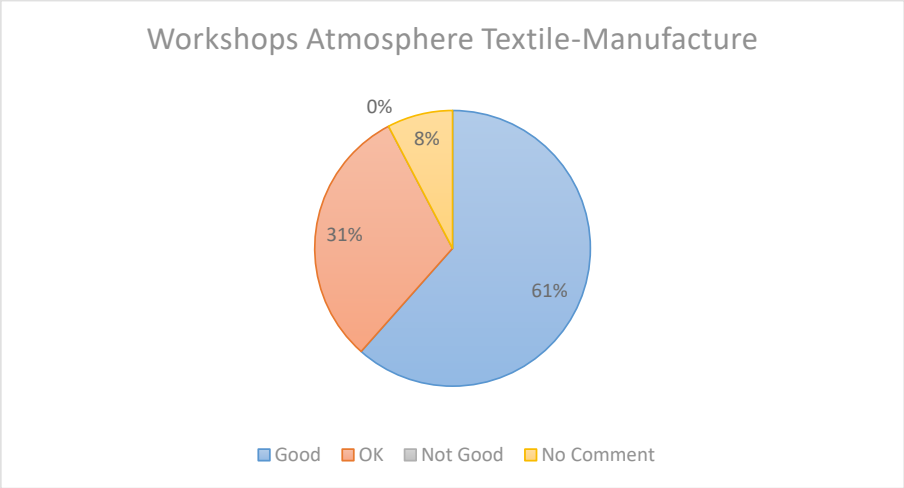

Figure 4.124: Statistical overview about the athmosphere at the individual workshops of the Textile-Manufacture.

Figure 4.124 depicts that most of the workshops were good or ok. There have been no workshops that were not good.

Movement Profile

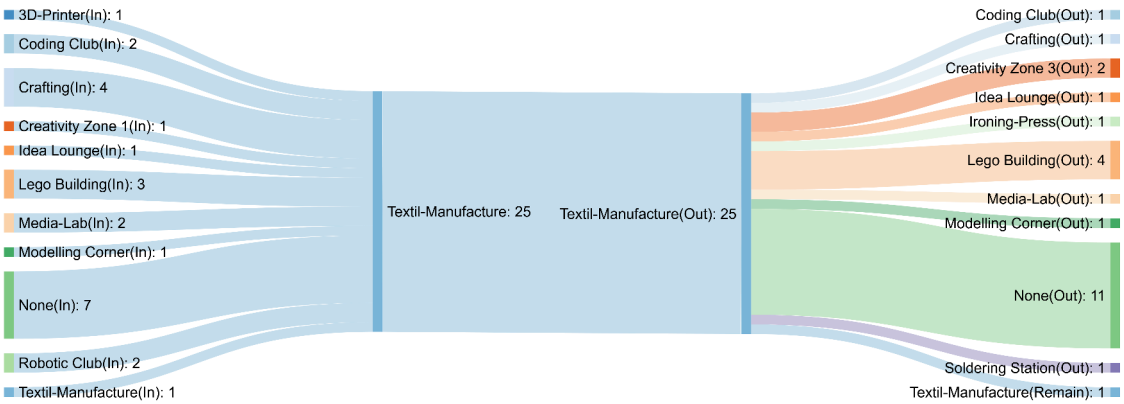

Figure 4.125: Overview of the input and output movement profile of the Textile-Manufacturestation.

In Figure 4.125 on page 107 input and output movement profile of the Textile-Manufacture station can be seen. Most of the participants joined this station from

the other workshop room as seen in Figure 4.126 on page 108. The station attracted the workshop participants that much that most of them stayed at this station, as seen in Figure 4.127 on page 108.

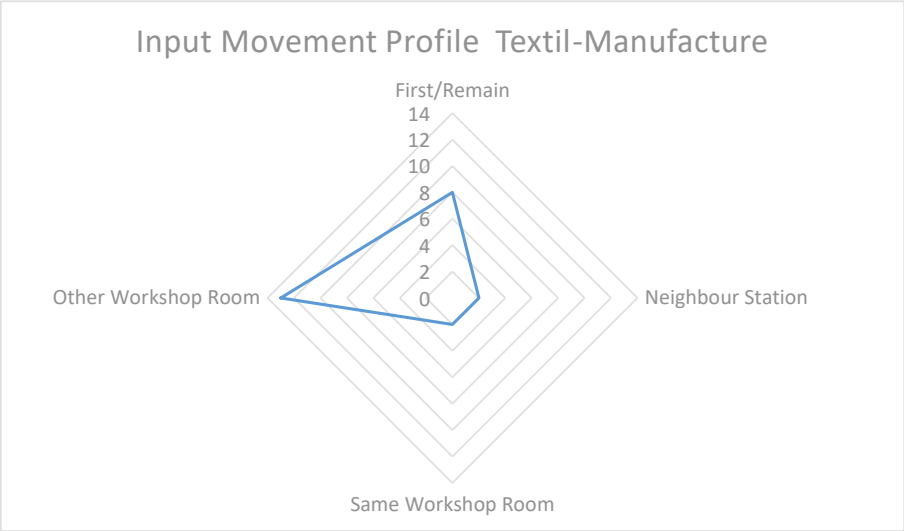

Figure 4.126: Overview of the input movement profile of the Textile-Manufacturestation.

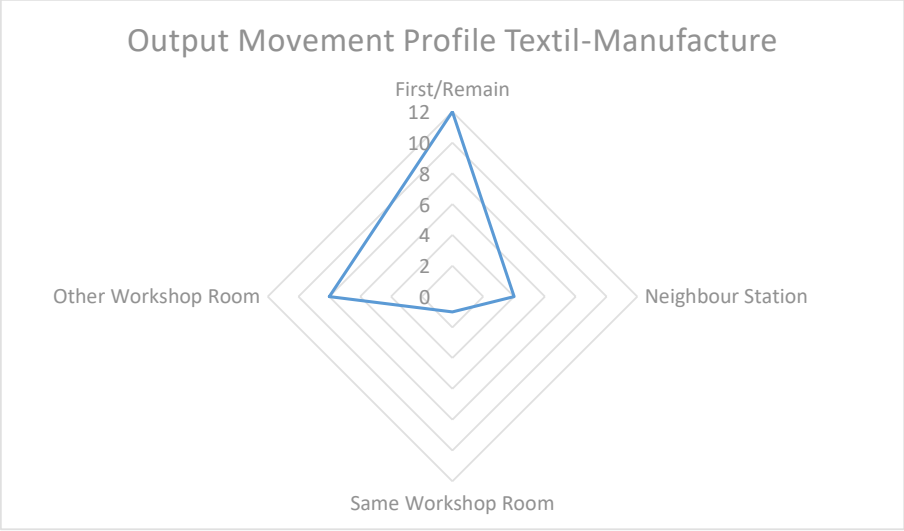

Figure 4.127: Overview of the output movement profile of the Textile-Manufacturestation.

4.4.8 3D-Printing

Participants

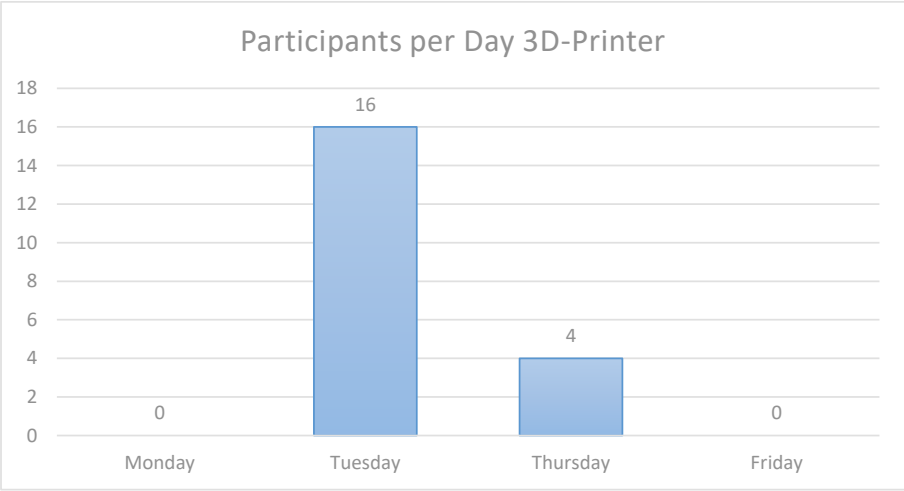

Figure 4.128: Statistical overview about the participants per day of the 3D-Printer.

Figure 4.128 shows that on Tuesday the station had about 16 participants and on Thursday 4. On Monday and Friday there is no recorded data of workshop cards available, but there was at least a single workshop on Monday and Friday because of filled product cards from participants.

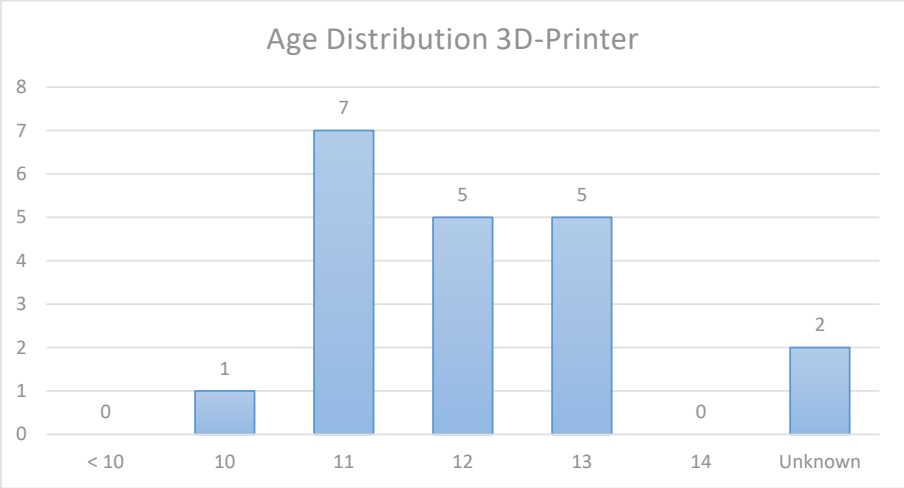

Figure 4.129: Statistical overview about the age distribution of the 3D-Printer.

In Figure 4.129 on page 109 the age distribution of the 3D-Printerstation can be

depicted. It clearly shows that the workshops attracted children that are between 10 and 13 years old.

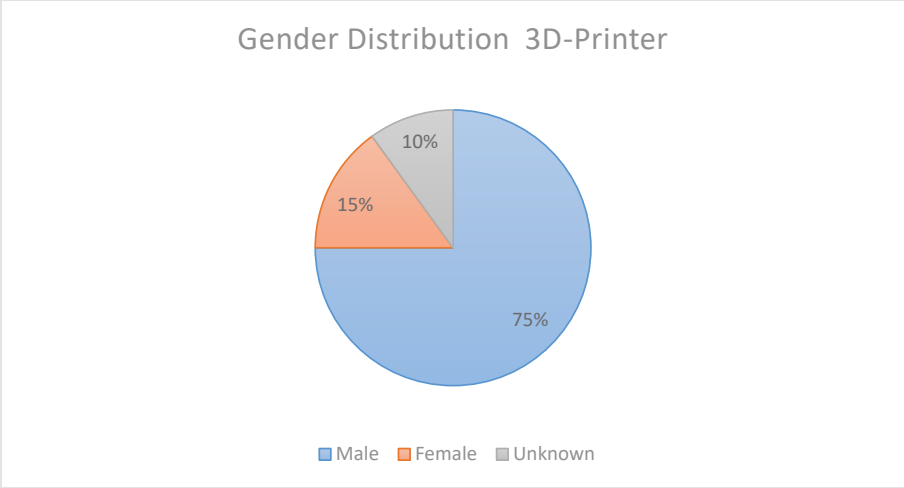

Figure 4.130: Statistical overview about the gender distribution of the 3D-Printer.

Most of the attendees were males with an overall share of 75%. Girls were underpresent with a share of 15%, as seen in Figure 4.130 on page 110.

Workshops

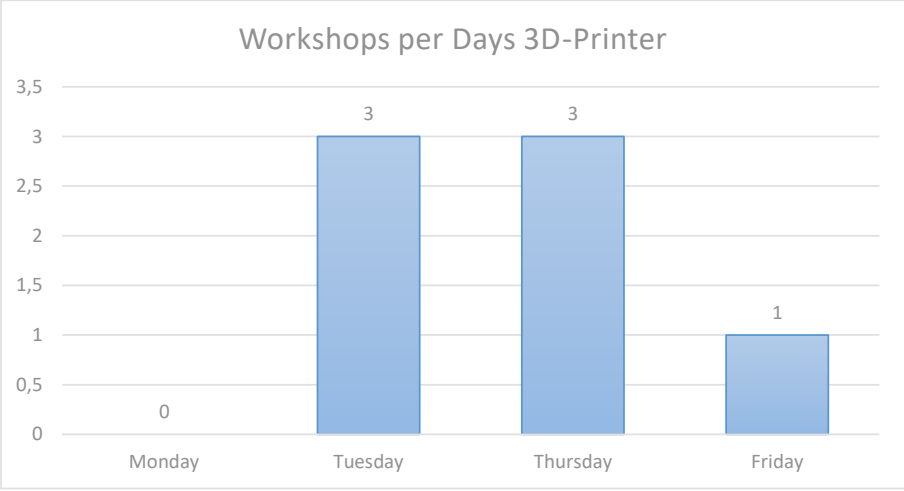

Figure 4.131: Statistical overview about the workshops per day of the 3D-Printer.

As Figure 4.131 depicts, on Tuesday and Thursday the staiton offered 3 workshops and on Friday a single workshop. On Monday there was no workshop offered.

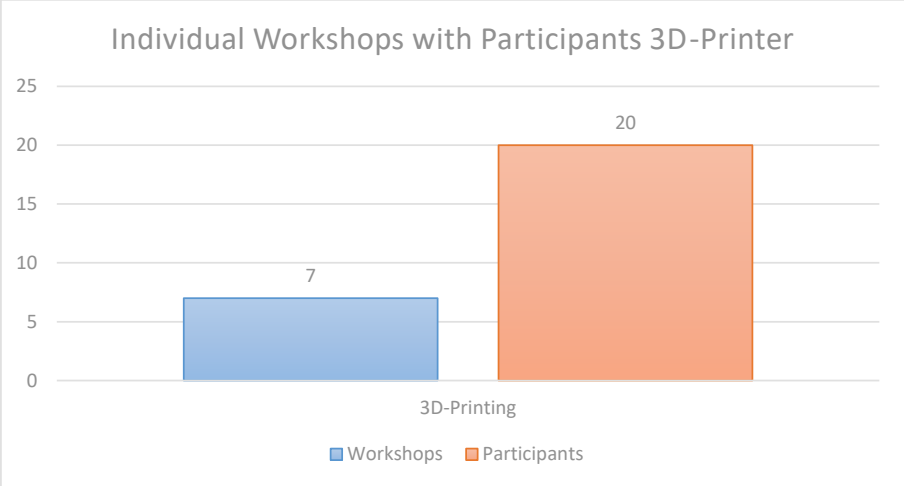

Figure 4.132: Statistical overview about the individual workshops with participants of the 3D-Printer.

Figure 4.132 shows that the station offered a single workshop called 3D-Printing. The workshop were offered 7 times with 20 participants overall.

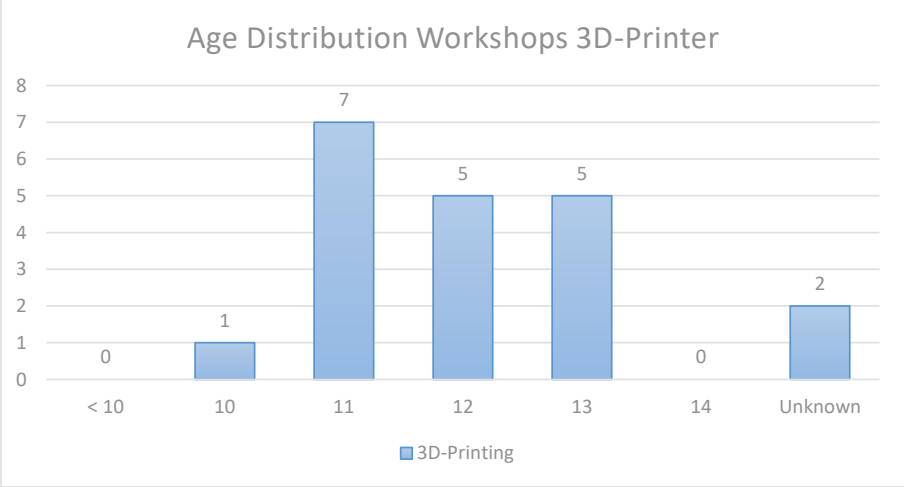

Figure 4.133: Statistical overview about the age distribution of the individual workshops of the 3D-Printer.

The age distribution Figure 4.133 clearly shows that the station were able to attract children that are between 10 and 13 years old. Especially, for kids in the age region of 11 years the workshops were most attractive.

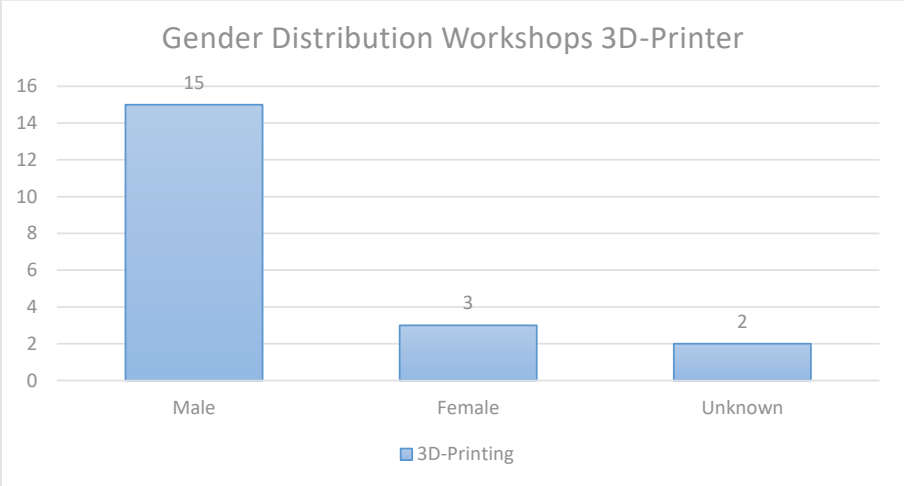

Figure 4.134: Statistical overview about the gender distribution of the individual workshops of the 3D-Printer.

Figure 4.134 shows that most of the attendees were boys with a total amount of 15 participants. There were just 3 girls at the station during the event. Future events should consider this and attract more girls.

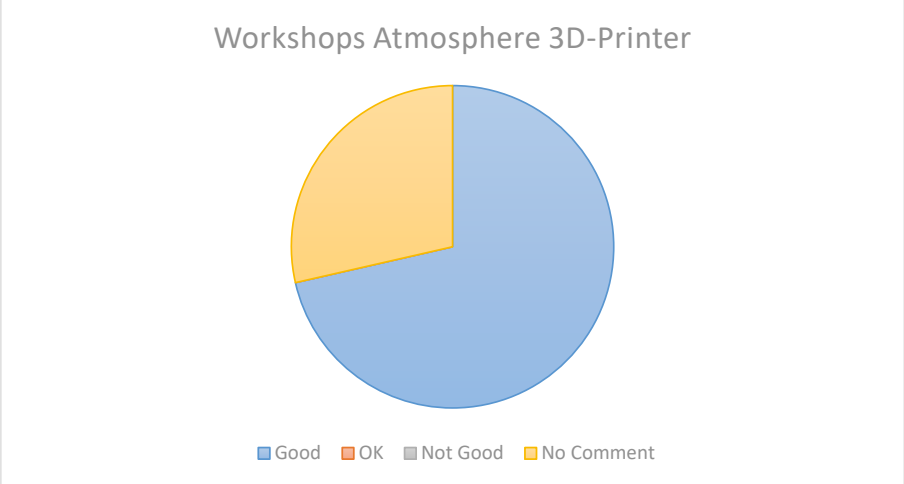

Figure 4.135: Statistical overview about the athmosphere at the individual workshops of the 3D-Printer.

Most of the workshops were good and for the remaining share, there is no data available, as seen in Figure 4.135 on page 112.

Movement Profile

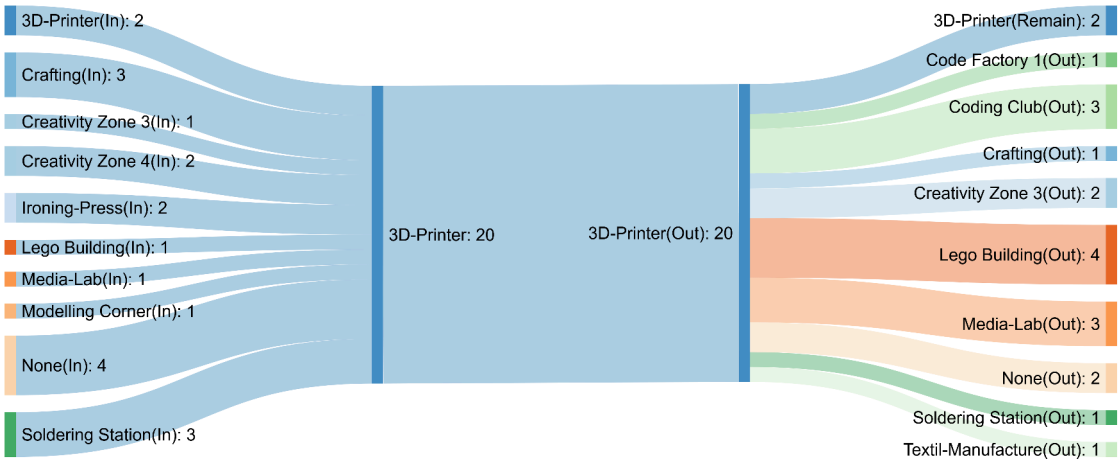

Figure 4.136: Overview of the input and output movement profile of the 3D-Printerstation.

Figure 4.136 on page 113 clearly shows that the 3D-Printer station attracted participants from different stations. Most of the attendees joined this station from neighbouring and from the other workshop room, as seen in Figure 4.137 on page 113. This station was mostly used as a station between other stations and for this reason most of the participants changed to other stations, mostly to the other workshop room, as seen in Figure 4.138 on page 114.

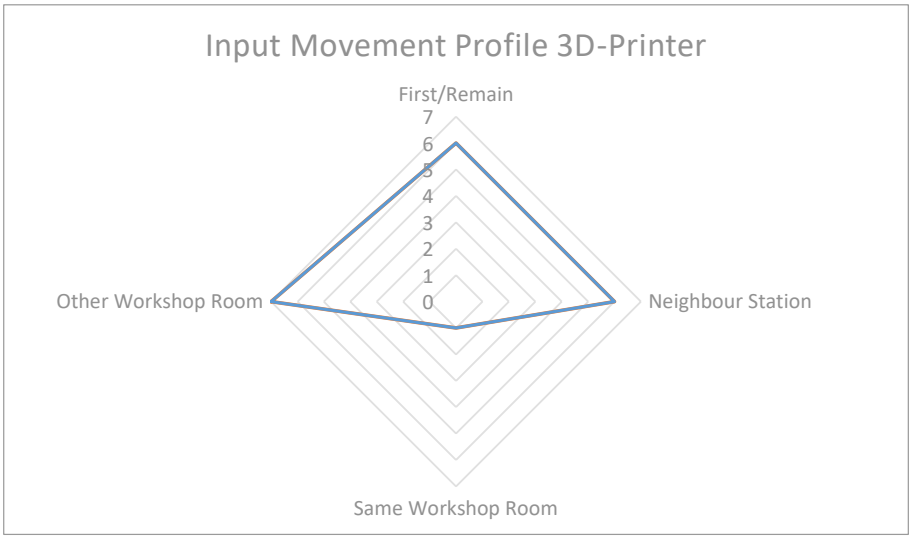

Figure 4.137: Overview of the input movement profile of the 3D-Printerstation.

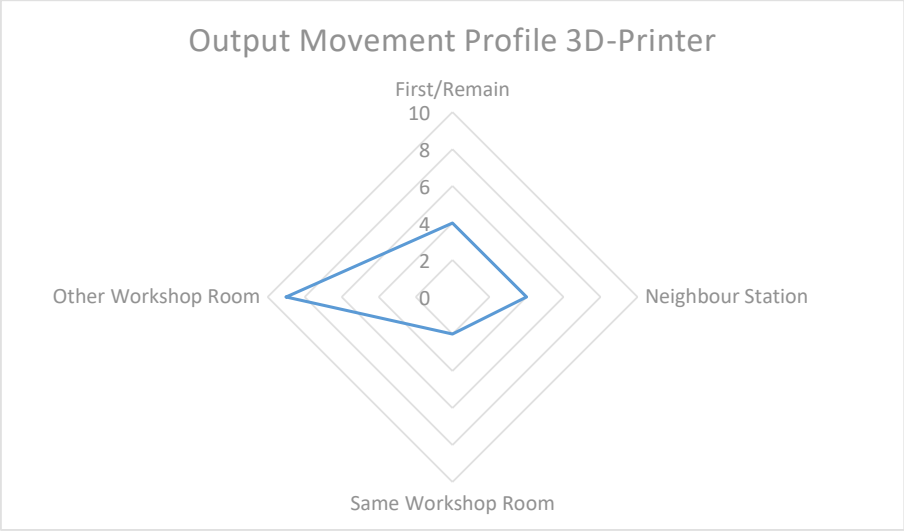

Figure 4.138: Overview of the output movement profile of the 3D-Printerstation.

4.5 Supply Stations

4.5.1 Crafting

Participants

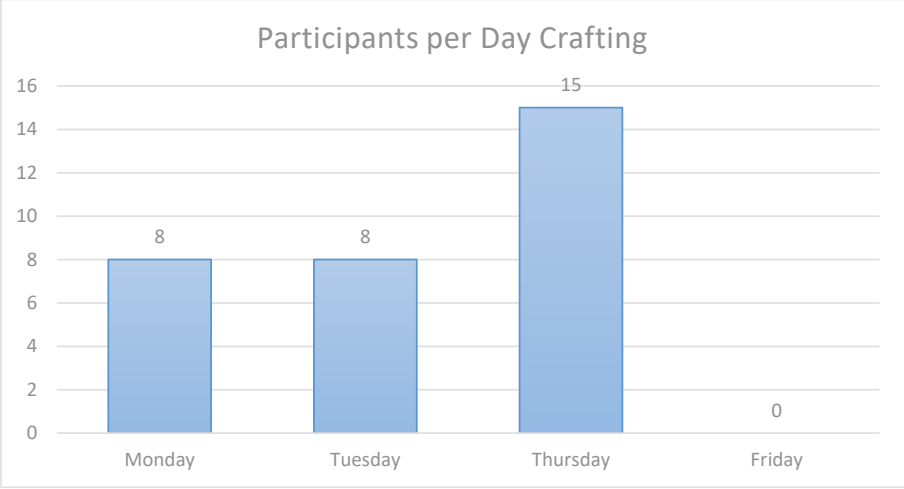

Figure 4.139: Statistical overview about the participants per day of the Crafting.

In Figure 4.139 on page 114, the statistical overview about the participants per day of the Craftingcan be seen. The most attendees were 15 participants that have been

reached on Thursday. On Monday and Tuesday, there were about 8 participants and none on Friday.

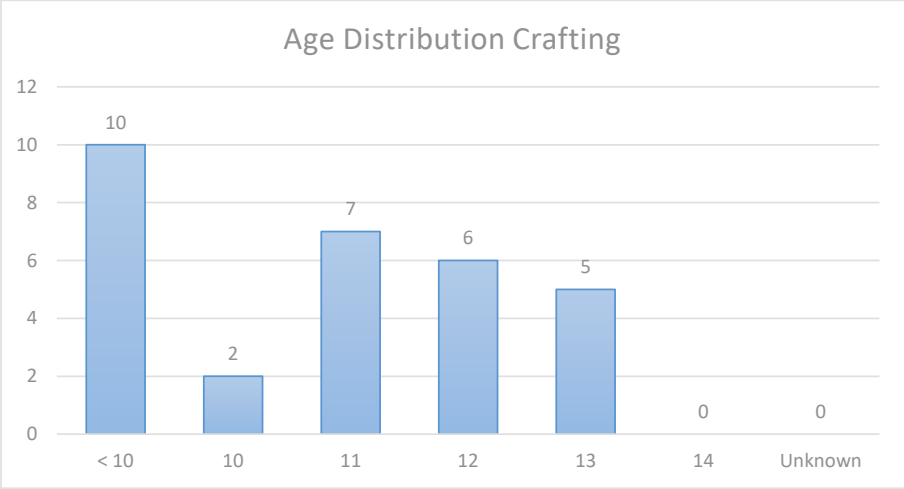

Figure 4.140: Statistical overview about the age distribution of the Crafting.

Figure 4.140 clearly shows that most of the attendees were below 10 years old and with higher ages the interest at this station was decreasing. Nevertheless, still five 13 years old children had interst to attend to workshops at this station.

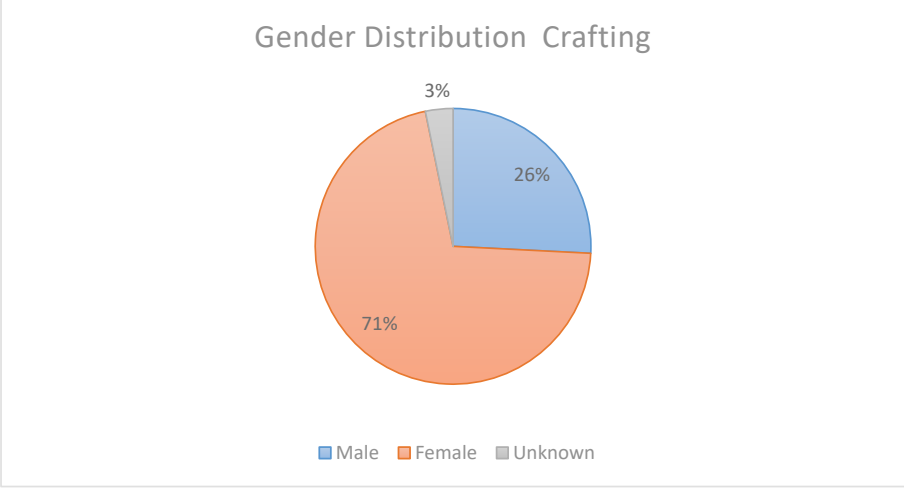

Figure 4.141: Statistical overview about the gender distribution of the Crafting.

Most of the attendees of the Craftingstation were girls with 71% and 26% were boys, as seen in Figure 4.141 on page 115.

Workshops

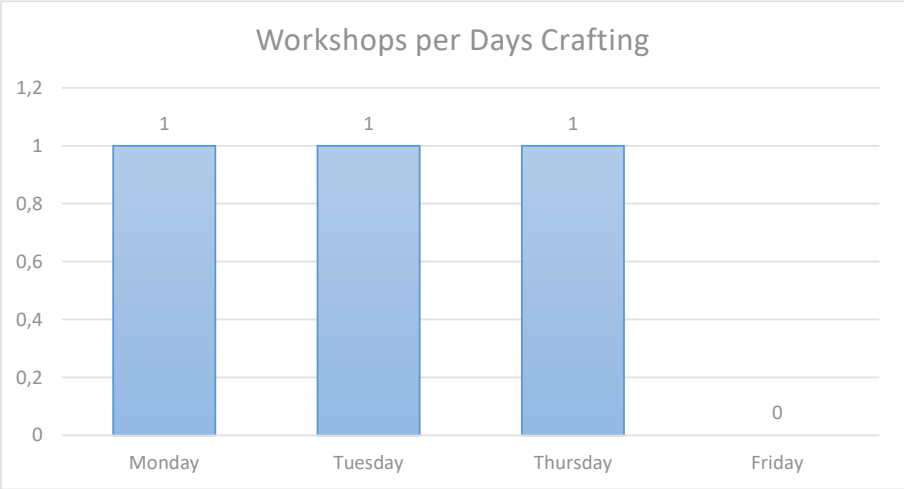

Figure 4.142: Statistical overview about the workshops per day of the Crafting.

In Figure 4.142 on page 116 it can be seen that the Crafting station has offered a workshop per day, excepting on Friday there were no recorded workshop cards but there was at least a single workshop because of filled product cards of participants.

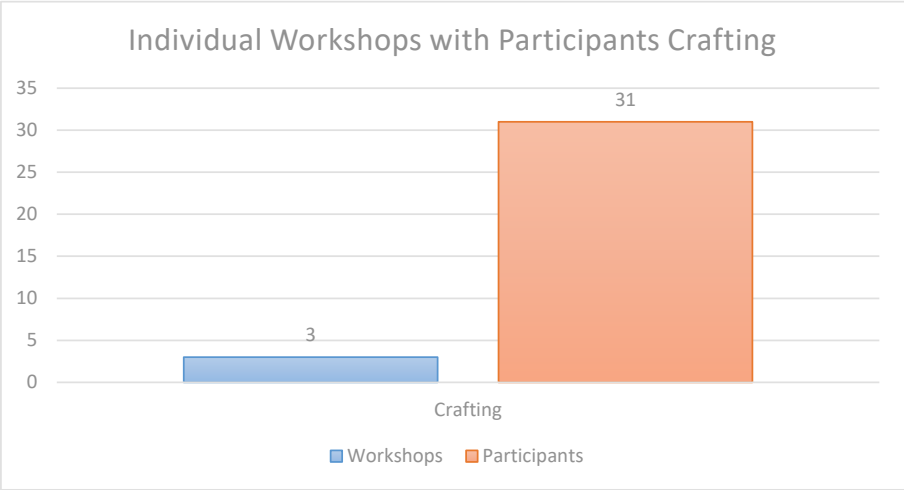

Figure 4.143: Statistical overview about the individual workshops with participants of the Crafting.

In Figure 4.143 on page 116 the amount of individual workshops as well as participants can be seen. The station offered three workshops and there attended 31 children.

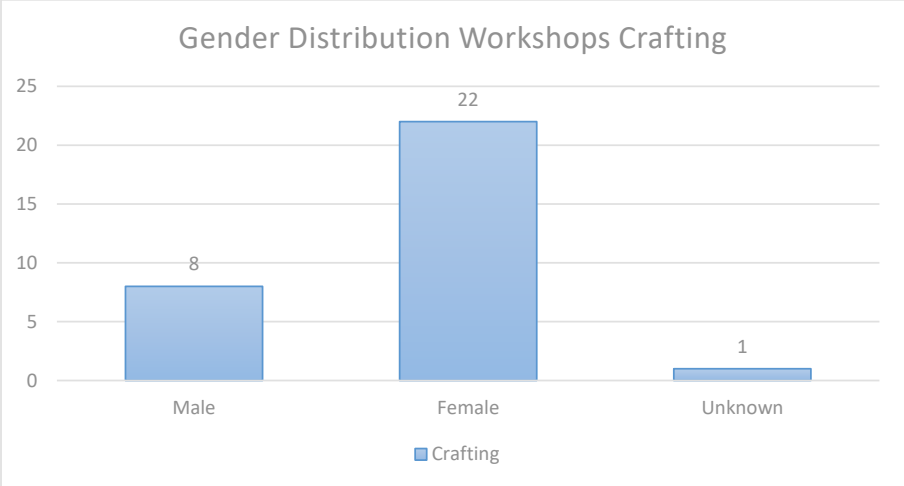

Figure 4.144: Statistical overview about the gender distribution of the individual workshops of the Crafting.

Most of the attendees were girls with 22 participants and 8 boys, as seen in Figure 4.144 on page 117.

Figure 4.145: Statistical overview about the athmosphere at the individual workshops of the Crafting.

As seen in Figure 4.145 on page 117, the atmosphere at the workshops were good without any problems.

Movement Profile

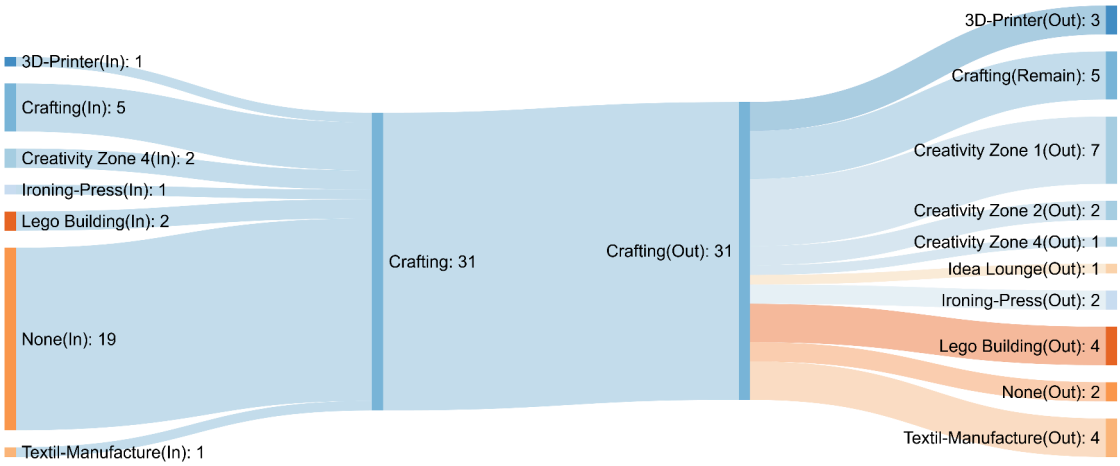

Figure 4.146: Overview of the input and output movement profile of the Craftingstation.

Figure 4.146 on page 118 shows the overview of the input and output movement profile of the Crafting station. Most of the attendees started at the Crafting station, as seen in Figure 4.147 on page 118. Afterwards, mostly half of them joined neighbouring stations and the other joined stations in the other workshop room, as depicted in Figure 4.148 on page 119.

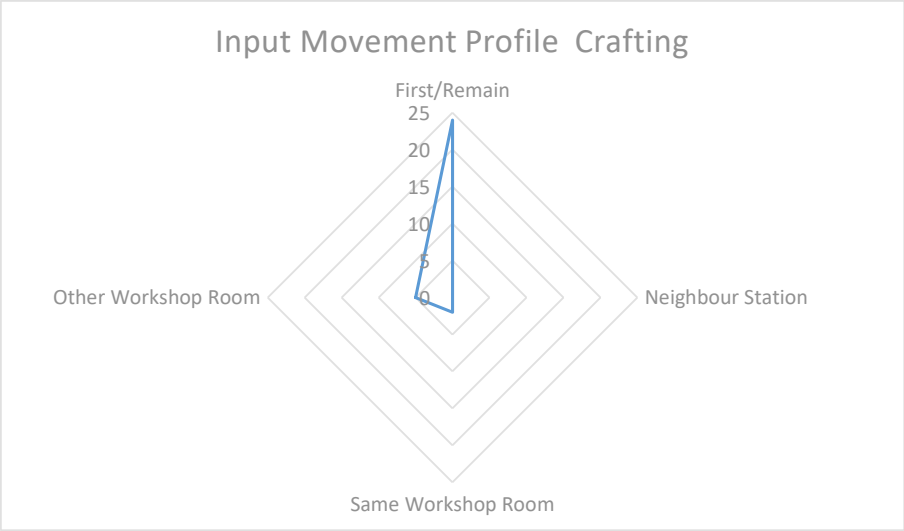

Figure 4.147: Overview of the input movement profile of the Craftingstation.

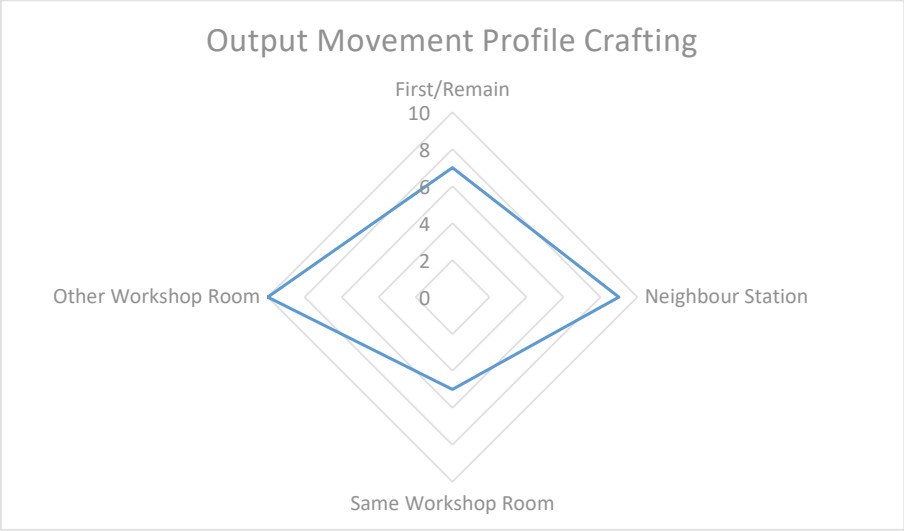

Figure 4.148: Overview of the output movement profile of the Craftingstation.

4.5.2 Idea Lounge

Participants

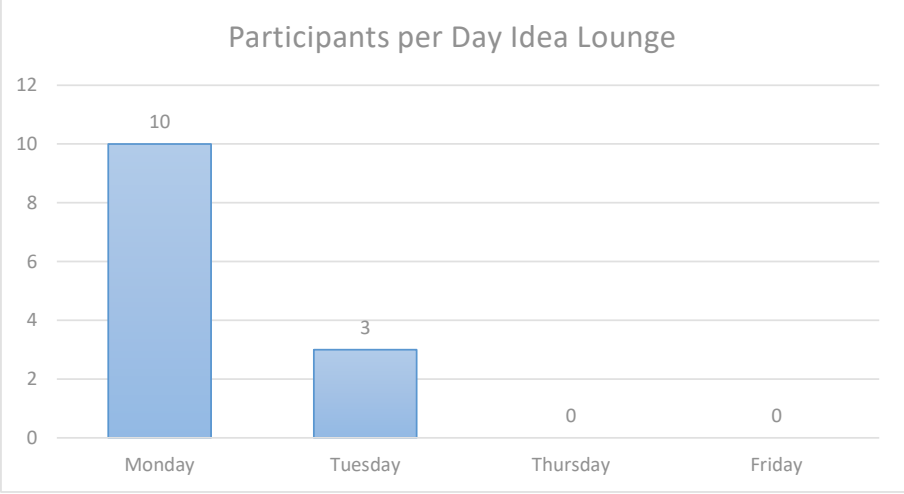

Figure 4.149: Statistical overview about the participants per day of the Idea Lounge.

The Idea Loungestation had the most participants on Monday with an amount of 10 and on Tuesday 3 participants, as seen in Figure 4.149 on page 119, and on the other days, the station had no attendees.

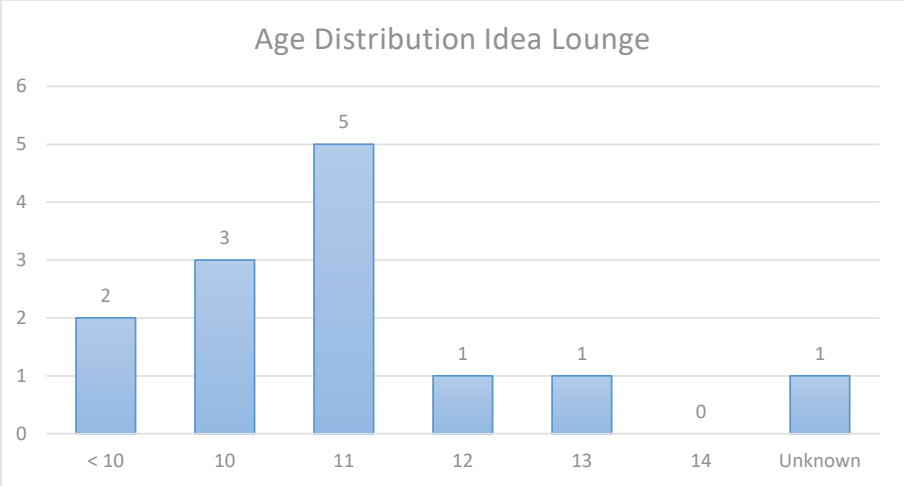

Figure 4.150: Statistical overview about the age distribution of the Idea Lounge.

In Figure 4.150 on page 120 the statistical overview about the age distribution of the Idea Loungestation can be seen. The highest interest for this station were at 11 years old children, closely followed by the 10 year olds. The other age ranges, except for 14 years old, have the same amount of 1-2 children per age.

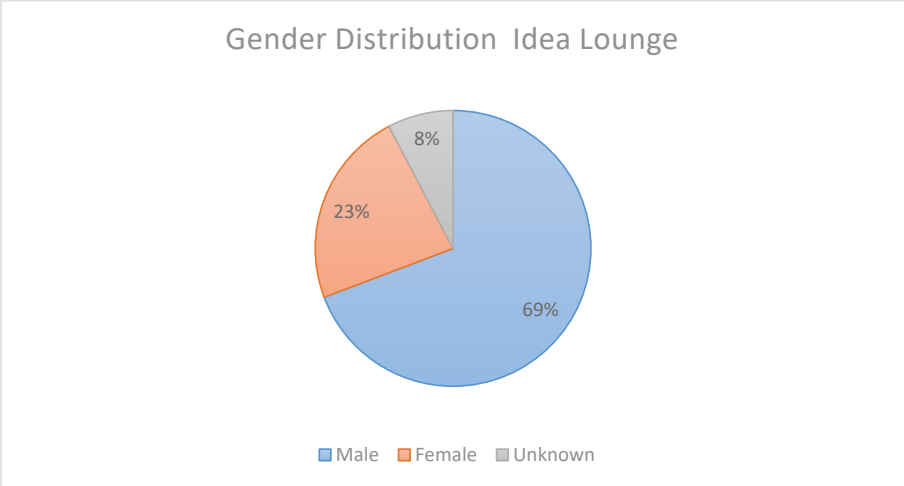

Figure 4.151: Statistical overview about the gender distribution of the Idea Lounge.

Most of the attendees were boys with a shrea of 69% and the girls were represented with 23%, as seen in Figure 4.151 on page 120.

Workshops

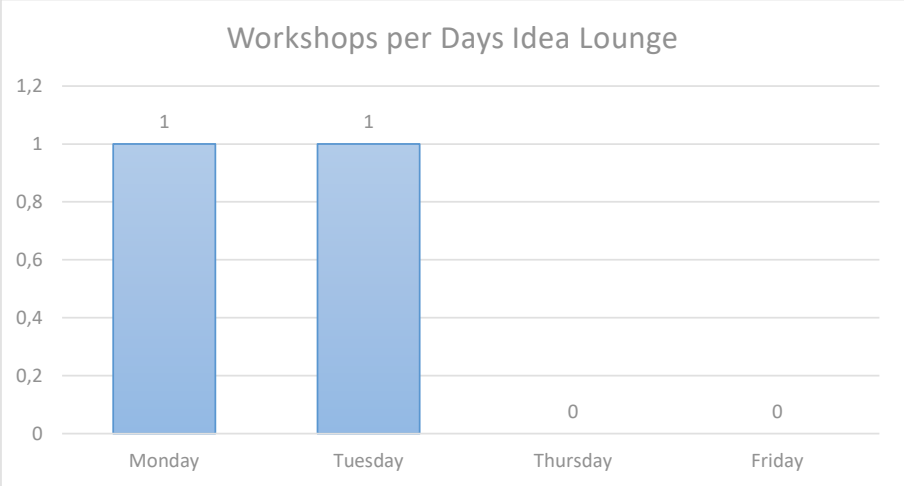

Figure 4.152: Statistical overview about the workshops per day of the Idea Lounge.

As seen in Figure 4.152 on page 121, the station offered two workshops that were offered on Monday and Tuesday. The other days, the station did not offer any workshops.

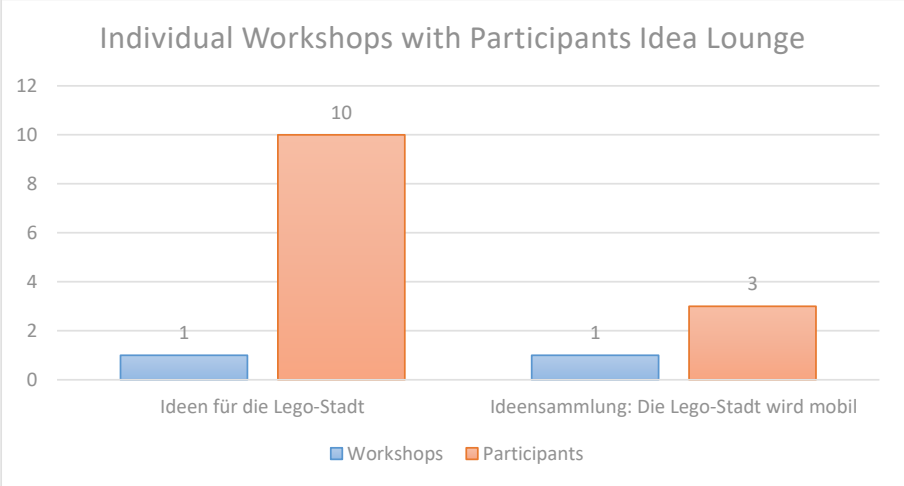

Figure 4.153: Statistical overview about the individual workshops with participants of the Idea Lounge.

The most attendees at this station have participated on the Ideen für die Lego-Stadt workshop with 10 individual participants. The amount of attendees that visited the second workshop dropped down to 3 participants, as seen in Figure 4.153 on page 121.

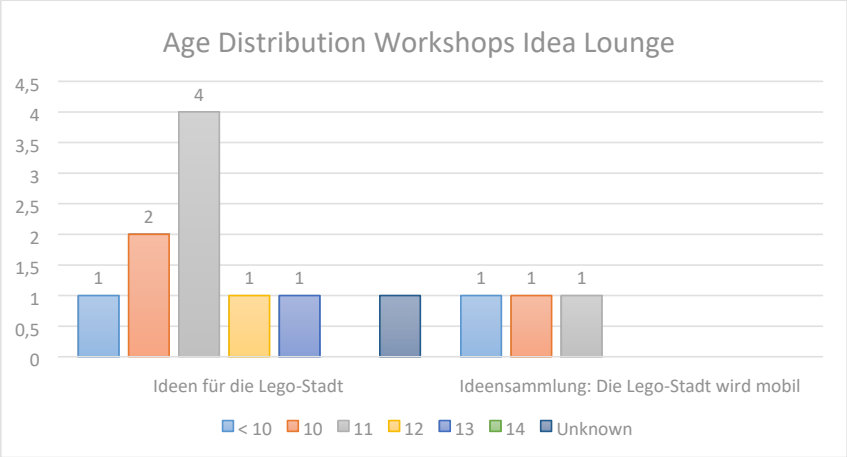

Figure 4.154: Statistical overview about the age distribution of the individual workshops of the Idea Lounge.

In Figure 4.154 on page 122, it can be seen that the first workshop has awaken interests to participants of the whole age region between 10 and 13 years.

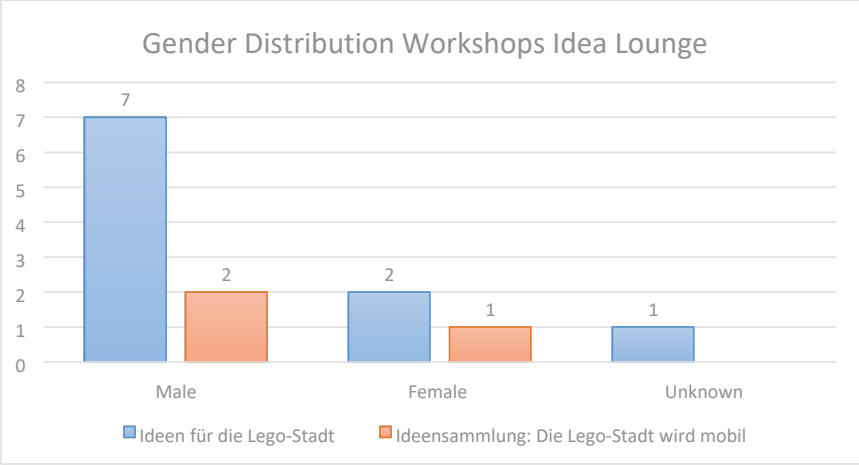

Figure 4.155: Statistical overview about the gender distribution of the individual workshops of the Idea Lounge.

Most of the attendees of the first workshop were boys with an amount of 7 individuals and the girls were underpresent with 2 participants, as seen in Figure 4.155 on page 122. The second workshop had too few participants to get any significant results.

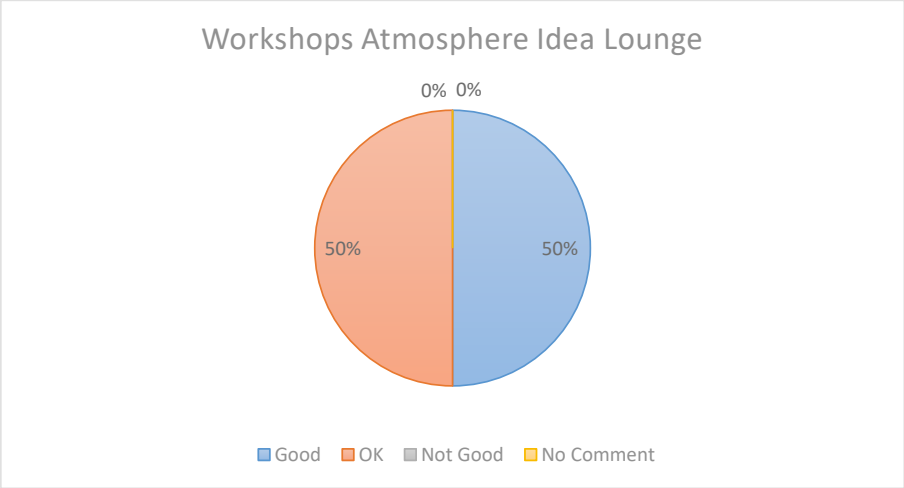

Figure 4.156: Statistical overview about the athmosphere at the individual workshops of the Idea Lounge.

The atmosphere of the Idea Loungestation, at the workshops, were between good and ok, as seen in Figure 4.156 on page 123.

Movement Profile

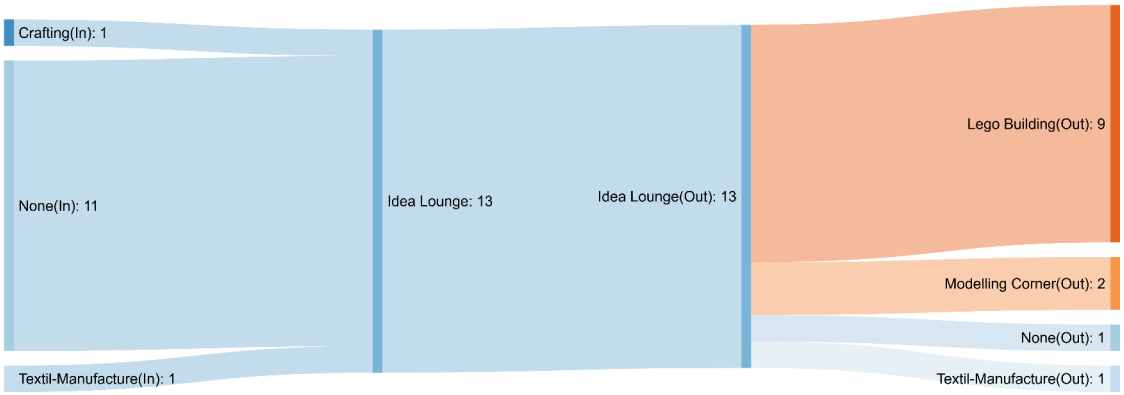

Figure 4.157: Overview of the input and output movement profile of the Idea Lounge.

In Figure 4.157 on page 123 the input and output movement of the Idea Lounge station can be seen. The Idea Lounge offered special workshops about finding ideas for the Lego City and therefore most of the attendees also switched afterwards to the Lego Building station. Therefore, most of them joined the station at the same workshop room, as seen in Figure 4.159 on page 124. Most of the attendees joined the station at the beginning of their day, as seen in Figure 4.159 on page 124.

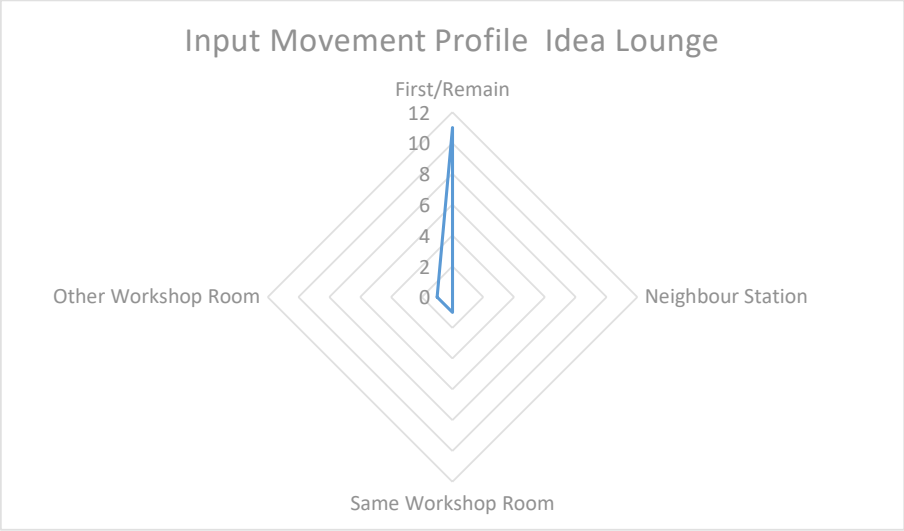

Figure 4.158: Overview of the input movement profile of the Idea Lounge.

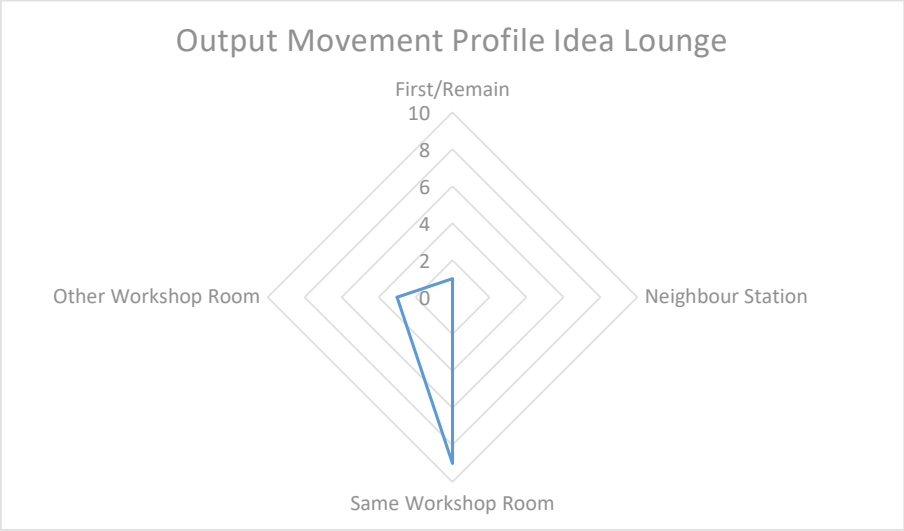

Figure 4.159: Overview of the output movement profile of the Idea Lounge.

4.6 Creativity Zones

Participants

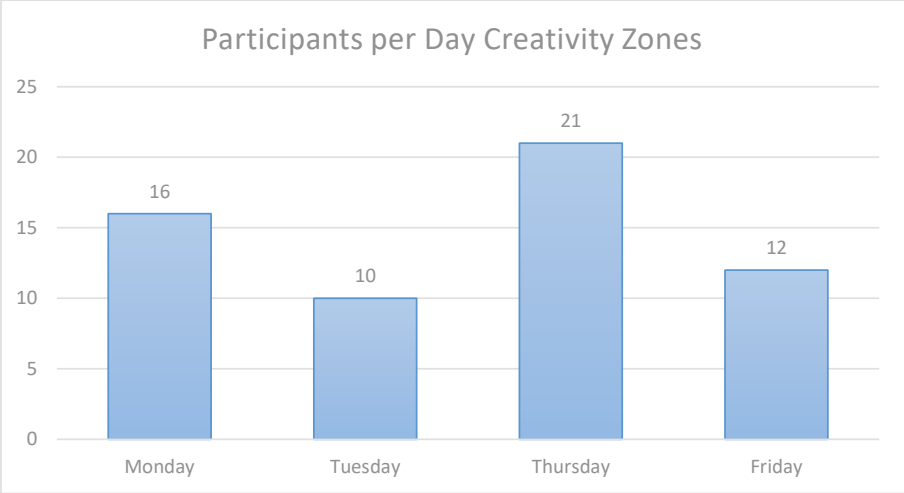

Figure 4.160: Statistical overview about the participants per day of the Creativity Zones.

The Creativity Zones were strong requested, as seen in Figure 4.160 on page 125, the most attendees were on Thursday with 21 participants and the least attendees were on Tuesday with 10 attendees.

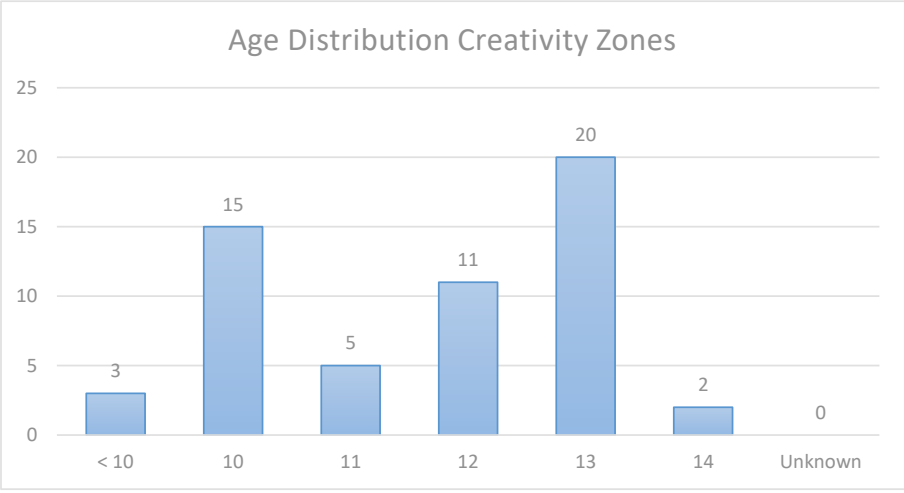

Figure 4.161: Statistical overview about the age distribution of the Creativity Zones.

The Creativity Zonesstation were able to attract participants at the whole age region,

as seen in Figure 4.161 on page 125. The most attraction were on children at the age of 13 years, closely followed by 10 year old children.

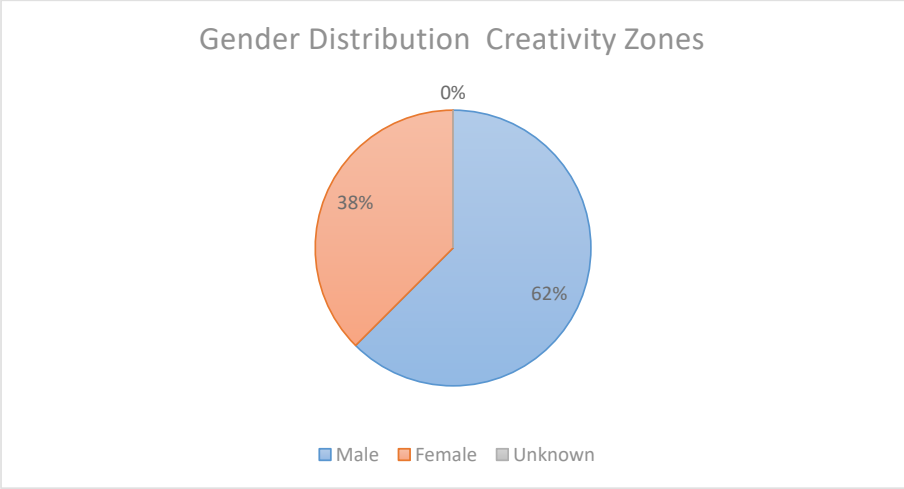

Figure 4.162: Statistical overview about the gender distribution of the Creativity Zones.

In Figure 4.162 on page 126, the statistical overview about the gender distribution of the Creativity Zonesstation can be seen. Most of the attendees were boys with a share of 62%. Girls were represented with a share of 38%.

Workshops

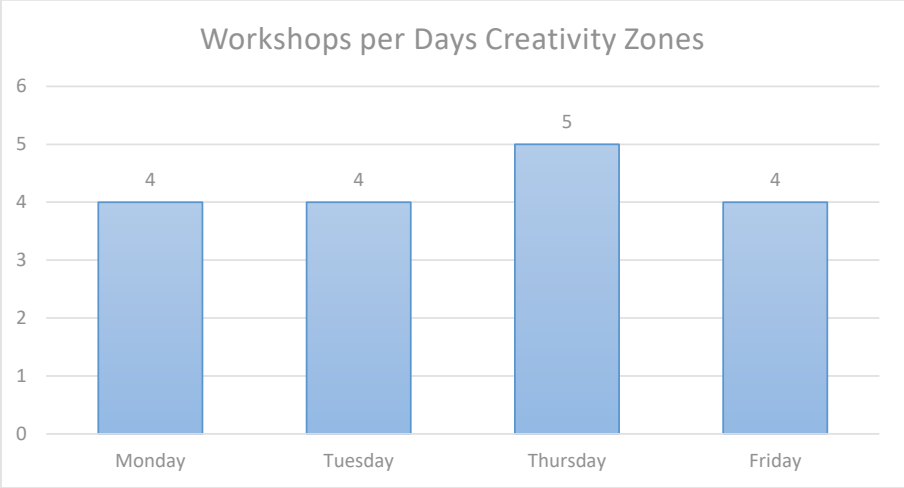

Figure 4.163: Statistical overview about the workshops per day of the Creativity Zones.

The workshop distribution was equally distributed on all four days of 4 to 5 workshops per day, as seen in Figure 4.163 on page 126.

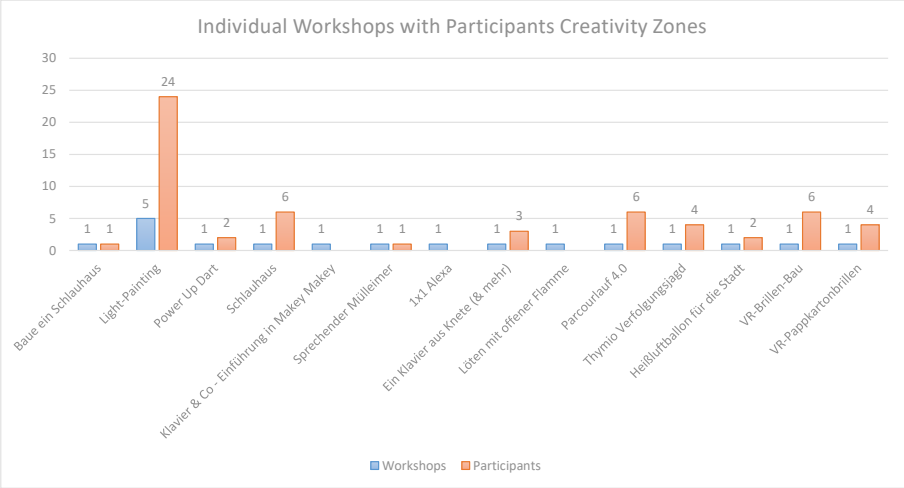

Figure 4.164: Statistical overview about the individual workshops with participants of the Creativity Zones.

As seen in Figure 4.164 on page 127, the most attractive workshop was the Light-Painting workshop with 24 participants, followed by the ”Schlauhaus“, ”Parcourlauf 4.0“ and ”VR-Brillen Bau“ with equally 6 participants. Most of the other workshops had about 1 to 3 participants but there were also workshops without any attendee such as Klavier and Co.

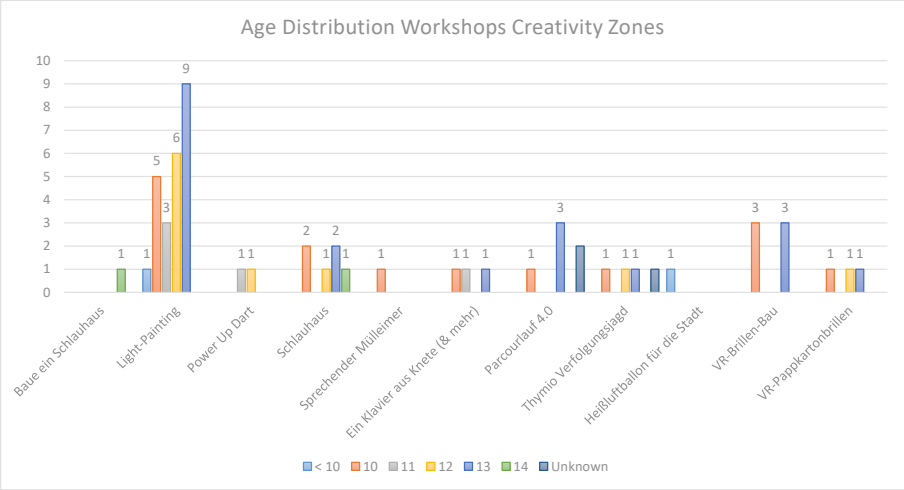

Figure 4.165: Statistical overview about the age distribution of the individual workshops of the Creativity Zones.

In Figure 4.165 on page 127, it can be seen that the Light-Painting workshops have

attracted all ages at the event. The other workshops have attracted different ages without any significances.

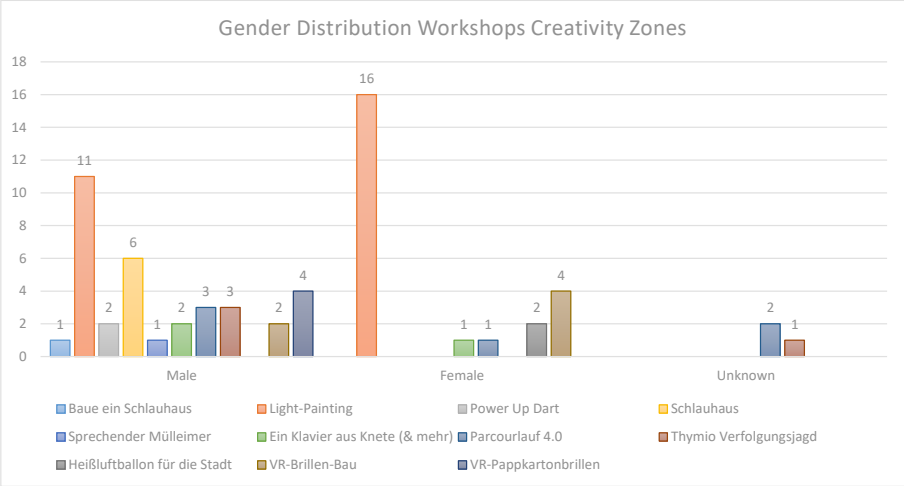

Figure 4.166: Statistical overview about the gender distribution of the individual workshops of the Creativity Zones.

As seen in Figure 4.166 on page 128, most of the boys were attracted by the Light-Painting workshop as well as from the ”Schlauhaus“ workshop. For girls the most attractive workshop was also the Light-Painting workshop. The second most visited workshops for the girls were the ”VR-Brillen-Bau“ workshop with 4 participants.

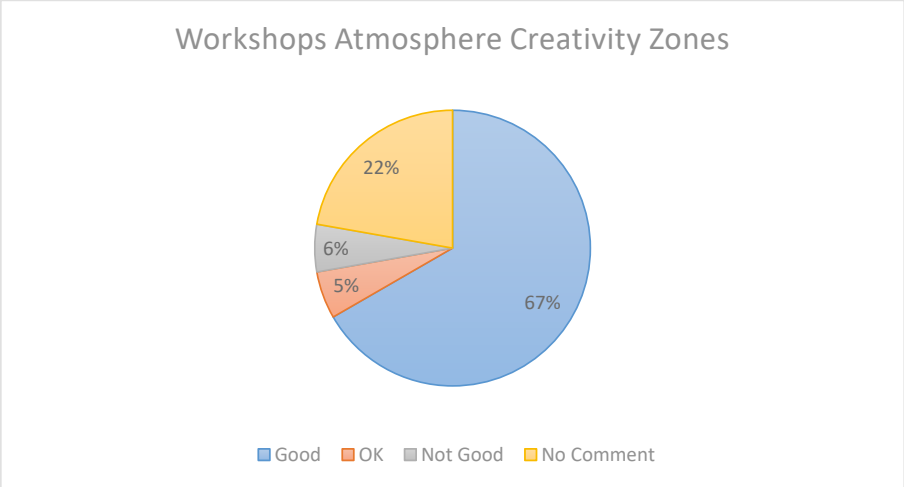

Figure 4.167: Statistical overview about the athmosphere at the individual workshops of the Creativity Zones.

The workshops atmosphere can be depicted in Figure 4.167 on page 128. Most of

the workshops were good with a share of 67% or OK with 5% but there were also 6% of the workshops that had no good atmosphere such as ”Parcourlauf 4.0“.

Movement Profile

Creativity Zone 1

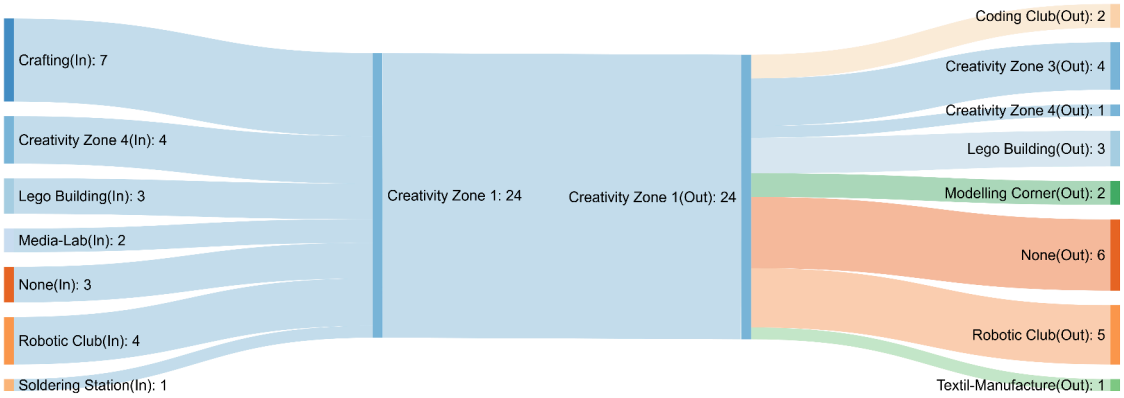

Figure 4.168: Overview of the input and output movement profile of the Creativity Zone 1.

In Figure 4.171 on page 131 the input and output movement profile can be seen. Most of the attendees joined this station from workshops from the same workshop room, as seen in Figure 4.169 on page 130, and they also left this station for workshops in the same as well as in the other workshop room, as seen in Figure 4.170 on page 130.

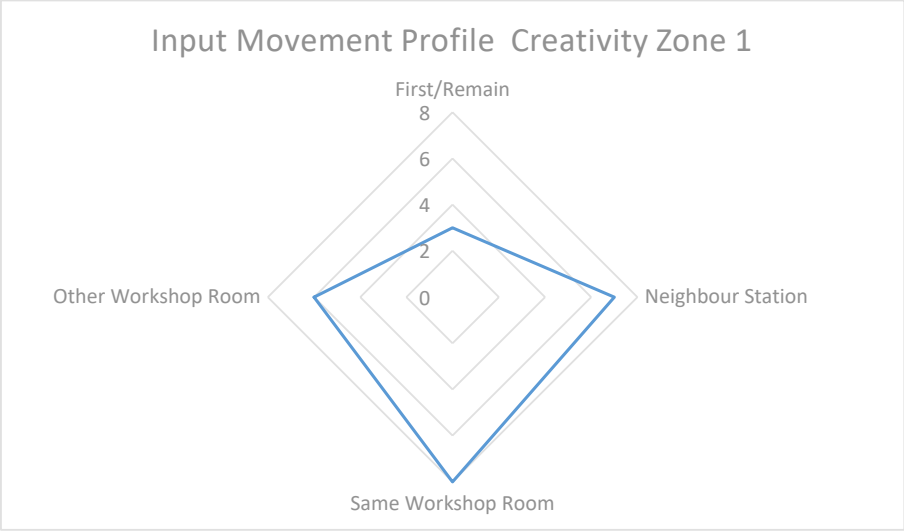

Figure 4.169: Overview of the input movement profile of the Creativity Zone 1.

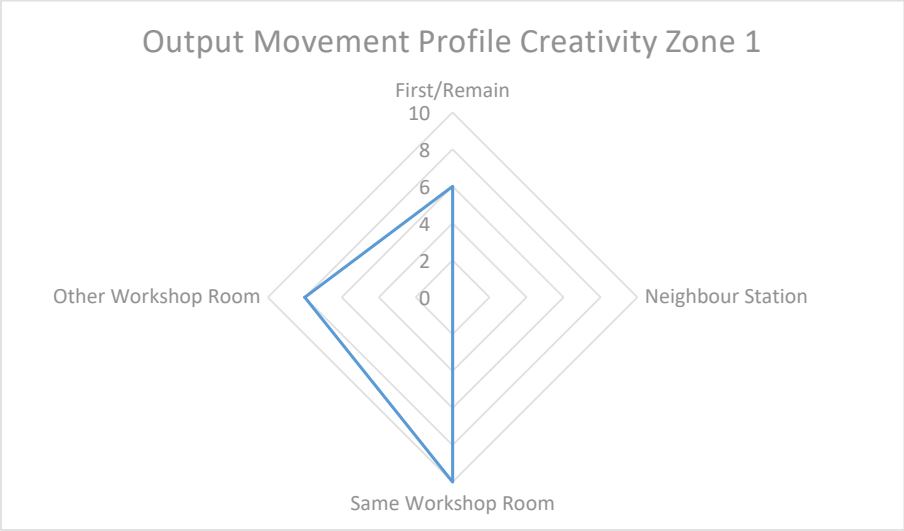

Figure 4.170: Overview of the output movement profile of the Creativity Zone 1.

Creativity Zone 2

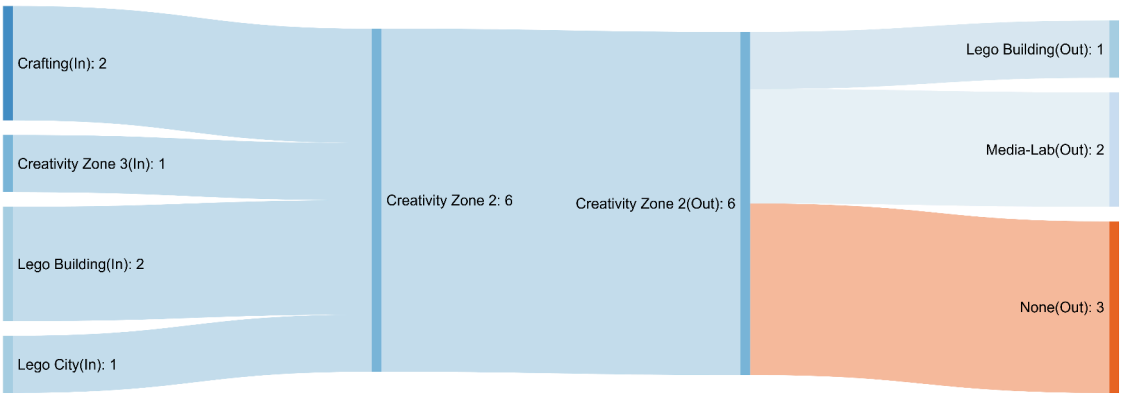

Figure 4.171: Overview of the input and output movement profile of the Creativity Zone 2.

Most participants were advertent from workshops at stations in the same workshop room such as Lego Building, as seen in Figure 4.172 on page 131 and Figure 4.171 on page 131. Half of the participants also remained at this station and others left to stations that were in the other workshop room, as seen in Figure 4.173 on page 132.

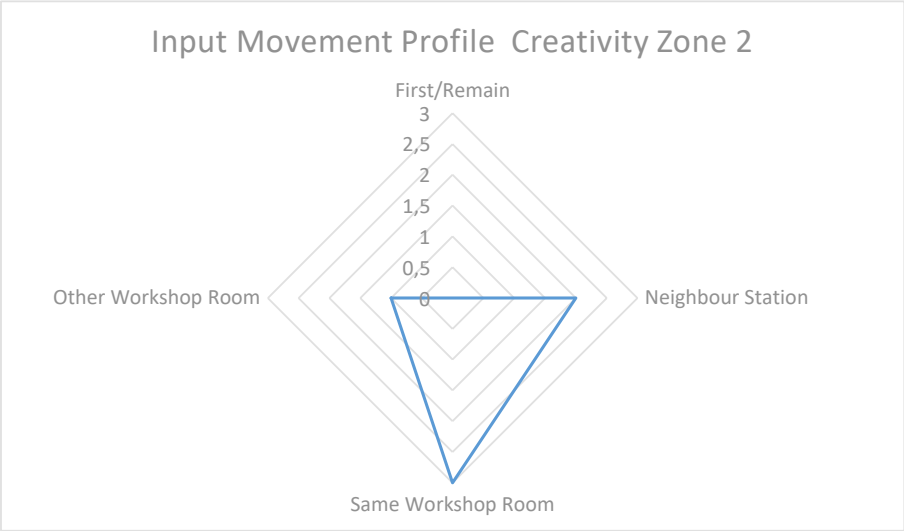

Figure 4.172: Overview of the input movement profile of the Creativity Zone 2.

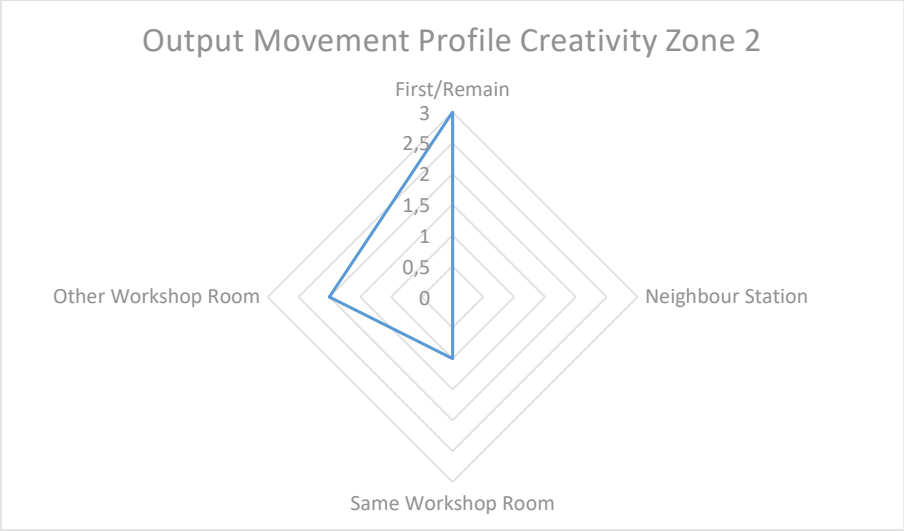

Figure 4.173: Overview of the output movement profile of the Creativity Zone 2.

Creativity Zone 3

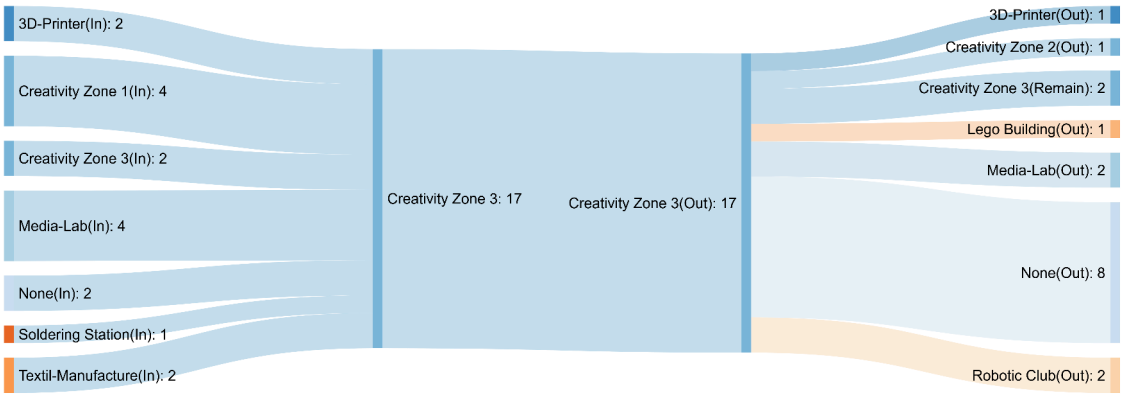

Figure 4.174: Overview of the input and output movement profile of the Creativity Zone 3.

Creativity Zone 3 was the most attractive stations of this category and attracted participants from different stations, as seen in Figure 4.174 on page 132. Figure 4.175 on page 133 depicts that the participants joined this station from neighbouring stations as well as from stations of the other workshop room and most of them remained at this station, as seen in Figure 4.176 on page 133.

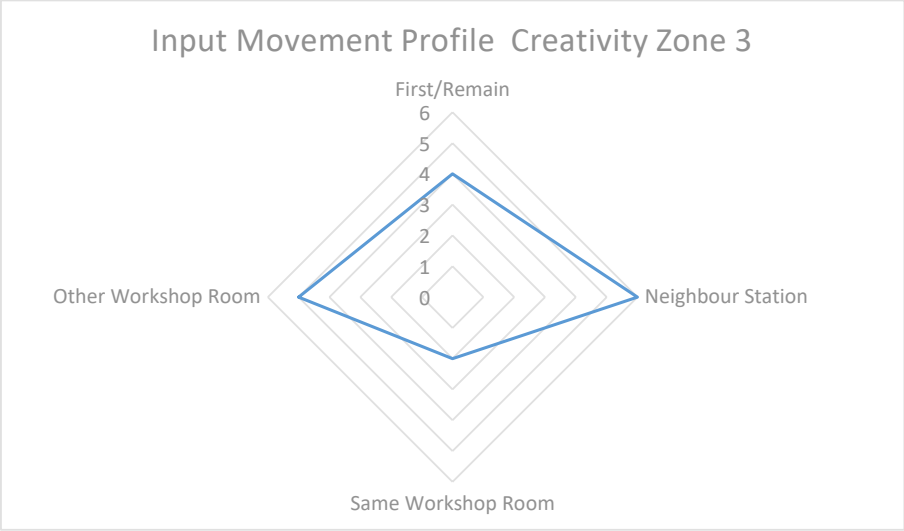

Figure 4.175: Overview of the input movement profile of the Creativity Zone 3.

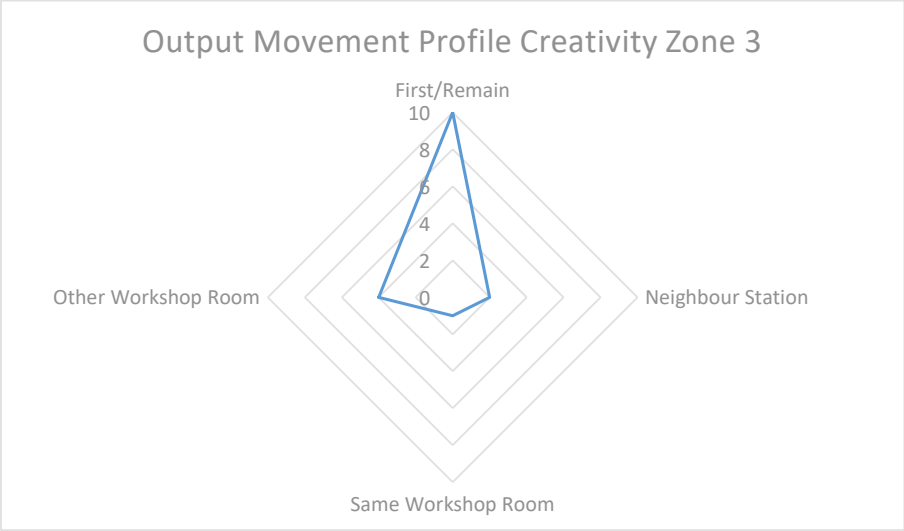

Figure 4.176: Overview of the output movement profile of the Creativity Zone 3.

Creativity Zone 4

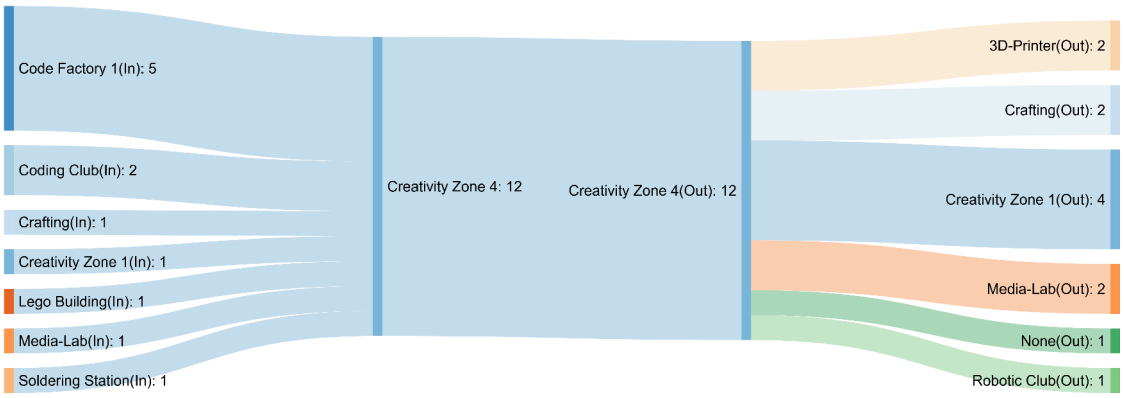

Figure 4.177: Overview of the input and output movement profile of the Creativity Zone 4.

In Figure 4.177 on page 134 the input and output movement of the Creativity Zone 4 can be depicted. Most of the attendees joined this station from stations of the other workshop room such as Coding Club or Soldering Station, as seen in Figure 4.178 on page 134, and also left this station for workshops in the other workshop room, as depicted in Figure 4.179 on page 135.

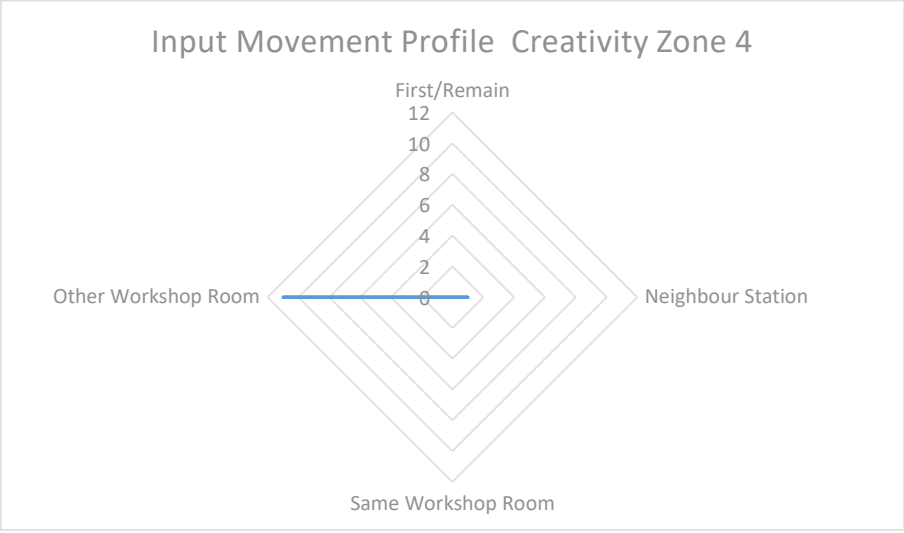

Figure 4.178: Overview of the input movement profile of the Creativity Zone 4.

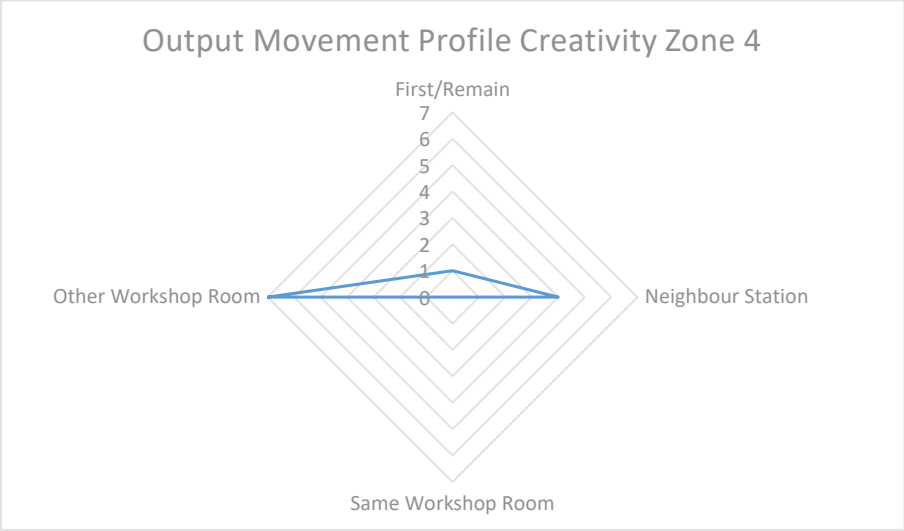

Figure 4.179: Overview of the output movement profile of the Creativity Zone 4.

Chapter 5

Discussion

This Chapter provides a discussion about the evaluation results of Chapter 4 as well as an evaluation of the Hypotheses of Gappmaier's previous work that has been introduced in Section 2.6.2.

5.1 Evaluation Problems

In Section 4.1 on page 41, we introduced the evaluation method process that is used for the evaluation of the Maker Days for Kids event in Graz. This process includes among others the recording of the participants as well as the general progress of the workshop. The recording of the workshop requires time and effort. Sometimes this time is not available because of high effort during the workshop caused by high demand of support by participants or high amount of participants in general. In these situations, tutors and peers had not enough time to record their workshop completely.

At the Maker Days for Kids event in Graz we encountered this problem at several stations such as VinylCutter and Modelling Corner, as seen in Figure 4.40 on page 64 and in Figure 4.106 on page 98. This problem clearly shows the limits of the manually data recording of the event. In future events, attractive and high demand stations should be supported by additional tutors and peers to achieve a higher completeness level of the recorded statistical data.

Another problem that widely occurred at all stations of the event was the appearance of non-registered participants, as seen in Figure 4.5 on page 45. One possibility for this phenomenon could be that the ID cards of the children were misaligned and that the tutors and peers asked the participants for their ID and they mixed up their numbers.

5.2 Digital Fabrication Stations

The Digital Fabrication stations had a special focus on producing digital products such as software or 3D objects. Overall there have been 51 participants that visited one ore more workshops at this domain, 42 of them were boys and 8 were girls. The stations were most attractive for children at the age of 11 and 13 years.

The most attractive workshop in this domain was the "Mache ein Spiel" workshop, in which the participants had the possibility to program their own game alone or in a team. This workshop was highly demanded by boys and this could result in a deterrence of girls. The "Hüpf-Konsole für Pacman" workshop instead was highly attractive to girls, in which the participants build their own input controller for a game. In future events, those two workshops could be combined together to attract more girls for this domain.

The Modelling Corner workshops also attracted mostly boys with a share of 84% in total. One possible reason for the low demand from girls could be the high abstraction level between the Computer-aided design software and their own creative ideas. For this reason, to minimize the abstraction, a further layer should be provided by providing Play-Doh to create their own models and later they can transfer the design into a virtual object.

5.3 Physical (Computing) Stations

The Physical (Computing) Stations had the most attendees with 298 workshop participants in total, 194 of them were boys and 76 were girls. The workshops of these domain were able to attract the whole age region of children at the age between 10 and 13 years. The most attractive were on boys at the age of 12 years and girls at the age of 13 years.

The most attractive stations for girls were the Coding Club, there they had a share of 44% of total and the Textile-Manufacture station with a total share of 48%. The reasons for the high girls attraction at the Coding Club was caused by the Milk Monster and Oracle Monster workshops. Both workshops combined the programming of a microcontroller for implementing the functionaliity of both monsters and a handcrafting part, in which the monster was creatively decorated and build. This clearly shows, that involving creative manual skills such as handcrafting can increase the attractivenss of workshops for girls. Compared to the first domain, the Digital Fabrication where girls were underpresent shows, that abstract software programming can be valorized for girls, if there are creative parts added.

At the Textile-Manufacture station, one of the most attractive workshop for girls was the "Programmierbare Stickmaschine“ workshop. In this workshop, participants had the opportunity to program a pattern that can be sticked. This workshop also combines abstract software programming with creativitiy and handcrafting methods such as sticking. For these reasons, to attract more girls in Physical (Computing) one possibility is to increase the amount of creativity and to combine the abstract work with handcrafting extensions such as stitching the program algorithm onto a clothing material.

5.4 Supply Stations

The Supply stations had about 44 participants in total, which are divided into 17 boys and 25 girls. This domain is the only that has more girls participated than others. This station mostly attracted participants that were younger than 10 years old but there were also attendees from the whole age region. The Crafting station was the most attractive to girls, about 71% of all attendees were girls.

The high attractiveness of the Crafting station for girls is not easy to evaluate. One possibility could be that there have been younger children and they have participated at this station every day because they felt comfortable. Moreover, handcrafting is more related to girls and less boys are attracted to this skills. For this reason, boys did not felt attracted by the whole station and thats why they did not participated at this station. The station also offered just a single workshop per day and therefore the workshop was to general described. In future events, the station could offer more individual workshops with a special focus on the interests of boys.

The Idea Lounge station instead, attracted more boys than girls with 69% to 23% in total. The most attractive workshop was the Ideen für die Lego Stadt. This workshop was well attended by girls and boys but at the successor workshop, the total amount of attendees decreased.

5.5 General

The Data we have analyzed in Section 4.2.1, 4.2.2, 4.2.3 provided us trends that should be analyzed in more detail with the data of the next Maker Days for Kids events of the next years as well as showing us improvement potentials such as the need of attracting more girls.

The Participation analysis showed us that participants with the age of 14 were

underpresent at this event. One of the reasons could be that the marketing campaign did not attract children at this age. Another concern is the low representation of girls. Future events marketing campaign should be designed for girls and emphasize stations and workshops that have been most visited by girls such as Crafting or Textiles. Most of the participants have visited more than a single day, mostly two days. This could be considered for future events to extend certain workshops to build larger projects.

The workshop statistic shows us that almost all participants, independently of their age and gender visited about four workshops. This equality could be interpreted that every gender in each age felt comfortable at the Maker Days event. Looking at the most popular workshops, we can readout that 3D-Printing and Soldering attracted the most. All other attractive workshops had a focus on programming. For future events, this could be combined together to workshops were children can build their own hardware devices by printing parts and solder hardware components together with the possibility to program special behavior.

5.6 Hypotheses Evaluation

The work of Gappmaier contains hypotheses about the behavior of girls and boys for open workshop Maker Days events. This Section tries to evaluate these hypotheses if they are also apply to the Maker Days for Kids event that have been hosted at Graz University of Technology in 2018.

1. **The most frequently visited workshops have a focus on Computers, Electronic and New Media such as 3D-Printer and Vinyl-Cutter [Gap18].**

   Comparing this hypothese with the statistical overview of the most attended workshops, as seen in Figure 4.23 on page 55 clearly shows, that this hypothese is still valid. The most attractive workshop was the 3D-Printer workshop with 44 participants, closely followed by the electronic workshop, most of the other workshops are in the Physical (Computing) domain. But there are also workshops that have not that many links to computers such as the crafting workshops or the Light-Painting workshops. For this reason, it can be seen that still classical handcrafting workshops such as crafting still is able to attract children.

2. **Pure Programming related workshops are less frequently visited [Gap18].**

   The most abstract programming workshop at the event was the ”Mache ein

Spiel“ workshop. In this workshop participants had the opportunity to build their own game. The evaluation clearly shows, that officially there were only 7 participants on all three days this workshop was offered. The other workshops at other stations always were related to specific hardware devices such as the Ozobots or programming a microcontroller such as the Monster workshops and they were attended high frequentl. Therefore, this hypothese is still valid.

3. **The more days of attandance, the more workshops on average will be visited by the individual participant [Gap18].**

   This hypothese is not confirmed at our event because at average participants that visited the event for a single day visited about 2.6 workshops at average. For participants with two days of participation just have 4.5 workshops in average and this trend is also obvious when looking at participants with three or four days because then the average participation is 6 workshops for three days and 6.2 for four days. Therefore, the amount of total visited workshops is not growing instead it is some kind of saturation for the participants.

4. **Girls are less attracted to pure technical or computer science related workshops such as 3D-Printing, soldering or programming [Gap18].**

   This hypothese was also not confirmed at this event because the most attractive station is the Crafting station with the crafting workshops but excluding the girls that were below 10 years old the situation is different. The most attractive workshops were Elektronik Basteln, Light-Painting, Milch-Monster, Ozobots and Stickmuster programmieren. Therefore, girls are also attracted to technical related workshops. The difference of attractiveness between the event of Bad Reichenhall and this event could be the combination of abstract programming with handcrafting such as the Milch-Monster workshop.

5. **Children are preferring adjacent stations when they move to other workshops [Gap18].**

   In contrast to the evaluation of Gappmaier [Gap18], the participants of the Maker Days for Kids event in Graz did not prefer neigbourous stations in first place, as seen in Figure 4.24 as seen on page 55 and in Figure 4.25 as seen on page 56. In these Figures, it can be depicted that there were more movements to stations in the other workshop room than to neighbouring stations.

6. **Girls are more attracted to stations that are supervised by female tutors and peers [Gap18].**

As seen in Figure 4.16 on page 51, the most attractive stations for girls were stations that were supervised by female tutors and peers such as Crafting, Lego Building and Textile-Manufacture, but there are also stations that had male tutors such as Robotic Club and Soldering Station. For this purpose, it is hard to make any statement because crafting and textile are strongly connected to female interests and for this purpose it is comprehensible that they were supervised by female tutors/peers but there are also male dominated stations that attracted female participants such as robotics and electrical engineering.

5.7 Novel Hypotheses

1. **The more days of attandance, the least workshops will be visited by the invidiual participant.**

   In contrast to the hypothese of Gappmaier that more days of attendance relates to a higher visit of workshops, the current data hypothesizes that the average amount of visited workshops per day will decrease with higher participation, as seen in Figure 5.1 on page 141.

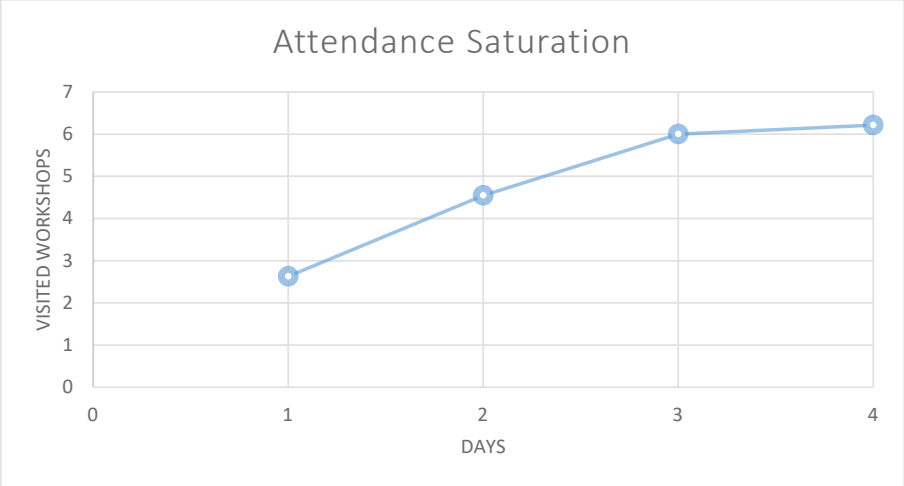

Figure 5.1: Attendance saturation trend.

2. **Children at younger ages (11 years) are attracted to Electronic and with higher age (13) they get more attracted to software programming.**

   The most attractive station for children at the age of 11 years were the Solder-

ing station. Elder children, at the age of 13, were less attracted to this station but prefered software programming related stations such as Robotic Club.

3. **Girls are visiting less workshops than boys.**

   At this event, girls visited in average 3.8 workshops and boys instead visited 4.1 workshops. Girls seems to spend more time at workshops and therefore they visit less workshops in average.

Chapter 6

Conclusion

This master thesis provides a summarization and evaluation of the Maker Days for Kids event at the Graz University of Technology of 2018. This event offers a temporary open workshop Maker Space for children that are between 10 and 14 years old. Children have the possibility to attend between a single and four days to participate on different workshops at 18 different stations such as Robotic Club, Textile Manufacture or Soldering Station.

In Section 2, this thesis provides an overview about Making and the related community as well as the roots of the Making culture. Furthermore, it gives an overview about the predecessor event in Bad Reichenhall. The event of Bad Reichenhall was already scientifically evaluated and the section is also providing information about the evaluation results and derived hypotheses. An overview about the event in general and details about the different stations can be found in Section 3. The event was held in two big rooms that offered 18 different stations. Section 4, provides evaluation diagrams that gives an insight to the distribution of age and gender as well as favorite workshops, workshop participation details and discussion of the results. At the end of this Section the hypotheses of the Bad Reichenhall event are evaluated with the results of the event of Graz University of Technology as well as novel hypotheses that arised at this event.

The evaluation results clearly shows that the event was very successful. Overall, there were 119 participants that visited 126 workshops at 18 stations and the atmosphere on most of the workshops was good. The most attended workshops were the 3D-Printer, Elektronik Basteln and Crafting. The most attractive station for girls were the Textile-Manufacture station and the Coding Club. Both stations provided a combination of programming and creativity and this also could be the reason for their great success in attracting girls. In general, girls had a general participant ratio of 28% and this is also one of the most important task for the next event to attract more girls for STEAM. The workshops provided at the Coding Club station

clearly shows how to awake interests in STEAM by combining programming with handcrafting and creativity with impressive workshops such as the Milk Monster. From the age distribution, the event was designed for children between 10 and 14 years but there were also children that were below 10 years and this worked great. These kids were most attracted by the crafting station but they also participated at more advance stations such as Soldering Station or Textile-Manufacture. The more worrying group were children at the age of 14 because there were only 3 participants within this age. Future events should try to advertise the event more to this age group. This could be reached through targeted advertising.

The evaluation of the hypotheses confirmed two hypotheses but also contradicted two of them. Still valid are the hypotheses that are describing that the most frequently stations offer workshops with a focus on computers, electronic and new media and that the less frequently visited workshops are about abstract programming. The other two hypotheses that are about the more days a participant visits the event, the more workshops he will visit. In this case, we have evaluated that with higher attendance the amount of workshops is decreasing. The last hypotheses we were able to contradict was about girls that are less attracted to technical related workshops. At our event, we have not observed this behavior because one of the most attractive workshop was at the Soldering station and the Coding Club. Furthermore, we have found three novel hypotheses that should be analyzed within the evaluation of future Maker Days for Kids events. One of them describes the theses that girls visit less workshops that boys. The second describes that children at younger ages are attracted to the electrical engineering domain and with higher ages they get more attracted to software programming. The last one postulates that the more days are visited by an individual the more they experience some kind of saturation and for this reason, they attend at less workshops the other days.

The evaluation clearly shows that the event was a success and that the event can bring the participant closer to STEAM. This could help to awake interest in this field and reduce fears in mathematical and science-oriented fields.

Bibliography

[BHAGB16] J. M. Banks-Hunt, S. Adams, S. Ganter, and J. C. Bohorquez. K-12 stem education: Bringing the engineering maker space, student-centered learning, curriculum, and teacher training to middle schools. In *2016 IEEE Frontiers in Education Conference (FIE)*, pages 1–5, Oct 2016.

[CASS16] V. Chaudhary, V. Agrawal, P. Sureka, and A. Sureka. An experience report on teaching programming and computational thinking to elementary level children using lego robotics education kit. In *2016 IEEE Eighth International Conference on Technology for Education (T4E)*, pages 38–41, Dec 2016.

[ESG18] Martin Ebner, Sandra Schön, and Maria Grandl. Materials, Descriptions and Pictures about the Maker Days for Kids at Graz University of Technology 2018 [Cloud]., 2018.

[ESN16] Martin Ebner, Sandra Schön, and Kristin Narr. *Making-Aktivitäten mit Kindern und Jugendlichen: Handbuch zum kreativen digitalen Gestalten*. BoD–Books on Demand, 2016.

[Gap18] Lena Gappmaier. *Analyse von Maker Days und Konzepterstellung zur Durchführung an Hochschulen*. PhD thesis, 2018.

[haca] Hacker - Wikipedia, [online]. `https://en.wikipedia.org/w/index.php?title=Hacker&oldid=855045288`. [29.01.2019].

[hacb] List of Hacker Spaces, [online]. `https://wiki.hackerspaces.org/List_of_Hackerspaces`. [29.01.2019].

[hac13] Make: DIY Projects and Ideas for Makers, [online]. `https://makezine.com/2013/05/22/the-difference-between-hackerspaces-makerspaces-techshops-and-fablabs/`, 2013. [29.01.2019].

[Hat14] Mark Hatch. *The maker movement manifesto: Rules for innovation in the new world of crafters, hackers, and tinkerers*. McGraw-Hill Education New York, 2014.

[HTP14] C. K. Harnett, T. R. Tretter, and S. B. Philipp. Hackerspaces and engineering education. In *2014 IEEE Frontiers in Education Conference (FIE) Proceedings*, pages 1–8, Oct 2014.

[ikea] Aus der Geschichte - IKEA, [online]. `https://www.ikea.com/ms/de_DE/about_ikea/newsroom/press_downloads/history/index.html`. [29.01.2019].

[ikeb] IKEA Daten und Fakten - IKEA, [online]. `https://www.ikea.com/ms/de_DE/this-is-ikea/ikea-highlights/IKEA-facts-and-figures/index.html`. [29.01.2019].

[JL13] S. Jordan and M. Lande. Should makers be the engineers of the future? In *2013 IEEE Frontiers in Education Conference (FIE)*, pages 815–817, Oct 2013.

[KB17] S. Khalifa and T. Brahimi. Makerspace: A novel approach to creative learning. In *2017 Learning and Technology Conference (L T) - The MakerSpace: from Imagining to Making!*, pages 43–48, Feb 2017.

[Kha13] A. Khanlari. Effects of educational robots on learning stem and on students' attitude toward stem. In *2013 IEEE 5th Conference on Engineering Education (ICEED)*, pages 62–66, Dec 2013.

[mak] Makey Makey, [online]. `https://makeymakey.com/`. [29.01.2019].

[ozo] Ozobot — Robots to code, create, and connect with, [online]. `https://ozobot.com/`. [29.01.2019].

[Pap80] Seymour Papert. *Mindstorms: Children, computers, and powerful ideas*. Basic Books, Inc., 1980.

[PH91] Seymour Papert and Idit Harel. Situating constructionism. *Constructionism*, 36(2):1–11, 1991.

[PRK10] C. F. Panadero, J. V. Román, and C. D. Kloos. Impact of learning experiences using lego mindstorms® in engineering courses. In *IEEE EDUCON 2010 Conference*, pages 503–512, April 2010.

[pro] Professor Seymour Papert, [online]. `http://www.papert.org/`. [29.01.2019].

[SE16] Sandra Schön and Martin Ebner. Digitales kreatives Selbermachen in der Schule. 2016.

[SE17] Sandra Schön and Martin Ebner. Die maker-bewegung macht schule: Hintergründe, beispiele sowie erste erfahrungen, 03 2017.

[SEG18] Sandra Schön, Martin Ebner, and Maria Grandl. Designing a Makerspace for Children - Let's Do It, 2018.

[SER16] Sandra Schön, Martin Ebner, and Ingrid Reip. Kreative digitale Arbeit mit Kindern in einer viertägigen offenen Werkstatt. *Medienimpulse*, 2016(1), 4 2016.

[Tho14] AnnMarie Thomas. *Making makers: kids, tools, and the future of innovation*. Maker Media, Inc., 2014.

[thy] Thymio and Aseba, [online]. `https://www.thymio.org/en:thymio`. [29.01.2019].

[top] Top Ed-Tech Trends of 2012, [online]. `http://2012trends.hackeducation.com/maker.html`. [29.01.2019].

[UR15] Daniela Ulicna and Rue Royale. Does the EU need more STEM graduates?, 2015.

Acronyms

DIY

Do-It-Yourself

ICT

Information and Communications Technology

MIT

Massachusetts Institute of Technology