Supporting Tool for Moderation in the Grading Process of Summative Assessments

Design and Prototype of a Software Tool for Moderation and Assessment with Variable Rubrics

Master Thesis

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Tool zur Unterstützung der Moderation im Bewertungsprozess Summativer Assessments

Entwurf und Entwicklung einer Software für Moderation und Assessment mit variablen Rubriken

Diplomarbeit

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Abstract

Nowadays, the growing amount of universities leads to a need of certification of the quality of these institutions for helping students in choosing a certain university. Therefore, so-called quality assurance agencies prove and certify the quality of educational institutions. One of the most important points to assure the quality is how a university treats the fields of teaching, learning and assessment.

In order to support students in their learning progress it is expected to help them wherever possible. The strategy of formative assessment becomes more and more important as an effective method to diagnose and support students best. Changings in life and society in the 21st century are caused by the influence of the global world and technology enhances nearly everything in our modern world. Due to this fact, there is no wonder that the use and support of technology in higher education and learning settings is increasing and provides a lot of opportunities for modern life's education.

The theoretical part of this thesis concentrates on the need and accountability of quality assurance in higher education. Furthermore, technology enhanced learning as an existing field of any university is elaborated. Assessment as an integral part of learning forms the main part of the theory presented. Different strategies and methods of assessment to support and measure students are declared. Finally, the focus is on e-Assessment and existing systems.

Based on the findings of the theoretical part of the thesis the practical part defines the requirements for a software tool to combine formative (in form of feedback) and summative assessment. The tool should support students in their learning process by providing appropriate, consistent and immediate feedback on their performance. Together with the requirements of a well-developed software these requirements are implemented within a prototype. This prototype should ease the process of assessment for teachers and support students in their learning progress. A user study to evaluate the implemented software was conducted and showed that teaching staff could save a lot of time in the assessment process.

Kurzfassung

Heutzutage steigt die Anzahl an Universitäten ständig an und das führt zu einer Notwendigkeit, die Universitäten bezüglich ihrer Qualität zu zertifizieren, um den Studenten bei der Auswahl der Universität zu helfen. Eigens dafür gibt es Agenturen, welche die Qualität prüfen. Die Bereiche Lehren, Lernen und Bewertung sind die wichtigsten in Bezug auf Qualitätssicherung im Hochschulbereich.

Um Studenten bestmöglich in ihrem Lernprozess zu unterstützen wird jede mögliche Hilfestellung der Universitäten verlangt. Dabei erlangt die Strategie von formativen Assessment immer größere Bedeutung als Methode zur Diagnose und Unterstützung der Studenten. Gründe für die Veränderungen im Alltag und der Gesellschaft im 21. Jahrhundert ist die globale Welt und Technologie wird nahezu überall verwendet. Aus diesem Grund ist es nicht verwunderlich, dass auch die Unterstützung und Verwendung von Technologie im Hochschulbereich und Lernsituationen ansteigt und eine Menge an modernen Bildungsmöglichkeiten bietet.

Der Theorieteil der Arbeit konzentriert sich auf die Notwendigkeit und Verantwortlichkeit der Qualitätssicherung im Hochschulbereich. Weiters wird technologiegestütztes Lernen als bestehender Bestandteil nahezu jeder Universität behandelt. Bewertung ist ein integrierter Bestandteil des Lernens und formt den Hauptteil der Theorie. Verschiedene Strategien und Methoden zur Beurteilung und Unterstützung von Studenten werden aufgezeigt. Am Ende liegt der Fokus auf e-Assessment und vorhanden Systemen.

Basierend auf Erkenntnissen der erarbeiteten Theorie definiert der praktische Teil Anforderungen an eine Software, welche formative und summative Bewertung kombiniert. Das Programm soll Studenten unterstützen, indem es passendes, konsistentes und schnelles Feedback in Bezug auf ihre Arbeit liefert. Zusammen mit den Anforderungen an eine gut entwickelte Software bilden sie die Basis und werden in einem Prototyp implementiert. Der Prototyp sollte den Bewertungsprozess für Lehrpersonal erleichtern und Studenten bestmöglich unterstützen. Durch eine Benutzerstudie zur Evaluierung der Software konnte gezeigt werden, dass eine Zeitersparnis für das Personal erzielt werden kann.

Statuary Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources and resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

<u> Graz, January 26, 2011 </u>   <u>   </u>
     date   signature

Notes of Thanks

The biggest thank you is for the most important people in my life. My family, girlfriend and closest friends supported me in any possible way during the whole study, that had several ups and downs. They also supported me in my decision for doing a part of the thesis in Perth, Australia.

Concerning the time when I was working on my thesis I want to thank all the university staff who worked with me. Especially my two supervisors, Univ.-Doz. DI Dr.techn. Christian Gütl and Associate Professor Dr. Heinz Dreher supported me in every possible way during this time. As it was very difficult to get used to working in a foreign country, I also want to thank Muriel Bijoux and Naomi Dreher representative for the whole department of Curtin Business School for well-integrating me in the daily schedule. It was challenging and interesting to work in an international research team and therefore I am very glad.

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Chapter 1

Introduction

Life and society in the 21st century are changing rapidly and strongly influenced by facts caused from the global world. Fast development and change of information or technology that enhances nearly everything in our modern lifestyle are just some of these facts. The educational system is no exception and has changed as well over recent years. As a fact, the use and support of technology in higher education and learning settings are increasing which provides a lot of possibilities for modern education (AL-Smadi & Gütl, 2008; Gütl, 2008).

Using the new information and communication technologies in the educational process provides many opportunities. Especially e-Learning and e-Assessment are very popular these days. In order to support students in their educational development it is very important to concentrate on the communication between students, teachers and tutors. Another key factor of effective teaching and learning is to provide feedback to students whenever possible for a better support and development of students (Bransford, Brown, & Cocking, 2000).

> ”E-assessment enables feedback to be delivered instantaneously.
> This provides an opportunity for students to take immediate action
> to 'close the gap' between their current level and a reference point,
> and thus for the feedback to be effective”(Jordan & Mitchell, 2009)

Due to the fact that e-Assessment provides several opportunities for summative assessment as well as for formative purposes it is very important to see both of them as an interconnected approach. The concentration should be on both of them in order to support students best.

The aim of this thesis is to develop a prototype for a software tool that combines summative and formative assessment for several types of assignments.

In order to support students best (see citation above), the main goals for the tool are the preparation and delivery of appropriate, consistent and immediate feedback regarding students' work. The project within this thesis is a cooperation of Curtin University of Technology (Perth, Western Australia) and University of Technology (Graz, Austria).

1.1   Motivation and Objective of the Project

In order to the growing amount of students and nearly constant teaching staff it is important to reduce the time spent on assessment for both formative and summative purposes. The challenging part in this field is the improvement of quality of assessment regarding consistency, fairness and other relevant facts. To reach this it is important to concentrate on new information and communication technologies (ICT) in order to develop new systems that make teaching, learning and assessment easier.

Special attention should be paid to the communication between students and teaching staff. To support students best in their learning process it is helpful and necessary to get appropriate and immediate feedback on performances in order to react in time for upcoming exercises. Therefore, the aim of this thesis is to develop a prototype for a software tool that would enable instantaneously, consistent and fair feedback combined with an integrated possibility of grading.

1.2   Structure of Work

Generally, the thesis consists of two different parts, a theoretical part and practical part. Chapters 2, 3, 4 and 5 describe the theoretical part and Chapters 6 and 7 concentrate on the practical part. Below a short overview of the content of every chapter will be given.

In Chapter 2 the need of quality assurance in higher education is shown and the focus is on the fields of teaching, learning and assessment. With the growing amount of universities it is necessary for them to provide certificates to guarantee high quality education. In this case, they ease the students' decision in preferring them against other universities. National and international agencies are for proving this quality and certificate them for good approaches in QA.

Due to the fact that technology is improving and gets more and more involved in teaching and learning, the focus of Chapter 3 is on technology enhanced learn-

ing (TEL) in higher education. e-Learning as a key phrase in the fields of education is the most common part in TEL but as Dichanz and Ernst (2001) mention in their article, learning is an individual and active process. Learners need to know this to deal with the fact that technology and e-Learning can support them in their learning. But they also need to recognize that they have to learn in order to obtain a learning goal no matter what technology they use for support.

As learning is one of the most fundamental parts in someone's life it is also very important to measure this learning. Assessments for summative and formative purposes are essential for supporting students in their learning behavior (Bransford et al., 2000, p. 232) and in Chapter 4 all about assessment will be presented.

In order to support students adequately in their learning process it is important for them to get timely, consistent and appropriate feedback as well as clear and transparent marking schemes. e-Assessment is one way that can guarantee and help to reach this goals and Chapter 5 will concentrate on several forms of e-Assessment as well as existing software on this sector.

With Chapter 6 the practical part of the thesis begins. Based on the findings from previous chapters, especially according to the findings made on existing software in this fields, the requirements for the prototype are defined. Out of these matters the conceptual design of the prototype is described.

Chapter 7 describes the development and implementation of the prototype based on the requirements and design presented in the previous chapter. After showing the usage of the software tool the focus is on evaluating the tool. This happens with a qualitative user study in form of a thinking aloud test. Regarding the evaluation of the tool the research questions are presented as well as the methodology and termination of the user study. At the end of the chapter the findings regarding evaluation and development are shown.

Finally, Chapter 8 includes the lessons learned and the last one, Chapter 9, shows a conclusion of the whole thesis and presents an outlook.

Chapter 2

Quality Assurance in Higher Education

The quality of an educational institution is highly sensitive and needs to be transparent. With the growing amount of universities and colleges it is very important for the customer (student) to know about the quality of these institutions for making the right choice. In this chapter the focus is on defining the term *quality* in the context of higher education and finding the most important points to assure the quality.

After listing the basic terms regarding quality assurance in higher education (HE) one main point of this chapter will be to outline, that universities themselves are responsible to guarantee high quality and progress on this sector. External agencies have the job to evaluate if a university is doing well regarding to assure high quality. They determine, if there still need to be work done to provide high quality education and certify educational institutions that that meet different standards.

2.1 Definition and Meaning of Quality Assurance in Higher Education

The term *quality assurance (QA)* is often mixed up with the term quality control which means the testing of results. The difference to quality control is that QA includes any activity that is needed to provide and guarantee effective service for students during the whole educational process till the graduation which is the end of a student's life cycle (Mrozek, Adjei, & Mansour, 1997, p. 157).

The widely used definition of quality assurance also used in the industry consists of the four following components (Fraser, 1992, p. 10-11):

1. Everyone in the university is responsible for keeping up the quality of the service or product.

2. Everyone in the university is responsible for enhancing the quality.

3. Everyone understands, feels and uses ownership of the system that are in place for maintaining and ensuring the quality.

4. The management or some external check the validity of the quality assurance system.

If a university practices quality assurance seriously based on the four points from above, then the educational institution is a self-critical community of staff and students. They all strive for a continuous improvement and therefore assure the quality of the university (Fraser, 1992, p. 11).

2.2   Motivation for Assuring the Quality on the Educational Sector

The question regarding the motivation for quality assurance in higher education is often answered by using one keyword: *Accountability* . But what is meant by accountability and for whom? The triangle in Figure 2.1 shows the three different groups universities are accountable for.
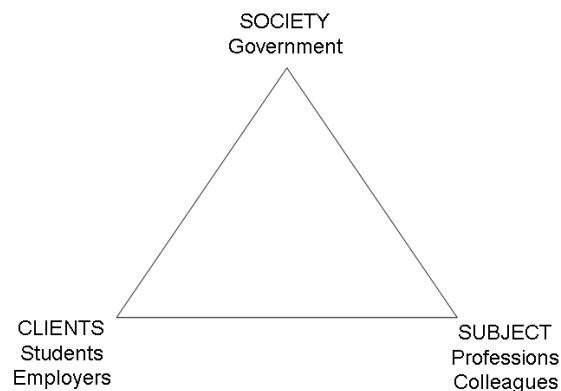
Figure 2.1: Accountability in higher education (Fraser, 1992, p. 17)

Accountability to Society
Higher education institutions need money to exist and improve their quality and in most countries this money comes from the government through student fees or fundings. In fact, the society is paying for higher education because the main part of the money comes from fees the society is paying. Regarding to the fact that society is paying for higher education the government has a responsibility to society to ensure that the universities provide value for this money. Therefore, society needs the assurance that the development of the universities is not failing (Fraser, 1992, p. 16-17).

Accountability to Clients and to the Subject
Students and employers of graduates are the clients of higher education and they want to get the best possible education available. After successful graduation students want to get a certification to show their reached knowledge and competences in the business world. The subject is the third corner of the triangle and here teachers are accountable for a positive development of their students to reach the expected outcome (Fraser, 1992, p. 17).

2.3 How to Assure the Quality of Universities

There are many characteristics for the quality of a university and in this section the focus is on how to assure the quality. Starting with the self-evaluation of a university the further subsections will discuss what an accreditation of a university is and what it is for.

2.3.1 Self-Evaluation

The practice of quality assurance within universities has always to be done by the universities themselves. Self-Evaluation is the basis for assuring the quality, inspection from outside would not work. It is not easy to evaluate oneself but Fraser (1992, p. 18-19) names three aids that make self-evaluation possible. The first one is external assistance to get assistance in being self-critical and reflective enough. The second aid includes special staff training to prepare for the task of self-evaluation. Finally, there is a need of national and international indicators that describe qualitative and quantitative performance of the university in the context of teaching, learning and assessment. A typical indicator is information about the teaching staff and students regarding experience and qualification. Another one is the output of the university, for example international and national

comparison of examination results or the students' viewpoint five years after graduation.

The key for meaningful and professional self-evaluation is a detailed documentation of all the processes regarding teaching, learning and assessment. If the university has a good documentation they can compare the development of the institution and make changes in the process if needed.

2.3.2   Accreditation

There are many different definitions of what accreditation is. In the American meaning both, a programme or institution, can be accredited. Fraser (1992) quotes Chernay (1990) for the definition of accreditation:

> "Accreditation assures that an institution or programme (a) has clearly defined and educationally appropriate objectives, (b) maintains conditions under which their achievement can reasonably be expected, (c) is in fact accomplishing them substantially, and (d) can be expected to continue to do so."

It is important to mention that in this definition there is no need to meet any threshold standards of the objectives. The definition is from the Northern American area and in many other countries the addition phrase to this definition is that the objectives of the institution or programme meet at least a threshold standard (Fraser, 1992).

2.3.3   Accrediting Institutions

When speaking about accrediting institutions or accrediting agencies, Fraser (1992) differs into three different institutions doing the accreditation of a higher education institution. The classification is done by who is running the accrediting institution:

1. **University Owned Agencies**, for example "Committee of Vice-Chancellors"

2. **Governmental Agencies**, for example "Deutsche Forschungsgesellschaft"

3. **Non-Governmental Agencies**, for example "European Foundation for Management Development"

As already mentioned there are hundreds of different accrediting institutions or agencies and all of them have a certain accrediting methodology and different standards they require to be followed. A university or other higher education institution can reach more than one of these standards or get accredited by more than one agency. Of course, it is better to have more standards reached and for the international competition it is obviously an advantage to get accredited by institutions from all over the world (for example to meet the standards of an European and American institution). Hereafter, some of the most important and most reliable accrediting agencies are described with its standards.

AACSB - Association to Advance Collegiate Schools of Business[1]
The AACSB is an association of educational institutions, businesses and several other organizations which are advancing the management education. This association is also a popular accrediting agency for educational institutions and programmes all over the world (AACSB, 2010).

AUQA - Australian Universities Quality Agency[2]
The AUQA is a non-profit organization of Australia. This organization's function is to promote, audit and report the quality of the higher education in Australia (AUQA, 2010a).

EFMD - European Foundation for Management Development[3]
The EFMD is one of the most popular accrediting institutions in Europe and recognized all over the world as an accreditation agency of quality in management education. It provides three different types of accreditation (EFMD, 2010b):

- **EQUIS (European Quality Improvement System):**
  This kind of accreditation is one of the leading international systems of quality assessment, improvement and accreditation of higher education institutions in management and business administration (EFMD, 2010d).

- **EPAS (European Programme Accreditation System):**
  EPAS is a programme accreditation and was introduced in 2005 for institutions that want to have a certification for the excellence and successful internationalization of their academic programmes (EFMD, 2010c).

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[1]`http://wwww.aacsb.edu/`; visited on November 30th 2010
[2]`http://www.auqa.edu.au/`; visited on 30th November 2010
[3]`http://www.efmd.org/`; visited on 30th November 2010

- **CEL (Programme accreditation for teChnology-Enhanced Learning):**
  CEL is another programme accreditation especially for technology enhanced learning programmes to raise the standard that vary widely. Reason for the varying quality is caused by the quality of different products and programs in the field of information and communication technology (EFMD, 2010a).

ENQA - The European Association for Quality Assurance in HE[4]
The ENQA is not just an accrediting agency. It is an association that propagates information and good practices regarding the field of quality assurance in HE. ENQA provides a standard for quality assurance agencies, public authorities and institutions in higher education (ENQA, 2010).

QAA - The Quality Assurance Agency[5]
QAA is a quality assurance agency placed in the UK which checks if the educational institutions meet their responsibilities. They also identify what good practice is and help the institutions to elaborate procedures to improve their quality. The QAA also provides useful guidelines for the development of effective systems that students have the possibility of high quality experiences (QAA, 2010).

2.4 The Different Standards for Quality Assurance in Higher Education

As already mentioned in Section 2.3 there are several accrediting institutions and every single one has a manual about what the meticulous documentation of the system and methodology of quality assurance practiced in an institution of higher education should include. The aim of this section is to show the similarities of these different standards for identification of the most important points of QA in higher education.

2.4.1 How the Different Standards Describe QA in Teaching, Learning and Assessment

The one true standard for quality assurance is not easy to find or define and therefore, the competing accrediting agencies provide unique definitions or guides and

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[4]http://www.enqa.eu/; visited on 30th November 2010
[5]http://www.qaa.ac.uk/; visited on 30th November 2010

manuals for describing their point of view. Of course, all the manuals include different parts regarding the quality of universities, but this section will concentrate on facts in the area of teaching, learning and assessment - all essential for the students' outcome.

The research result about the different standards is given in the following subsections. Usually, every institution provides their standard in so called audit manuals or guidelines. The results show every agency with the reference to the document of their standard and the most important findings then are listed.

2.4.1.1 AUQA: Audit Manual Version 7.1

The AUQA provides a detailed framework for a well organized quality assurance system. Appendix E of the document shows a framework that should be used to guarantee quality regarding evidence, standards and outcomes (AUQA, 2010b, p. 95-98):

- **Assessment and Grading of Students:**
  In the assessing procedure of students it is important to focus on transparency of assessment criteria and procedures for moderation of assessments. The criteria for assessment should be clearly defined and the different methods used for assessment should be clearly documented.

- **Curriculum and Courses:**
  The relevance and quality of courses should be monitored and reviewed and the consistency of courses across equivalent programmes should be guaranteed.

- **Quality of Teaching and Learning:**
  A clear definition and strategy to improve and ensure the quality of teaching and learning within the educational institution should be provided.

- **Learning Support and Resources:**
  The focus here is on appropriate support and contact with the student as well as providing high quality student services, for example learning services and IT support. The integration of e-Learning into courses and training and support strategies for both, students and teachers, should also be an integral part for reaching the expectations of the outcome.

2.4.1.2   EFMD: EQUIS Standards and Criteria

This standard provides a detailed documentation about the information that an educational institution has to give regarding the assessing procedure of students. The listing below shows the most important points from Chapters 3 and 4 of the manual developed by this accrediting agency (EFMD, 2010e, p. 20, 25-32):

- The description of the assessment system a university is using should be described as detailed as possible, including all information for grading and monitoring students' work and progress.

- Course preparation and progression: an explanation of how the university prepares students before the entry into a course should be given and it is also important to know what a university is doing for students with problems in meeting the requirements.

- Supporting systems for students in their learning process should be used and described for a successful accreditation.

- Programme evaluation: programmes need to be evaluated from time to time so they can be adopted for better suiting to the needs of the market and participants.

2.4.1.3   ENQA: Standards and Guidelines for QA in HE

The main points of meeting the requirements for a well designed quality assurance system within a university are (ENQA, 2009, p. 15-19):

- Approval, monitoring and reviewing of programmes provided by a university is very important. One big part of the monitoring should be the recognization of the students' progress and to always improve a programme to the changing needs of society.

- Assessment of students has to meet the needs of the expected outcome. It is also necessary that clear and transparent marking criteria are published. The regulations for circumstances of illness or absence should also be defined.

- Students should be supported and informed by existing resources and information systems. To get accredited a clear structure of this practice should be given.

2.4.1.4   QAA: Code of Practice

The *Code of Practice* provided by the QAA is a standard for assuring academic quality and standards and is made up as a manual consisting of 10 sections. Section 6 of this manual is interesting for the fields of teaching and learning in higher education and some interesting points can be found below (QAA, 2001):

- The integration of the different types of assessment (diagnostic, formative and summative - see Section 4.3) into the teaching process are essential and should be designed in a way that students can show what they do to reach the expected outcome.

- All decisions regarding assessment should be documented and discussed to always improve the students outcome a university wants to reach.

- The marking and grading of students' work should be clear and fair and therefore concrete grading schemes and moderation should be used in the process of assessment.

- To support students in their learning progress they should get appropriate feedback to submitted work as soon as possible. The university needs to clarify if they are doing so and how.

2.4.2   Similarities of the Different Standards

In Subsection 2.4.1 the most important points of quality assurance regarding teaching, learning and assessment in higher education required from the different accrediting agencies are described. But what kind of points do all of them have in common? In this thesis the focus is on assuring the quality in the assessing procedure of students to meet their needs in reaching the wanted progression and therefore the following points are essential:

- Clear and transparent assessment criteria for consistency and to inform students what is wanted by the university to reach the expected outcome.

- Appropriate and instantaneously feedback regarding students' work and performance during the semester to support students in their learning progress rather than just giving grades and marks at the end of a semester.

- Continuous improvement of the quality of the programmes and courses by monitoring and comparing the progress.

- Making changes in programmes and courses to meet the changing needs of our society.

2.5   Summary

The assurance of quality in higher education is very important, especially nowadays, when there are continuously increasing amounts of universities and other higher education institutions. Another reason for having a well organized QA system is the accountability to society, clients and the subject. As described in this chapter, QA is a detailed documentation or plan of all the processes in an institution regarding quality and it is important to follow this plan to guarantee the quality.

A university is responsible for the quality of its institution, but there are so-called accrediting agencies to check if and how they do so. If a university gets accredited by such an agency it has the approval, that it is practicing quality assurance in a way to meet the requirements of the standard provided by this agency.

Similarities in the different standards provided by the agencies are obvious and focusing on guaranteeing the quality of the students' outcome - permanent improvement in the fields of teaching, learning and assessment to reach this goal. Therefore, clear and transparent assessing procedures and the practice of formative, diagnostic and summative assessments are essential. One of the most important points is the support of students, so they can reach the expected outcome. A fundamental strategy to do so is the moderation and supply of timely and appropriate feedback (see Section 4.3) to positively influence the learning behavior of students.

As a fact, our society has rapidly changed over the last decades. Almost everybody grows up with different kinds of technologies. All of them are surrounded by technology and especially the young generation, also known as net generation (Gütl & Chang, 2008; Brahm & Seufert, 2007), wants to use the new information and communication technology in nearly any situation. According to the aim of assuring the quality of learning, teaching and assessment the focus has to be more and more on technology enhanced learning (TEL) and the next chapter will deal with this field.

Chapter 3

TEL - Technology Enhanced Learning

This chapter focuses on one of the most fundamental processes of an individual's life, the process of learning. Based on the fact, that technology is improving continuously and is used more and more in the educational sector, there will be a closer look on technology enhanced learning (TEL) and e-Learning. At the beginning there is a discussion about the most important terms regarding learning and with this knowledge then the detailed explanation of TEL and e-Learning will follow.

3.1 Motivation for Technology Used in Teaching and Learning

New technologies influence life in any possible way and also in the fields of education and learning it is important to use such new technologies appropriately. The new information and communication technologies (ICT), as it will be described in Subsection 3.3.1, should be seen as a media and also as an opportunity to enhance both, the learning of teachers and administrators as well as the learning of students.

Bransford et al. (2000, p. 207) name five ways how new technologies can be used:

- Development of new curricula based on real-world problems.

- To enhance learning, more and better tools should be provided.

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- Feedback, reflection and revision are important points of effective teaching and learning and therefore every institution of higher education should reach a good level to guarantee this.

- Organization of communities where students can communicate with other students as well as teachers, administrators or practicing scientists.

- Give teachers the opportunity for further development by using new technologies.

In the listing above Bransford et al. (2000) figure out the huge possibilities on the educational sector and in the further thesis the main focus will be on points three and four. For students it is very important to get appropriate feedback to their work to improve further development. This fact, combined with the decreasing presence time on campus caused by different reasons (for example, job or distance study), is an important reason for improving technology enhanced learning and e-Learning in higher education.

3.2   Basic Terms Regarding Learning

In order to get familiar with the things and terms regarding learning there will be an explanation of the most important terms within this area first. In this introductional section it is important to get familiar with the basics like what knowledge or learning is. Another focus in here will be on the different learning theories (see Subsection 3.2.3) and types (see Subsection 3.2.4).

3.2.1   From Data to Knowledge

In the context of teaching and learning it is very important to understand the differences and relations between data, information and knowledge. A short description of all the terms is given below (Gadomski, 1999; Holzinger, 2000):

- **Data:**
  Is every single thing that can be transformed in a computational processes.

- **Information:**
  Is data with a special meaning. For example, some numbers collected are data, but if the meaning of these numbers is connected to an address of a person than the meaningless data becomes an information.

- **Knowledge:**
  Is far more than just information. It can be generated from simple information.

To form knowledge out of information Gadomski (1999) speaks about the I-P-K (information, preferences, knowledge) conceptualization. The part of the preferences here is the logic, the intelligence to form knowledge out of information. Holzinger (2000) uses another term for these preferences, especially in order to the learning process of people: the cognitive process. Regarding to teaching and learning this means that teachers just give information to their students and the students themselves are responsible for processing the information they get. The connection between all this terms is also shown in Figure 3.1. An important fact is the preexisting knowledge of each student. This preexisting knowledge is deciding if the student is able to form a cognitive connection based on the information given. At last, every student is responsible for gaining knowledge.
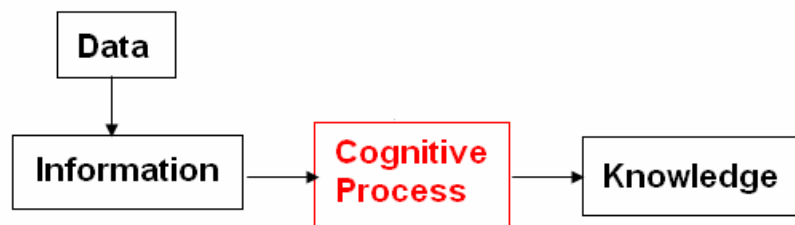
Figure 3.1: The way from data to knowledge (adopted from Gadomski (1999) and Holzinger (2000))

3.2.2 Types of Knowledge

After discussing the facts above the way from simple raw data to knowledge is known. But there are still differentiations to make regarding the kind of knowledge somebody has reached. Based on a literature research done by Gorman (2002) there are four different types of knowledge:

- **Declarative Knowledge:**
  Scientists call this kind of knowledge declarative because of referring to memory for facts and events. Sometimes the term factual knowledge is used instead and is characterized by the fact that somebody is knowing something. The factual knowledge is stored in the brain and the person

knows that he or she knows it. This knowledge then can be used if necessary. One big problem of this type of knowledge is the huge amount of information nowadays. Based on this fact, it is sometimes more important to know where to find an information than really knowing it, so this could be the consequence of effective education.

- **Procedural Knowledge:**
  Whereas declarative knowledge stands for *knowing that*, procedural knowledge stands for *knowing how*. This changing is based on the fact that people associate things for their factual knowledge and the understanding becomes better and better. Other names for this kind of knowledge are *know-how* or *skills* of a person.

- **Judgment:**
  A further increase of the level of knowledge is judgment. Judgment means that people are able to make right decisions regarding a problem based on the solution of earlier problems they have already solved or known. First they need to identify the problem as a similar one they had before and then use a known procedure to solve the problem.

- **Wisdom:**
  This kind of knowledge is related to judgment but it is more *knowing why* than just *know when*. First it is important to identify the problem as a well-known preexisting one and then reflect the possible ways of solution. The difference to judgment is thinking about a better solution and coming up with a new strategy for the similar but not identically new problem.

Once the different types of knowledge are discussed, the main question should be: What kind of knowledge is the best to use? It seems obvious to say that wisdom should be used, if possible, but it is not as easy to say. The kind of knowledge to use for solving a problem depends on the problem and of course the grade of knowledge of the individual. For example, nobody needs judgment or wisdom to be able to brush the teeth but for solving a mathematical problem you may need it if you are familiar with using it.

3.2.3   Learning Theories

Prior to describe the learning theories we need to think about the word learning. What is *Learning* in the educational sector?

Lefrancois (1994, p. 3) defines learning as all behavioral changing because of personal experiences. Variation in behavior because of genetic or fake chemical reasons (e.g. changes in the course of drug or alcohol consumption) are excluded by this definition.

When talking about learning theories, there are three major ones: behaviorism, cognitivism and constructivism. It is very important to understand that there is no best learning theory. Every single one of those learning theories has its strengths and weaknesses, but it depends on the learner and, of course, the things to learn to figure out what is the best to use (Schumann, 1996; Ebner & Holzinger, 2002).

Schumann (1996) gives a short description of these three learning theories:

- **Behaviorism:**
  Is based on visible changes in behavior and therefore focusing on new behavioral patterns, which become automatic after repeating.

- **Cognitivism:**
  Contrary to the behaviorism it is not focused on behavioral changes but in the thought process behind, so it indicates what is happening inside the learners's mind.

- **Constructivism:**
  Focuses on preparing the learner to problem solving through individual experience (all learners construct their own perspective of the world) and schema.

3.2.4 Different Types of Learning

There are many existing models for the different types of learning but the most common are introduced by Benjamin S. Bloom and Robert Gagne. The following subsections will give an overview for both of them.

3.2.4.1 Bloom's Taxonomy

Taxonomy is another word for classification and Bloom's classification was first published in 1956 by Dr. Benjamin S. Bloom, an academic and educational expert. In its initial meaning this taxonomy was first created for academic education (for assistance in the design and assessment of educational learning), but then it

became clear that it was relevant for all types of learning (Milatzo, 2009).

The model that Bloom defined consists of three overlapping domains:

- **Cognitive Domain:** describes the intellectual capability

- **Affective Domain:** includes emotions, feelings and behavior

- **Psycho Motor Domain:** physical skills

Every domain consists of different levels and the important part of Bloom's Taxonomy is that a level can only be reached if the levels before are mastered. In Table 3.1 the levels of the three domains are shown. ´

Cognitive Domain	Affective Domain	Physical Domain
1. Recall Data 2. Understand 3. Apply (Use) 4. Analyze (structure/elements) 5. Synthesize (create/build) 6. Evaluate (assess, judge in relational terms)	1. Receive (awareness) 2. Respond (react) 3. Value (understand and act) 4. Organize Personal Value 5. Internalize Value System (adopt behavior)	1. Imitation (copy) 2. Manipulation (follow instructions) 3. Develop Precision 4. Articulation (combine, integrate related skills) 5. Naturalization (automate, become expert)

Table 3.1: Bloom's Taxonomy (Milatzo, 2009)

3.2.4.2 Classification of Gagne

Robert Gagne gives another classification of the different types of learning. These classification describes the levels in increasing order of complexity. He has a similar opinion as Bloom about the different levels regarding the precondition of

knowing the easier ones to reach the levels of higher complexity. As described in Tücke (2004, p. 137-140), Gagne (1973) classified learning types into the eight levels as listed below:

- **Stimulus Recognition:** is the description of a conditional reaction, that means if event X is happening, Y will follow.

- **Response generation:** increased learning, that means to learn when the reaction should happen and when it should not.

- **Procedure Following:** is continuously learning; combining of two or more elements.

- **Use of Terminology:** similar to procedure following but combined with internal reactions.

- **Discriminations:** is the type of learning where the learner needs to associate animals, chemical elements or similar things with certain names.

- **Concept Formation:** is the abstraction of a procedure learned in an internal representation.

- **Rule Application:** uses the learned stuff based on internal rules.

- **Problem Solving:** the learner is able to control his or her environment with the rules gained - 'thinking' is the keyword in this context and means to solve problems with the rules learned and combining them.

3.3 e-Learning and Technology Enhanced Learning: What is the Difference?

The educational sector in the last decades is dominated by new acquisitions like e-Learning or technology enhanced learning. Everybody is speaking about these new forms of learning but does really everybody knows about the meaning of these words? In this section the focus is on explaining *e-Learning* and *technology enhanced learning (TEL)* and figures out the advantages and possibilities for future learning as well as the problems and disadvantages coming with new technologies.

3.3.1   The Use of New Media

One of the catchphrases of new technologies as well as new learning methodologies is the use of new media. But what are new media? New media have always been influencing our society. In the 1970s there was the first hype about the use of the term new media. At this time new media was an umbrella term for all procedures and technological devices that use new, innovative technologies to extend the use of the old mass and storage media (like cable or satellite television) (Hüther, 2005, p. 346).

Nowadays, the term is particularly used to describe the digital, computer based multimedia technology. Especially the wide use of computer for work, entertainment or teaching and learning device became an integral part of the new information and communication technology. Hüther (2005) names the fundamental characteristics of new media as following:

- Digitality

- Networking

- Globality

- Mobility

- Convergence

- Interactivity

3.3.2   What is e-Learning?

There are many different and broad definitions of e-Learning, but one often used is by Micheal Kerres. In his opinion, we are speaking about e-Learning for all the learning situations, where digital media is used for presentation and distribution of learning contents or to support communication between people (Kerres, 2001, p. 13-14).

Stangl (2005) is more specific in his explanation. For his understanding e-Learning is a special kind of computer based learning where the learning systems and materials have following characteristics:

- Digital and online available.

- Distinguished by a high degree of multimedia.

- Have to support interactivity between learners, co-learners, system and teachers.

Furthermore he is writing that e-Learning is a learning strategy based on technology, especially on computers, which will take humans place in teaching. Learners should be self organized and independent in time and speed of learning. Although learning should become more efficient because of the lower long term costs and self organization, Stangl (1997) points the problems referring to the high self discipline needed by learners.

Strokely (2003), for example, writes that e-Learning is also called online learning or online training and his definition is the following:

> *"The delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material."*

Caused by the huge amount of different but very similar definitions, Ebner (2009) argues about what all of these definitions have in common. His opinion is that all of them use the word electronical or electronic in some variations.

The first use of the term leads back to the time where computer based training was invented. Then the same term e-Learning has been used for web based training or learning management systems. Regarding to the varying definitions and different uses of the term it is very hard to draw the line. Over and above that, the rapid change of the technology is another reason why e-Learning is so hard to define in just one way (Ebner, 2009).

3.3.3 TEL - Technology Enhanced Learning

As mentioned in Subsection 3.3.2 it is very hard to define e-Learning. So what to do with the term *technology enhanced learning (TEL)*? TEL in general is a broader field than e-Learning but there are better and unique definitions available. Technology enhanced learning means every form of teaching and learning where technology is used, not just computers or the internet. There is a long list of technology which includes of course the internet and computers as an integral part but also rudimentary electronic boards are meant when speaking about TEL. So it is obvious that e-Learning with its unclear borders is one possible part of technology enhanced learning and the main focus regarding this topic will be

on e-Learning because of improving technologies like web applications or others (Ebner, 2009; Dror, 2008).

Technology enhanced learning is an interdisciplinare, special field that is broadly influenced by following three subdivisions (Ebner, 2009):

- Pedagogic Science - for didactical design and the targeted use of technology in teaching and learning.

- Computer Science - information and communication technology as the main technology used.

- Human Computer Interaction and Usability Engineering.

As just described, technology enhanced learning and e-Learning as its most common form is teaching and learning through technology. But there is one important fact that has to be kept in mind: Learning is an active process and has always been one. Every learner needs to know that there is technology which can support one in learning in different ways but there is still the need to learn. There is no teacher, no tutorial and also no e-Learning that can replace this part (Dichanz & Ernst, 2001).

In further subsections the focus will be on e-Learning as a special and the actually most common form of technology enhanced learning.

3.3.4   Trends of e-Learning

Technology is always improving and by the reason of the increasing supply of better web applications, obviously the kinds of e-Learning methods are changing. Kleimann (2007) classifies e-Learning by three different levels of development:

- e-Learning 1.0

- e-Learning 1.1 (or e-Learning 1.3 as often used (Karrer, 2007))

- e-Learning 2.0

In the following subsections the different stages of development will be explained.

3.3.4.1 e-Learning in Versions 1.x

The first generation of e-Learning (e-Learning 1.0) is the simplest form of online learning. Learners can download lecture notes from a homepage or CD-Roms are provided. In the Mid-1990s e-Learning changed and based on new technologies more variegated learning scenarios have been used. WBTs (web based training), virtual laboratories, online seminars and e-Assessments are only some of them (Kleimann, 2007).

But e-Learning 1.0 and 1.1 or 1.3 have a very important thing in common: The content of these two kinds of e-Learning comes from people who have some expertise in learning design and presentation. They all also have a lot of learner-empathy which is the main contrary to e-Learning 2.0 (Thalheimer, 2008).

3.3.4.2 Web 2.0 and e-Learning 2.0

With the further development of the internet the term e-Learning 2.0 was born and has been used as a collective name for Web 2.0 applications in learning or distance learning environments (Lambert & Kidd, 2008). Web 2.0 is well-known by everyone but where is the cut to Web 1.0. In the first generation users are browsing and searching the internet and in the second generation it changes to an environment where everybody can read and write to the web. Web 2.0 applications allow people to interact, collaborate and create content rather than just reading web pages (Coutinho, 2009). In Table 3.2 there are some main examples which show the differences between both versions.

As the previous explanations of the term Web 2.0 show it is not a new technology but an attitude. Gütl and Chang (2008) write that the concept of Web 2.0 *"addresses aspects of (1) Web technologies as a platform, (2) specific types of services and applications built on top of Web 2.0 technologies and (3) specific kind of development approach"*.

The most popular Web 2.0 applications are wikis, blogs, podcasts, virtual worlds and RSS feeds and all of them have improved the possibilities of learning in higher education. New ways of collaboration and communication are possible but also the richness of content and functionality is amazing. But there are not just advantages with e-Learning 2.0. Complexity is also increasing and therefore effective design of courses and pedagogical approaches are very important to guarantee the successful learning (Lambert & Kidd, 2008).

Karrer (2007) gives a good overview about the three e-Learning generations as seen in Table 3.3. There you can see the differences and it is also important

Web 1.0	Web 2.0
DoubleClick	Google AdSense
Ofoto	Flickr
Akamai	BitTorrent
mp3.com	Napster
Britannica Online	Wikipedia
personal websites	blogging
content management systems	wikis
page views	cost per click
screen scraping	web services
stickiness	syndication

Table 3.2: Examples for the differences between Web 1.0 and Web 2.0 (O'Reilly, 2005)

to understand that all the e-Learning generations will be used in the future; e-Learning 1.0 for content presentation or delivery for a big audience, e-Learning 1.1 or 1.3 for the opportunities of quick-hit learning or basic information transfers and the new e-Learning 2.0 for widely different learning needs.

3.3.5   Different Types of e-Learning

First e-Learning was meant to revolutionize the education but after some time experts recognized that computers alone cannot replace teaching and learning at traditional institutions of education. It rather helps to improve and support well-established forms of learning. Rawolle and Rohland (2008) names the most common types of learning used in the educational sector:

1. **Computer Based Training (CBT):**
   CBTs are multimedia learning programs delivered on CD/DVD or other storage devices. These programs enable independent learning via computer with one disadvantage: there is no way to keep the learning content up-to-date and therefore obsolete (Dittler, 2003, p. 12; Hilberg, 2008, p. 6).

2. **Web Based Training (WBT):**
   WBT is based on online learning and the possibility to communicate with other learners via mail, chat or forum to discuss and debate about the different learning topics (Dittler, 2003, p. 12; Hilberg, 2008, p. 6).

	e-Learning 1.0	e-Learning 1.1 or 1.3	e-Learning 2.0
Main Components	- course ware - LMSs - authoring tools	- reference hybrids - LCMSs - rapid authoring tools	- wikis - blogs - Add-ins - Mash-ups - tools for social networking and bookmarking
Ownership	top-down, one-way	top-down, collaborative	bottom-up, learner-driven, peer learning
Development time	long	rapid	none
Content size	60 min	15 min	1 min
Access time	prior to work	in between work	during work
Virtual meetings	class	intro, office hours	peers, experts
Delivery	at one time	in many pieces	when needed
Content Access	LMS	email, intranet	Search, RSS feed
Driver	ID	Learner	Worker
Content Creator	ID	SME	User

Table 3.3: Main differences between the versions of e-Learning (Karrer, 2007)

3. **Learning Management Systems (LMS) or Course Management Systems (CMS):**
   Further development of WBT leads to learning management systems which provide the learners much more learning opportunities, integrated features for discussions/questions and coaching functionality (Dittler, 2003, p. 12). There is a huge offer of LMSs, for example Moodle[1] or Blackboard/WebCT[2].

4. **Virtual Classroom or Seminars:**
   With this form of e-Learning it is possible to provide synchronous but

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[1] `www.moodle.org`; visited on May 11th 2010

[2] `www.blackboard.com` or `www.webct.com`, visited on May 11th 2010

location-independent teaching for many learners. The teacher presents the learning materials - without any restriction on media - and the learners can launch the presentation via internet stream. Virtual seminars guarantee the advantages of the face-to-face teaching, because learners are always able to interact with the teaching person (Dittler, 2003, p. 12-13).

5. **Rapid e-Learning:**
   Fournier (2006) discusses rapid e-Learning in his article and defines it as all the tools offered where creation of e-Learning or the conversion of PowerPoint into web-based learning content is automated. Rapid e-Learning guarantees a cost and time efficient way to produce learning content and is easy to learn and use.

6. **Blended Learning:**
   Procter (2003) defines blended learning as following: *"It is an effective combination of different modes of delivery, models of teaching and styles of learning"*. A possible and often mentioned combination when speaking about blended learning is the one of online and face-to-face approaches as shown in Figure 3.2. So it is possible to combine the pedagogical advantages of face-to-face teaching combined with all the possibilites of online learning, like additional learning material, blogs and wikis for group discussions and so on.
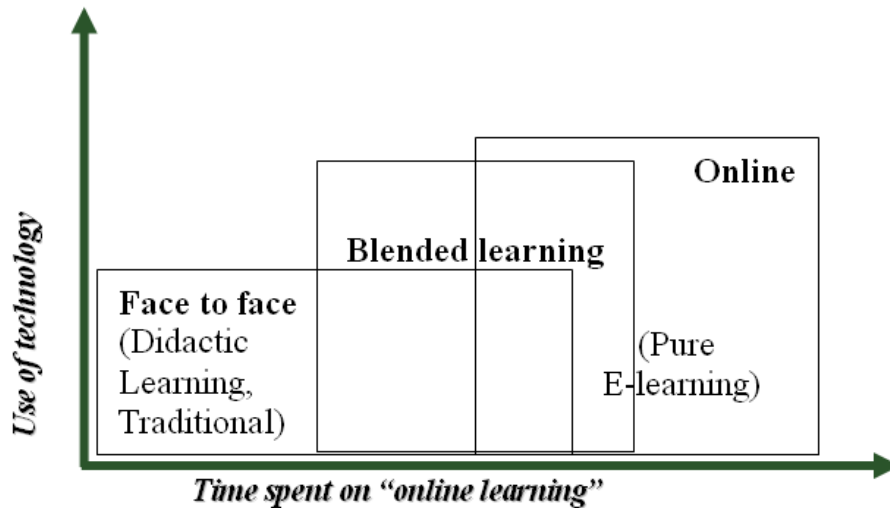
Figure 3.2: Concept of blended learning (Heinze & Procter, 2004)

7. **Learning Communities and Web-Based Collaboration:**
   These two kinds of e-Learning are getting more and more popular because of Web 2.0. Many people are learning or working on the same topic in a software environment provided, so collective and collaborative working is possible. Wikis, Blogs and other similar environments are just some examples (Rawolle & Rohland, 2008).

CBT (which is an obsolete form of e-Learning), WBT and Blended Learning are the most popular forms of e-Learning but with increasing technology, particularly Web 2.0, learning communities (Wikis, Blogs, etc.) seem to overtake (Rawolle & Rohland, 2008).

3.3.6 Pros and Cons of e-Learning

In the meantime e-Learning is an inherent part of higher education and universities try to convey knowledge in a better and more efficient way. The reason for the use of e-Learning in education are multifarious. Because of the tight study programs there is less time for other activities. Online learning helps learners to study at any time and place they want to and provides flexibility in education. The problem with many learners of different industrial sectors who need to learn at different places and times is not a problem any more. With a good choice of learning software and systems it is also possible to adjust the learning progress individually.

Another big advantage is the term of multimedia. With digitalization complex data can be prepared in a way that it is more understandable for learners and because of that fact efficiency of learning is increasing. It is also easier to look for relevant information, because searching functionalities and programs are becoming better and better. In addition, the cost factor is also often discussed. Therefore it is very profitable that knowledge can be published and distributed without growing costs (Tschumi, 2006; Schulmeister, 2006).

But there are not just good sides of e-Learning. A big disadvantage of online learning is the motivation of learners. Learners need to be self-organized and without any interaction to students the motivation is decreasing. For this case the online course has to be well-prepared and enough interactivity should be provided - blended learning is the best approach to guard against this problem.

With the beginning of e-Learning experts prognosticated lower costs, because less teachers are needed. But quite the contrary was the reality. People to support and guide learners, maintain the systems and so on are needed. All these

facts need to be analyzed and correctly managed, otherwise the costs are to high to use e-Learning in a profitable way (Tschumi, 2006).

3.4 Summary

Learning is one of the most fundamental processes in a person's life and with changing and improving technology the way of learning is changing as well. Technology enhanced learning is the key phrase used in the fields learning at the moment and will become even more important in near future.

Concluding to this chapter it could be said that teaching and learning in higher education is strongly influenced by the new information and communication technologies. But as Dichanz and Ernst (2001) discuss in their article, learning is an individual and active process. Every learner needs to know, that it is necessary to learn to reach a specific learning goal - no matter what kind of technology enhanced learning possibilities are available. e-Learning as the most popular form of TEL provides a wide range of possibilities and application in higher education as discussed within this chapter and it can be helpful and support learning, of course, but there is still the need of active learning and nobody can go around this hurdle.

As mentioned in this chapter learning is fundamental for a person's life and it is also very important to measure learning. That exactly is what educational institutions are doing and therefore assessment is nearly as essential as learning. But assessment is not just for measuring learning it also can be used for diagnostic or formative purposes. What can be said is that learning and assessment are two interconnected fields and there is no assessment without learning and the other way around.

> *"Assessment and feedback are crucial for helping people learn. [...] Assessment should reflect the quality of students' thinking, as well as what specific content they have learned."* (Bransford et al., 2000, p. 232)

As shown in the quotation above summative and formative assessments are an integrated part of learning and are for measuring students as well as helping them to improve their learning behavior. The following chapter (Chapter 4) will discuss and explain all about assessment regarding learning in higher educational institutions.

Chapter 4

Assessment in Higher Education

As mentioned in Chapter 3 the whole life is about learning. To get a clue, if people undertake valuable learning, it is important to measure learning in some way. Due to this fact the focus of this chapter is on one of the most contrived processes in our life - the assessment of the prior described learning.

Therefore, the assessment procedure is one of the most important parts of teaching and learning in higher education and essential for the students outcome. In this chapter the discussion is about why assessment is so important and what assessment exactly is. Furthermore, the main focuses in this part of the work are the different types of assessment and the aim of this chapter will be to find out which kind of assessment fits for the different purposes needed in higher education. Beside this another focus will be on identifying the issues and critical points regarding assessment, especially in terms of practice in higher education.

4.1 What is Assessment in the Educational Process? A Brief Definition

When speaking about assessment, an ongoing process is meant. Walvoord (2010, p. 2) defines assessment as the continuous collection of information regarding students learning activities. The information gathered are for using them to affect students learning in a positive way and therefore all the expertise, knowledge and resources available need to be used in the assessing procedure.

According to Northern Iowa (2006) assessment in higher education is a *"partici-patory, iterative process that:*

- *provides data or information you need on your students' learning*

- *engages you and others in analyzing and using this data or information to confirm and improve teaching and learning*

- *produces evidence that students are learning the outcomes you intended*

- *guides you in making educational and institutional improvements*

- *evaluates whether changes made improve or impact student learning, and documents the learning and your efforts"*

4.1.1   The Assessment Process as a Continuous Cycle

As mentioned above, assessment is a process with many different tasks. Martell and Calderon (2005) define successful assessment as a continuous cycle that include many different tasks with one big goal: to improve student outcomes. Figure 4.1 show the interaction and order of the different tasks involved in the assessment process.
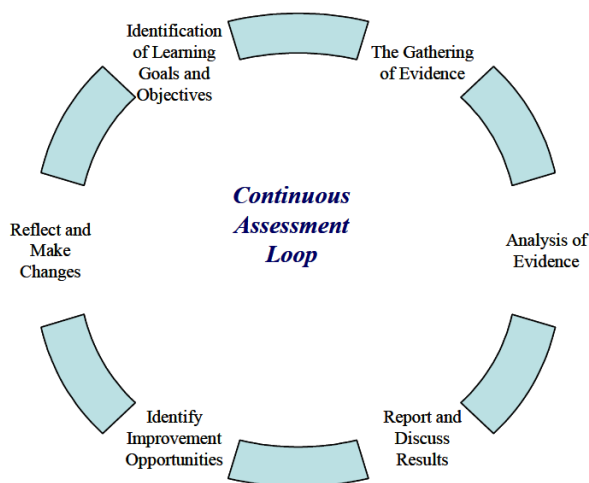
Figure 4.1: The cyclical process of successful assessment based on
Martell and Calderon (2005) cited in Buzzetto-More and Alade (2006, p. 256)

The first task is to identify the learning goals and objectives to know where the institution wants to go. After this step the collection, analysis and discussion of relevant data are important for making suggestions and implementations of improvements. The last step is the reflection of the changes made and to start with the first step again. By that the loop is closed which is essential for further positive development of the institution of higher education (Buzzetto-More & Alade, 2006).

The important parts in this process are the gathering and analysis of data. These data build the basis of the evaluation for all the learning goals and objectives. But not all the data collected is useful data in this meaning and therefore an effective data management is needed to guarantee a satisfying development of the institution (Buzzetto-More & Alade, 2006).

4.1.2   Seven Purposes of Assessment

Most of the people have a simple understanding of assessment. They see it as a collection of data for measuring students learning and giving them a grade at the end of a course or program but it is far more than that. According to Buzzetto-More and Alade (2006), Kellough and Kellough (1999) identified seven purposes of assessment as listed below:

1. Assist students and improve their learning.

2. Identification of the strengths and weaknesses of students.

3. Collect data for improving the effectiveness of specific teaching strategies.

4. Evaluate and improve the effectiveness of curriculum programs.

5. Evaluate and improve the teaching effectiveness.

6. Collection of administrative data that can be useful in making decisions.

7. Communication and involvement of parents and other stakeholders.

4.1.3   The Author's Classification of Assessment

There are many possible partitionings of assessment but the author concentrates on dividing the kinds of assessment into two levels which are indicated by answering one of the two following questions:

- **Who is assessing?**
  This question will be discussed in Section 4.2 and thereby the author writes about 'Types of assessment' in this meaning. Self-assessment, peer-assessment, collaborative and automated assessment will be mentioned according to that question.

- **What is the assessing process for?**
  Another section (see Section 4.3) discusses this question and states the answer as 'Strategies of assessment'. Hereby summative, formative and diagnostic assessments are the classifications made.

The next sections will show the different types and strategies of assessment and the author will show the important things in the context of teaching and learning in higher education.

4.2   Types of Assessment: Self-, Peer- and Collaborative Assessment

In this section the author gives the definitions for the terms of self-, peer- and collaborative assessment. They all will be needed in the following sections and therefore a clear definition for a good understanding is given. All the terms are widely-used and the author's definitions concentrate on its meaning in the educational sector.

4.2.1   Self-Assessment

According to Klenowski (1995, p. 146), the definition of self-assessment is *"the evaluation or judgment of the worth of one's performance and the identification of one's strengths and weaknesses"* . The identification of the strengths and weaknesses should be used for improving students learning and outcome.

Regarding the question why teachers use self-assessment in the education process a variety of answers are given. The most common answers found in a study are listed below (Ross, 2006, p. 2):

- The students engagement in assessment tasks increases when they are involved in the assessment of their own work. Especially when they get the opportunity to contribute to the criteria on which the work will be graded they are getting more enthusiastic.

- Using self-assessment is essential for getting students' interest and attention because it heads to more variety in methods used in the assessment process.

- When practicing self-assessment other important information are gathered by teachers, for example the effort students put in preparing for a task.

- The cost efficiency of self-assessment is higher than using other techniques.

- If students share responsibility for the assessment of what they have learned it is in evidence that they learn more.

4.2.2 Peer-Assessment

Topping (1998, p. 250) is the most common author cited when speaking about a definition of peer-assessment and he defines it as *"an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of the learning of peers of similar status"*. This explanation means that in an educational environment where peer-assessment is practiced students assess the quality of their fellow students and give feedback to each other.

Students learning behavior improves by assessing other works or when they study educational materials together. There is a lot of potential in peer-assessment but Topping also alarms about the difficulty to see the responsible factors for the effects of peer assessment. To avoid such complications it is important to have a consistent descriptional framework (Topping, 1998).

Teachers, tutors and students working collaboratively together in the assessing process may bring some advantages in this procedure. Some could be the decrease of staff workload and time spent on assessment. Other advantages may be the development of additional skills for students like communication and observation skills as well as self-criticism and self-evaluation (Al-Smadi, Guetl, & Kappe, 2010).

4.2.3 Collaborative Assessment

Collaborative Assessment, or co-assessment and cooperative assessment as often used as well, is a more traditional assessing procedure than self- and peer-assessment. Here the tutor or teacher plays an essential role in the assessing process. Dochy, Segers, and Sluijsmans (1999, p. 342) quote Hall (1995) and Somervell (1993) to describe co-assessment as a process of teaching and learning where students and staff are included. Students have the opportunity to assess themselves or to be integrated in clarifying objectives and standards but the

teacher or tutor has the control for final assessments.

Furthermore, there are three purposes identified by Hall (1995) as Dochy et al. (1999, p. 342) show in their article. The first one is the role-change of students from being a student to being a teacher where teachers play an essential role in providing their assistance for this process. A second purpose is to let students figure out how the assessing process works. This insight in the process helps them to act professionally when they are in the position to assess other students work. The third one is the development of special skills towards efficient and effective self-assessment which is also helpful for further educational development.

One of the main differences between collaborative assessment and self- and peer-assessment is the reason it is used for. Self- and peer-assessment are usually used for formative[1] purposes whereas collaborative assessment finds its use in the summative[2] way as well (Dochy et al., 1999, p. 342).

The main aspect of collaborative assessment is the combination of students and tutors or teachers in the assessing process. Another widely-used assessing practice is the combination of self- and peer-assessment. Students assess their fellow students and they are also included in the group that should be assessed. In this case, which is often mistaken with the term of collaborative assessment, one part of the overall assessment of a work is from oneself (Dochy et al., 1999, p. 340).

4.2.4   Automated Assessment

The continuously increasing number of students over the last decades is the reason for many academic staff to spend a lot of time in assessing their students assignments. Therefore the development and research on automatic or semi-automatic assessment are also increasing and should be an integral part of educational institutions although it is not practicable for all sorts of courses and assignments (Harvey & Mogey, 1999, p. 7-8).

Automated assessment or computer based assessment as often used as well is using a software system for assessment. In this special case the student answers the questions or does the task on the computer and the results are recorded and archived. The grading process then is done by the system electronically. The essential point of computer based assessment is that the assessing procedure is done electronically and automatically (by a computer program or system), contrary to computer assisted assessment (see Chapter 5.4 for classifications of e-Assessment)

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[1]for formative assessment see 4.3.2
[2]for summative assessment see 4.3.1

where the assessing process is done with the computer but not necessarily automatically (Symeonidis, 2006, p. 12-13).

According to Gütl (2008), computer assisted assessment can support many different parts of the assessment procedure. For example, it can be supportive in authoring, managing and re-using assessment items or the compilation and management of assessment results. Over the last years the trend of automated assessment has been induced by the increasing workload of teaching staff and is another approach to decrease time spent on the assessing process instead of peer-assessment (see Subsection 4.2.2). The practice of formative assessment and need of quick feedback in order to support students in their learning process are just some reasons why automated assessment gets more and more involved in the assessing procedure (Al-Smadi et al., 2010; Gütl, 2008).

4.2.5 Issues for the Practice of Self-, Peer- and Collaborative Assessment

All in all it is obvious that self-, peer- and collaborative assessments do improve some important aspects of the quality of students learning. The literature research presented in Dochy et al. (1999, p. 345-347) shows some positive effects that justify the use of these different kinds of assessment in higher education. For example, the performance of students learning and quality of work are increasing. The reasons for these facts are the self-reflection of their own work and the work of their peers as well. They also gain a lot of knowledge by being in a collaborative assessing process with the teacher or tutor. Another important fact is the improving learning climate of the class. Students are ambitious and the practice of peer- and collaborative assessment is very effective because of the competing situation in the class and the better knowledge of how the other students are performing. When students realize what is wanted to meet the standards of work and are integrated in defining criterias, the results will become better. Especially knowing the fact that tasks get more complex and open ended. Other decisive advantages are to get and give feedback from and to peers and to have the possibility of comparison of different works for a better understanding of the standards in each course.

Several studies show that self-, peer- and collaborative assessment methods fit best with problem-based and authentic learning contexts. Hereby, peer- and co-assessment are very important aspects of problem-based working within a group, in the majority of the cases guided by a tutor. In addition with self-assessment the practice of these three types are very good approaches to meet the needs of the

society for lifelong learning. That means all the skills that can be learned through practicing these techniques will be needed in life and therefore it is important to concentrate on self-, peer- and co-assessment in higher education (Dochy et al., 1999, p. 345-347).

4.3   Strategies of Assessment: Summative, Formative and Diagnostic Assessment

Different assessment tasks are used for different purposes. Crisp (2009, p. 1585-1586) figures out three forms of assessment - summative, formative and diagnostic assessment - and puts it in relation to the learning process. Figure 4.2 shows the simple model for these relationship.

Formative and diagnostic assessments are very important for teachers to find out the level of understanding of a class. If they do it properly the results can be useful to adjust the way of teaching, so the positive influence on students is best. All of them are important to gather information about students learning progress and therefore have to be an integral component in a balanced assessment system. In the following subsections the special focus is on formative assessment in teaching and learning.

4.3.1   Summative Assessment

Summative assessments are an integral part of the assessment approach in education and summarize the learning progress of students at a particular time. So it is a periodically evaluation of students and in general used as a part of the grading process. There are heaps of different summative assessments, for example state assessments, end-of-unit or chapter tests, semester exams, district benchmark, etc.

All the information gathered with summative assessments are very important for the grading process but can also be used for diagnostic purposes. Because of the assessing after a certain time of teaching the information are useful to detect possible ineffectiveness of programs or help to evaluate the alignment of curriculum and school improvement goals. These weaknesses can be diagnosed by summative assessment but no adjustments or interventions during the learning process can be done. To achieve this goal formative assessment is needed (Garrison & Ehringhaus, 2007).
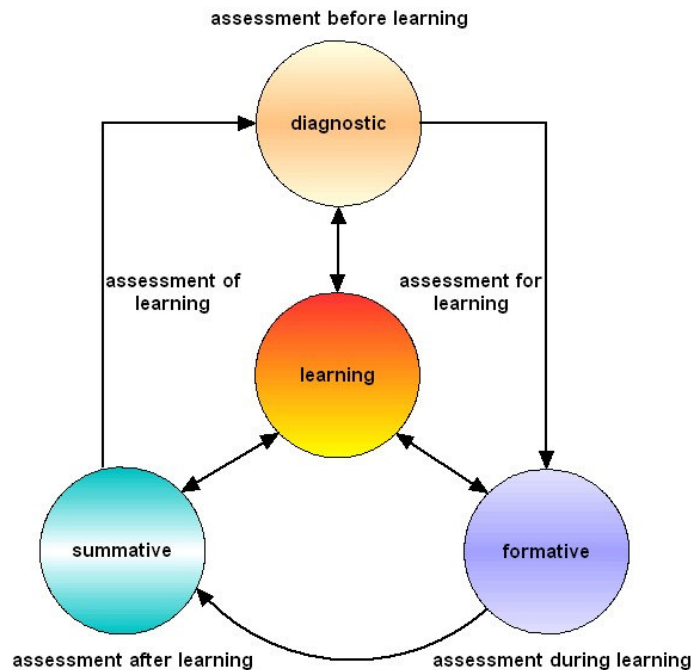
Figure 4.2: 3 strategies of assessment integrated in the learning process by Crisp (2009, p 1586)

4.3.2 Formative Assessment

As mentioned in the previous chapter, summative assessment is for grading students but it is also very important to support students during the instructional process. In addition to test and evaluate students, teacher have the possibility to change the way of teaching and learning by using formative assessment or assessment for learning as a term also often used. So formative assessment is for teachers to find the best way of teaching and adjust teaching during the semester on the behalf of students. But formative assessment is far more than that. It is also useful to students because they change the way of learning for better results in the end (Boston, 2002) (Chappuis & Chappuis, 2007).

Now the question is what exactly does a formative assessment look like? All assessments can be used for summative or formative needs although some kinds of assessment are more useful for the one or other. The differences now just are how the information gathered are used and that the information gathered are for improving teaching and learning rather than getting a grade at the end of semester (Chappuis & Chappuis, 2007).

Baroudi (2007, p. 39) gives following detailed definition of what formative assessment exactly is:

> "Formative assessment consists of activities used by the teacher to determine a student's level of knowledge and understanding for the purpose of providing the student with feedback and planning future instruction. The feedback and future instruction may be concerned with remediation or the provision of further learning opportunities."

4.3.2.1   Framework for a Powerful Assessment Strategy

Atkin, Black, and Coffey (2001) provide a framework which should be used to have a powerful assessment strategy for learning. The framework is represented by the following three questions which are interconnected and interdependent:

- **Where do you want to go?**
  Students should be aware of where the course should lead to. They should get a list of all the stuff to do during the course so they can adopt their learning in a better way. Additionally, positive and negative examples would be very useful, so they know exactly what teachers want to have.

- **Where are you standing now?**
  At the beginning of a course students should know what strengths and weaknesses they have so they can focus on the weaknesses to reach the goals declared in the first question. Therefore different procedures can be chosen, for example a non graded quiz at the beginning of the courses so teachers and students know where they stand.

- **How can you reach this goal?**
  With the results found in question two teachers should give feedback to students that they use for defining goals individually. Another good approach to reach the goals is asking students to describe and comment their progress and, if necessary, discuss individual changes in learning with students.

Formative assessment can be practiced in many different forms but it consists of any action undertaken by teachers to help students answering the three important questions above. Students use the interaction with teachers to improve the learning success, for self-assessment and to set new goals. The role of the teacher in this assessment environment is the one of a supporter rather than judge learning (Atkin et al., 2001) (Chappuis & Chappuis, 2007).

4.3.2.2 Five Elements of Formative Assessment

There are many different approaches and ways of thinking about the elements of formative assessment. In this thesis the concentration is on the article of Baroudi (2007, p. 39-43) where formative assessment is categorized by five elements that are explained hereinafter.

Classroom Questioning and Discussion:
This element of formative assessment is integrated in nearly every kind of teaching intuitively. Hereby the important thing is to know what kind of questions are useful. Closed questions, where there is only one possible answer, are good for assessing students. For planning future instructions and uncovering misconceptions it is better to ask open questions - the term *rich question* is often used in this context. Baroudi (2007, p. 40) refers to Sullivan and Liburn (2004) for a definition of such good questions:

- Remembering a fact or skills are not enough for answering and there may be more correct or at least acceptable answers.

- Both, students and teachers learn from this situation - students by answering the question and teachers learn about the way of thinking and knowledge of their students.

Feedback:
It is very essential to get appropriate feedback during learning to improve the outcome. In this context, feedback are information which help to answer the question how a student can close the gap between the actual level and the level that should be reached at the end of a course. Obviously this kind of information transfers occur from teachers to students.

Feedback is a practical method for the improvement of learning and Bone (2005) identified the seven following principles of what good feedback practices have to guarantee:

- Ease the development of self assessment.

- Includes dialogue with tutor during learning process.

- Gives clear definition of what good performance is.

- Support students in reaching the expected level.

- Is responsive to the learners' needs.

- Is consistent in terms of criteria and assessing standards.

- Includes positive motivational beliefs which give student self esteem.

Sharing Criteria with Learners:
This element of formative assessment is essential because the performance of students is much better if they know the criteria exactly. One possible approach is to involve students in developing criteria by ranking unknown responses. The information gathered through this process can be used by teachers for finding an appropriate grading system or to avoid misunderstandings in how students think they should perform.

Student Peer- and Self-Assessment:
Self-Assessment is very important for improving learning techniques and also for later usage. For practicing self-assessment in an efficient way peer- assessment should form the base of training. After studying programs, where lots of self- and peer-assessments are included, it is obvious that people are much better in identifying problems on their own.

Subsequent Instruction:
One of the most important elements of formative assessment is subsequent instruction. Information gathered by using formative assessment should be used to always improve and adopt teaching and learning. Without such kind of knowledge it is impossible for teachers to interpret students' answers and ask the right questions. Therefore it is necessary to use further formative assessment information to plan subsequent action.

4.3.2.3   Benefits of Formative Assessment

Formative assessment is known as a very efficient way of teaching to improve students' outcome. The equity of students' outcomes increase in institutions where formative assessment is practiced. Other important facts are that students improve their ability to learn and the overall level of attainment is raising (OECD, 2005).

It seems to be clear that teachers have an advantage when they know how their students progress and in which areas they still have troubles. They can then use this useful information to make adjustments, such as offering additional practice opportunities and reconstructing the way of teaching in the classroom. All these activities help to improve students learning behavior and then, of course, the outcome of a programme (Boston, 2002).

A very important part of formative assessment is giving feedback to students. This activity can help learners to become aware what gaps are existing between their actual knowledge or skills and the desired goal. Formative assessments do not just identify these gaps, they can also be used to guide students through actions necessary to achieve this goal. The feedback on tests, homeworks and assignments with best impact on students learning behavior provides both, specific comments about errors and detailed suggestions how to improve and encourage students to focus on the tasks to achieve their goals. Using formative assessments therefore means that students get help to reach their goals and improve their learning behavior through getting meaningful feedback (Boston, 2002).

4.3.3 Diagnostic Assessment

Diagnostic assessment is also called pre-assessment and it is for providing the teachers with important information about their students' prior knowledge. Usually, diagnostic assessments are employed at the beginning of an undergraduate program or single course. Then the university or teacher, depending on what it is used for, know exactly about the strengths and weaknesses of each student. On the one hand this information can be used to find the best education and study program for each student. In this case students do not need to waste the first year of their studies to look for the study suitable for them and a lot of time and money in education would be saved (Miller, Imrie, & Cox, 1998).

On the other hand teachers can use this kind of information for planning and modifying the course. With the exact knowledge about their students' knowledge they can change the mode and content of the course to better meet the needs of their students. For example, short multiple-choice tests or essays at the beginning of the semester can be a good form of diagnostic assessment as well as interviewing every single student if the class is small enough (Miller et al., 1998).

From the definition and description of formative assessment (see subsection 4.3.2) the conclusion can be that diagnostic assessment is a special form of formative assessment. One difference is that it is not formative to the student but to the teacher to organize the content and termination of the course.

4.4 Rubrics in the Assessing Process

Rubrics are often an integral part of a powerful and effective assessment tool, also because it is useful for formative and summative purposes. The use of rubrics is for supporting students in the learning process. This is made by guiding students

activities and also give them a clearer understanding of their own learning process and progress (TLT, 2009).

4.4.1   Definition of the Term Rubric

The TLT (2009) define rubric as an explicit set of criteria. In the educational sector this set of criteria is used for assessing a part of students' work or performance. A well designed rubric includes several things for each criterion, for example levels of possible achievements or samples of pieces of the work that specify the required level of performance more detailed. Most rubrics describe the levels of possible achievement as numerical scores where the sum of the score can be used for grading. Another element of a rubric may be space for the assessor to state the reasons for each judgment or suggestions for improvement.

Goodrich-Andrade (2001) provides some interesting research results in her article. There she writes that undertaken research on assessment, self-regulation and feedback suggests to use instructional rubrics in teaching, especially for written assignments. They have the potential to improve students writing when certain characteristics are met. To meet this characteristics:

- the rubric should insist of specific, clear criteria that suits to the type of assignment. It is also important that the criteria is written in a language that students understand, so they can improve their work and future learning behavior.

- the rubric should come with a guidance that students have an insight how to meet the requirements.

- assessing procedure should give students the possibility for improving their work through revision after a thoughtful study of the rubric.

- the design of the rubric needs to be sensitive to the level of the class. It should also provide students with hints to their weaknesses to guide them in their learning process.

Table 4.1 shows an example rubric especially created for assessing an invention report. Goodrich-Andrade (1997) gives just one detailed example where everybody can get a good insight in what a rubric in general looks like.

Criteria	Quality			
Purposes	The report explains the key purposes of the invention and points out less obvious ones as well.	The report explains all of the key purposes of the invention.	The report explains some of the purposes of the invention but misses key purposes.	The report does not refer to the purposes of the invention.
Features	The report details both key and hidden features of the invention and explains how they serve several purposes.	The report details the key features of the invention and explains the purposes they serve.	The report neglects some features of the invention or the purposes they serve.	The report does not detail the features of the invention or the purposes they serve.
Critique	The report discusses the strengths and weaknesses of the invention, and suggests ways in which it can be improved.	The report discusses the strengths and weaknesses of the invention.	The report discusses either the strengths or weaknesses of the invention but not both.	The report does not mention the strengths or the weaknesses of the invention.
Connect-ions	The report makes appropriate connections between the purposes and features of the invention and many different kinds of phenomena.	The report makes appropriate connections between the purposes and features of the invention and one or two phenomena.	The report makes unclear or inappropriate connections between the invention and other phenomena.	The report makes no connections between the invention and other things.

Table 4.1: Sample rubric for an invention essay (designed by Goodrich-Andrade (1997))

4.4.2 Always Using a Rubric?

As described in the previous section rubrics are very useful in the assessing process but there are also situations where using rubrics is sensible. In this section the author figures out why and when to use a rubric and circumstances to prevent from using them.

4.4.2.1 Reasons for Using a Rubric

Several literature discusses how important and useful rubrics are. The following listing shows the most often mentioned in the literature (TLT, 2009; Goodrich-Andrade, 1997):

- In several cases it is more useful to provide the student a descriptive assessment rather than a single, holistic grade.

- Rubrics are preset and therefore the producers of work - in the educational sector students are meant - know in advance what kind of criteria will be judged.

- When students get a single grade without a provided rubric sometimes it is incomprehensible to know why the work is graded this way. By providing a rubric a lot of time for defending the judgment is saved.

- Rubrics are an important and often used strategy of supporting students with formative feedback. For later assignments it is a big advantage for students to get such kind of information. They also get a better understanding of judging the quality of a work which is very useful when practicing self- and peer-assessment.

- Preset rubrics are also a big advantage for students. Before submitting an assignment it is easy for them to check if all the requirements are met or some corrections need to be done.

- With a preset rubric it is possible to enable multiple judges to focus on the same criteria for assessing a work. For example, the work of students within a course can be easily assessed by faculty members, other students or external assessors using the same rubric. The same rubric can also be used for experts to assess the performance of the course using the same rubric.

- Finally, when using rubrics teachers reach a very important thing in teaching and assessing: keeping complex operations simple to explain and use.

4.4.2.2   Reasons for Avoiding the Use of Rubrics

As shown in Section 4.4.2.1 there are many reasons why to use a rubric, but there are also some circumstances when it is better to avoid using them. Some interesting points are listed below (Goodrich-Andrade, 1997; TLT, 2009):

- As defined above rubrics use the same preset criteria for all assignments of a specific submission. Sometimes assessors would judge two different pieces of work with the same mark although they have nothing in common. In this case flexible criteria would be needed instead of preset rubrics.

- Students should get an insight how their assignments will be assessed, so they can prepare them adequately. In some cases it is not appropriate that students know this in advance and assessors will create the rubric inductively during or after correcting the work, if needed. In such instances, the rubric can be used to guarantee the consistency of judgments instead of the reasons used typically.

4.5   The Role of Assessment in Higher Education

In previous sections the focus is on different types and strategies of assessment but there is another important focus to concentrate on. The Australian Universities Teaching Committee presents a concept where the differences and independences of both, the view and expectation of teachers and students, are shown. In Figure 4.3 these different sights are shown (CSHE, 2002).

As shown in Figure 4.3 it can be highly challenging for academic staff to design efficient assessment where students are driven in the right direction. For staff it is important to design outcomes and therefore they are looking for suitable teaching and learning activities to reach these outcomes. Students are thinking exactly the other way around and that makes things so difficult and challenging. They first focus on how they will be assessed and drive the way of learning into the direction to what is required for getting a good mark. These facts underline the challenges of an effective and efficient procedure of a learning program (CSHE, 2002).
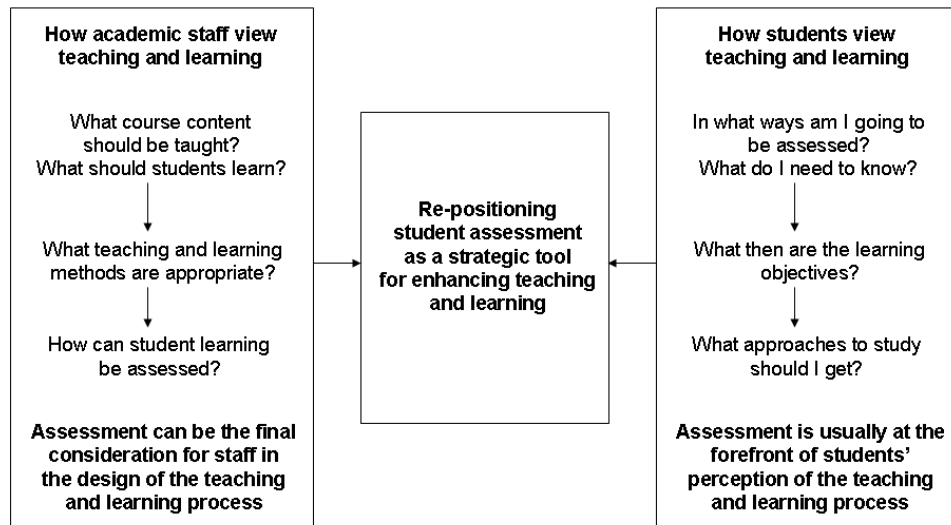
Figure 4.3: The role of assessment taken from CSHE (2002)

4.6 Summary

Assessment is a very essential part of higher education and exceedingly important for the quality of the student outcomes. As presented in this chapter assessment can be classified into four different types and all of them have their reasonableness in higher education. Whereas self-assessment is for reflecting the own skills and improve ones learning activities, peer- and collaborative assessment are relevant for group projects and therefore obviously good approaches for usage after education to identify problems. The reasons for the use of automated assessment are also easy to argue. With the growing number of students a lot of time can be saved and storing, reusing and monitoring are just a view of the advantages of automated assessment that, of course, is not practicable for all types of assessment as mentioned in this chapter.

Apart from the different types of assessment, the varying strategies of assessment are very important. Students do not only need a grade at the end of a course or program. Of course, it is necessary to measure students learning but what they also need is a guidance through the whole study program as best as possible. For this special guidance through the program formative assessments are the most efficient practices.

A very important part of the assessing procedure in the educational sector is

the use of rubrics, both for assessing students in a formative and a summative way. The use of rubrics is highly recommended by experts for more than just one thing. For example, they are good for detailed feedback to students after and during an assessment. Another meaningful use of rubrics is the guidance of students and their improvement in learning, which is very important for the quality of an educational institution at the end. In fact, rubrics are the heart of effective assessment and therefore very essential for further work within this thesis.

The author's special attention in this thesis is on supporting students learning with appropriate and timely feedback. This part is an important one of formative assessment in the area of teaching and learning. To support students in this way and concentrate on the consistency of feedback it is essential to enhance students learning and improve their outcomes as described in this chapter.

> *"It is widely recognized that rapidly received feedback on assessment tasks has an important part to play in underpinning student learning, encouraging engagement and promoting retention"*(Jordan, 2009, p. 2)

As the quotation above shows it is important to give quick feedback to students and using e-Assessment, especially formative e-Assessment, will provide the opportunity of instantaneous feedback for students. The overflow of some study programmes also leads to use e-Assessment relating to the lower costs and effort needed. All these are reasons for seeing e-Assessment as what it is, an integral part of the growing e-Learning industry (Jordan, 2009). Therefore this field will be discussed in detail in the following chapter.

Chapter 5

e-Assessment and e-Portfolio in Higher Education

As described in Chapter 3 technology enhanced learning and especially e-Learning is widely-used in the educational programs of the universities all over the world. Whereas e-Learning is an important term in higher education over a long time now, e-Assessment is relatively new. In this chapter the focus is on figuring out what e-Assessment is. The misunderstanding of the term e-Assessment and mix up with the often used term of e-Portfolio will also be resolved in this chapter.

Furthermore, a special focus of this chapter is on existing e-Assessment systems and detecting their strengths and weaknesses. In order to support students in their learning it is very important to use formative assessment to guide students and help them reaching their goals. Especially the different approaches regarding feedback and formative assessment are mentioned when discussing the existing e-Assessment systems.

5.1 Introduction into the Fields of e-Assessment and e-Portfolio

e-Assessment and e-Portfolio are finding more and more use in the educational sector which has its reason in the improving technologies. Nowadays, both have wide appliance in higher education and are an integral part of e-Learning. It is often the case that these two terms are used in the same context and therefore people who are not experts in this area think they are the same (Brahm & Seufert, 2007, p. 3). This chapter gives definitions of both terms and figures out the differences and things they have in common.

5.1.1   Definition of e-Assessment

e-Assessment is not simple to define and there are also other names which mean
nearly the same, for example computer based testing and assessment or com-
puter assisted assessment. A possible detailed definition of e-Assessment is given
in Brahm and Seufert (2007, p. 5). They quote Bloh (2006) and describe e-
Assessment as the identification, evaluation, assessment, documentation and feed-
back based on the new electronic information and communication technologies.
Content of the points mentioned above can be the learning preconditions, the
current learning level and performances or already reached learning goals. All
these events can happen before, during and after the specific learning period.
Therefore the differentiation between diagnostic, summative and formative as-
sessment is done as described in Section 4.3.

The definition of Bloh is a broad one and especially for the anglo-american
area there is a similar definition of e-Assessment given by the Joint Information
Systems Comittee (2006) as given below:

> *"The end-to-end electronic assessment processes where ICT (in-
> formation and communication technology) is used for the presentation
> of assessment activity and the recording of responses. This includes
> the end-to-end assessment process from the perspective of learners, tu-
> tors, learning establishments, awarding bodies and regulators, and the
> general public."*

5.1.2   What then is an e-Portfolio?

The Salzburg Research Forschungsgesellschaft (SRFG) describes the term of e-
Portfolio as a digital collection of artefacts including their steps of development.
These artefacts and steps of development should show the efforts, progress and
achievements of the students' learning over a certain time. Essential here is that
the relevant person selects the artefacts itself and can also set permissions about
how many information everybody is allowed to see at any time. The difference of
an e-Portfolio to a normal portfolio is that the creation, documentation, manage-
ment or presentation of data is based on using electronic assistance. Synonyms
for e-Portfolio are electronic portfolios or digital portfolios (Schaffert, Hornung-
Prähauser, Hilzensauer, & Wieden-Bischof, 2007, p. 76-77; Brahm & Seufert,
2007, p.).

The use of e-Portfolios in higher education needs a special understanding from
both, students and teachers. Students are responsible for choosing the right data
and set permissions to teachers when they think it is necessary, so they need to

act independently. Staff also has a different role when using e-Portfolios. The teaching personal assumes the role of the consultant that supports the reflection and planing of the learning procedures (Schaffert et al., 2007).

5.1.3 Similarities and Differences of e-Assessment and e-Portfolio

Given the fact that learning preferences and preconditions of future learners are changing, the enormous potential of e-Assessments and e-Portfolios seem to be obvious. Online quizzes or self tests are often used by the young generation for challenging with peers in their free time. The important thing here is that people like it to get quick feedback and this should be the case in the educational sector as well. The goal is to guarantee exactly that with a good e-Assessment or e-Portfolio approach (Brahm & Seufert, 2007, p. 17-18).

The differences and boundaries between e-Assessment and e-Portfolio of the learners' view are listed in Table 5.1 and the pedagogical and technological differences are shown in the following subchapters.

e-Assessment	e-Portfolio
- quick feedback mechanisms (for example online quizzes) - diagnose of learning on testing results - quick feedback to designers for positioning and reconstructing formal and informal learning scenarios - summative and formative assessment	- active generation of content - diagnose of learning on development - promote self-learning (create own goals and learning strategies) - formative assessment

Table 5.1: e-Assessment and e-Portfolio from the view of the learner (adopted Brahm and Seufert (2007, p. 18))

5.1.3.1   Pedagogical View

From the pedagogical side it is important to analyze the potential of both, e-Assessment and e-Portfolio, and integrate them into the current e-Learning concept. The focus of e-Assessment from the pedagogical side is on generating tests whereas e-Assessment is for supporting coaching mechanisms. In the future the questions regarding e-Assessment will address the possibility of development in the sense of reaching higher educational learning goals, especially the development of new techniques regarding questioning and visualization. Contrary to e-Assessment it will be the focus of e-Portfolio to reflect and support meta cognitive skills of learners (Brahm & Seufert, 2007, p. 18).

5.1.3.2   Technological View

Both, e-Assessment and e-Portfolio, have in common that they are implemented with the new information and communication technology but the borders between them are clear.

Usually, e-Assessment is an integral part of a classical learning management system (LMS) or there are dedicated tools to use. e-Portfolio on the other side is a central element of a PLE (personal learning environment) and therefore Brahm and Seufert (2007) speak about a learner centered approach, contrary to a course centered approach that exists in a LMS. A PLE is personal and should help to manage the planning and control of ones own learning, in the best case a whole life long. In addition to the dedicated programs that realize e-Portfolios typical implementations are wikis or blogs (Brahm & Seufert, 2007).

5.2   Historical Development of e-Assessment

The use of computers for assisting in assessment goes back over a few decades. In the early 1960's one of the first projects of using computers for assistance in the assessment process was started at the University of Illinois (PLATO - Programmed Logic for Automatic Teaching Operations). TICCIT (Time-Shared, Interactive, Computer-Controlled, Information Television) from 1967 is another project representing the first attempts of the use of computers in education (AL-Smadi & Gütl, 2008).

But assistance in the assessing process is not the only thing that refers to e-Assessment. Another application is the automated assessment of students' work. Two of the earliest projects in this context were the *Automatic Grader* or the *grad book* . These programs were for automatically assessing students' programming

exercises, helped students to better learn programming and were an essential innovation in long distance teaching (AL-Smadi & Gütl, 2008).

5.3 Motivation and Rationales for the Use of e-Assessments

As mentioned in Section 3.3.1 the use of new media regarding teaching and learning is a standard one nowadays and there is no exception in the fields of Assessment. Therefore, e-Assessment is widely-used. The most important motivators for using e-Assessment in the higher educational sector are for practical and pedagogical purposes (AL-Smadi & Gütl, 2008, p. 3-4).

Practical Rationales: The use of the technology of e-Assessment becomes more and more needful caused by the increasing amount of students. Universities keep their staff resources approximately constant, so the workload for them is increasing as well. Still insisting on the practice of paper-based assessment involves that teachers need to spend more time on assessing students rather than concentrating on more important things, like the effective support of students in their educational development. As e-Learning systems are widely used on universities, the number of students that can be supported and accepted, can be increased. Hence, the assessing process needs to be also re-organized in a direction of using e-Assessment (AL-Smadi & Gütl, 2008, p. 3).

Pedagogical Rationales: The importance of formative assessment for the positive development of students is shown in Section 4.3.2 and for this process permanent feedback to students and teachers are needed. This feedback can improve both activities in teaching and learning and therefore better and higher learning goals can be reached. To guarantee a good support in formative assessment it is essential to use e-Assessment systems (AL-Smadi & Gütl, 2008, p. 3-4).

Another reason for using e-Assessment is the need for universities to assure their quality (see Chapter 2) and an important point regarding QA is to provide assessment which is *"fair, reliable, efficient and effective"*(AL-Smadi & Gütl, 2008, p. 3). Using e-Assessment makes the assessing process consistent and fair, if well integrated and implemented, what should be the aim of students' assessment.

5.4   Classification and Use of e-Assessment

There are many possible classifications to make when speaking about e-Assessment. In the following subsections some of these classifications are described as well as some techniques of e-Assessment dependable on different learning goals are shown.

5.4.1   Classifications of e-Assessment

As mentioned in Section 5.1.1 there are different words which mean e-Assessment and in literature it is inconsistently defined what exactly is meant. AL-Smadi and Gütl (2008, p. 2) show a distinction of e-Assessment in the following two terms which are often mixed up:

- **Computer Based Assessment (CBA):**
  Is the *"interaction between the student and computer during the assessment process"* (AL-Smadi & Gütl, 2008, p. 2). That means that the computer is delivering the test and also the assessment of the test and delivery of the feedback is done by computers.

- **Computer Assisted Assessment (CAA):**
  Contrary to CBA, computer assisted assessment is more general to see and understand. Any computer assisted procedures regarding the whole assessment process are covered by this term including marking and reporting as well as the analysis of any data relating to assessment.

Another classification regarding e-Assessment systems can be done regarding the question: *What kind of answer does the user give?* To answer this question the two types of answer possibilities can be distinguished (Culwin, 1998, p. 55-58; AL-Smadi & Gütl, 2008, p. 2):

- **Fixed Response Systems:**
  Consists of questions where the user is limited in the possibilities of giving the answer. This can be a single or multiple choice question, list or drop down boxes or just a single word to fill in but all of them are thought to be for fact or knowledge assessment. These kind of questions are also referred to be objective and can be assessed and marked automatically.

- **Free Response Systems:**
  Are questions with less constrained responses of the user. Possible answer are non-objective and could be free text, program code or construction of

designs and are for assessing skills rather than facts or knowledge. The answers in this case are varying, more difficult and one big problem is the automation of marking which is very complicated to deal with (see Section for 4.2.4 automated assessment).

A third possibility of classification of e-Assessment systems is regarding the time when the questions are generated. Culwin (1998, p. 55) makes following distinctions:

- **Pre-Prepared Questions:**
  The questions are already prepared when the test is starting.

- **On-demand Questions:**
  In this case the questions are generated at runtime (during testing time) and this type of questions can be subdivided in another two types. The first type includes questions randomly picked from a *question bank* and the second type means all the questions generated from a *question template*.

5.4.2 Different Techniques of e-Assessment Depending on the Learning Goal

From the didactic perspective it is important to have various, authentic and relevant assessments which check the different types of knowledge (see prior argumentation in Sections 3.2.2 and 3.2.4) of a student. If there is no sensitive thinking about the design of e-Assessments, all the advantages of e-Assessment can not be use. This could reduce the powerful usage of e-Assessment to only associate it with multiple-choice tests instead. But the possibilities of e-Assessment are far more than just that. Table 5.2 shows the different techniques of e-Learning depending on the learning goal (eTeaching.org, 2009).

5.5 The Abilities of a flexible e-Assessment System

To ensure that the e-Assessment system is flexible and well working some features and requirements have been identified. Al-Smadi and Gütl (2009) figures out seven abilities, an extension of the five abilities identified by Khaskheli (2004), and describe them as essential to have both, a flexible e-Learning and a flexible

Learning Goal	Technique of e-Assessment
Factual knowledge	e-Test (questions that can be automated assessed, mostly multiple-choice questions)
Conceptual connections	Create mindmaps
Historical data	Online timelines
Reflection of the learning strategy	e-Portfolios or learning diary
Ability of teamwork	online groupwork, collaborative work via wiki or practice of peer-assessment
Conceptual knowledge	Interaction via simulations or virtual Laboratories
Problem solving	Online role playing, case studies or problem-based scenarios
Communication and rhetorics	Discussion forums, weblogs, online-presentations
Creativity, technical competences	Creating podcasts, videos, scripts

Table 5.2: Different techniques of e-Assessment depending on the Learning Goal (adapted from eTeaching.org (2009))

e-Assessment system. The seven abilities are listed below and a short explanation of them is also given:

- **Interoperability:**
  Is the ability that the system works in a common file format and therefore it is possible to exchange data between different systems and also use services of them.

- **Reusability:**
  Means the possibility to reuse the learning content so that it is not necessary to create new content when another system or platform is used.

- **Manageability:**
  Refers to the ability of a system to keep track on the learning experience and activities. The ability of tracking how learning objects are created, stored and delivered to users is secondary in this context.

- **Accessibility:**
  Means the possibility to access, customize and deliver learning contents. The important thing hereby is that these abilities should be accessible at any time and place.

- **Durability:**
  Is important when new versions of the system are installed. In this case the content of the system should not need any redesign or redevelopment.

- **Scalability:**
  Is very important for such a system. It means that it is possible to expand the system so that it can grow from small to large without a lot of effort.

- **Affordability:**
  The affordability of a system refers to the costs of a system. The best system is useless if it is not affordable for the target group.

5.6 Security and Privacy in Online Assessments

When speaking about security and privacy in online assessments Marais, Argles, and Solms (2006, p. 2) see it as necessary to speak about two different categories of security: web security in general and the specific e-Assessment security. Web security is an area which is well researched and it deals with the security of servers, web applications, web traffic and suchlike. In the specific area of online assessment security means a lot more.

Apampa, Wills, and Argles (2009, p. 2105) define an e-Assessment system as secure by minimizing the threats affecting the P-I-A requirements:

- **Presence:**
  The learner has to be present from the beginning to the end of an assessment, physically and online.

- **Identity:**
  The learner has to be identified by unique characteristics.

- **Authenticity:**
  An evidence of genuineness must be provided by the learner.

In the following subchapters the author figures out what is essential to guarantee the same conditions to all candidates doing an online assessment, which means that no student has any advantages or disadvantages against other students.

5.6.1   Privacy and Confidentiality

Authentication is a must have in any e-Learning or e-Assessment system. The system allows every student to get access to ones private space, including e-mail, discussion facility, assessments and assignments, within the environment and the privacy and confidentiality of every single student has to be guaranteed. If the private space of a student is not secure an intruder could get access to assignments and assessments. In this scenario there would be problems with illegal submissions and plagiarism and therefore it is very important to deny all access to the private area of a student excluding him or herself. There are various options available to provide an authentication but not all of them are as secure as others (Marais et al., 2006, p. 2-3).

Passwords, sometimes in combination with challenge response questions, are the most common variant used as authentication for such systems. The costs for the implementation of passwords are low but unfortunately they just guarantee the secure access to a system and not the chance for dishonest or naive students to make their passwords public. In this case it is easy to have another person to write someones test or do someones submission for an assignment and an incorrect grading will be done, positively or negatively influenced (Marais et al., 2006, p. 2-3).

Other techniques like e-token, smart card or biometric authentication provide a higher grade of security but are also more expensive and not as comfortable to use as passwords. If biometric authentication is used the access to the system is secure but still does not guarantee that a malicious student let someone else doing the online assessment after logging in. Obviously, the question about a secure authentication is difficult but even if the authentication is secure there is still room for cheating (Marais et al., 2006, p. 2-3).

5.6.2   Location of Submission

Most of the e-Learning and e-Assessment systems have in common that they are accessible over the internet. This fact implies the possibility of every student to also access other web based services from the client. Obviously this is a big problem to deal with when managing e-Assessments. If needed for an assessment, students can access other web pages for helpful information or communicate with other students during the assessment. It is important to mention the type and design of the assessment in this context. There are a lot of preparations possible to reduce the sense of using help, such as time limitations and a large pool of different question. If those preparations can not be done, it is necessary to

introduce other restrictions (Marais et al., 2006, p. 3-4).

5.6.3 Test visibility

Marais et al. (2006, p. 4-5) describe the problem of test visibility as the opportunity of two students writing an online test and sitting next to each other. Most e-Assessment system already have a good strategy to prevent this by having a large range of questions and compile e-Assessments individually and randomly. In this case it is impossible to copy from another student because the questions are not the same but there are also disadvantages that lecturers have to deal with. First of all more questions mean additional work for lecturers and this fact is still an important one for making a decision pro written exams. Secondly, if students get different questions it is difficult to guarantee the same difficulty for all of them. Even if the difficulty is negligible students will do complain, if the mark is not as good as expected. In this case lecturers have a lot of extra work again, caused by the choosing questions of similar difficulty and paying attention on students complaining.

5.6.4 Electronic integrity

One of the main requirements of an e-Learning or e-Assessment system is integrity. The violation of the electronic integrity of a system is often caused by a student or malicious person, sometimes a virulent computer program can also be the reason.

5.6.5 The Non-Deniability of Submission

An e-Assessment in use must guarantee that a student has no possibility to deny the submission of an e-Assessment or assignment. The key technology for this is a secure authentication of the student as mentioned in 5.6.1. One possible solution for this problem is the biometric or electronic signature of every single submission, not only for getting access to the whole e-Learning or e-Assessment system. Of course, both mutations of signatures are expensive to implement and not comfortable for the students (Marais et al., 2006, p. 7-9).

5.7 Strengths and Weaknesses of e-Assessment

As nearly every and especially every new technology, e-Assessment has its proponents and opponents. In the following subsections both, the key benefits as well

as the key disadvantages are illuminated. Afterwards, in an additional subsection, a short introduction in the future of e-Assessment will be given.

5.7.1 Key Benefits of e-Assessment

The key benefits of e-Assessment are listed below but it is necessary to mention that all these benefits are not accurate to all sorts of e-Assessment and if the design is not well enough there are sometimes no benefits at all (Winkley, 2010, p. 20-21; Bournemouth, 2010).

- e-Assessments can be created with appropriate software tools that can save them for reusage as needed. This can save a lot of time in creating and distributing assessments.

- Reduces the turnaround time and allow immediate feedback: after the assessment the student gets immediate feedback and it is possible to concentrate on further assessments sooner and therefore improve further work.

- The flexibility can be highly increased by providing assessments more often and additionally on a variety of places.

- All assessments can be saved electronically and therefore it is easier to analyze them and provide statistics as well as make changes in the assessing process based on statistical information.

- The assessment validity can also be improved by providing rich information (for example video and sound) and interaction with this information. It can also improve the validity when students are able to present their information or assignments as flexible as possible.

- e-Assessment can guarantee a high efficiency when correctly used and reduces administrational effort on the university.

- In general, students like e-Assessment where it is implemented well including the consideration of personal preferences and support of those with learning or physical disabilities.

5.7.2 Disadvantages of e-Assessment

Bournemouth (2010) quote McCormack and Jones (1998) who identifiy the disadvantages of e-Assessments as well as the limitations of them:

- The development and implementation of e-Assessments can be very costly and time-consuming. e-Assessments should be fair and objective and therefore practice and skills are needed which underlines the problems regarding costs and time.

- The hardware and software of the system needs to be exactly monitored to avoid failure, especially during examinations. For using the software and e-Assessments students need appropriate IT skills and experience which can not always be assumed.

- All parties (administrators, academic and support staff, computer services) involved in the assessing process need a high level of organization.

5.7.3 Future of e-Assessment

Further development of e-Assessments is highly focused in several sectors and Winkley (2010, p. 21-22) sees the four following key areas where e-Assessment has a big potential in near future:

1. Development in the area of immediate test results and quick feedback to any sorts of assignments. Formative e-Assessments will be used more and more to improve learning behaviors and outcomes of students.

2. More authentic assessment will be provided by integrating interactivity and richness of information and communication technologies, that will reach the boundaries of technology and pedagogy and go even further.

3. Quality assurance in higher education will become easier, better and more consistent caused by recording all relevant assessment data.

4. In future e-Assessment will be used in all economic sectors because of its relatively low costs. This can provide higher standards and increase the responsiveness of all institutions, but especially helps higher education to react on changes in technology and society.

5.8 Related Work: e-Assessment Systems for Formative and Summative Purposes

As figured out in Chapters 2 and 4 it is very important for the outcome of a student to give appropriate support in the learning progress. One keyword in this context is *communication* with the students regarding things that are necessary to improve ones skills. In this thesis the special focus in order to support students is on providing timely, appropriate and consistent feedback in the assessing process combined with summative assessment if needed. Following subsections relate on existing e-Assessment tools for the mentioned purposes.

5.8.1 Feedback Possibilities within Learning Management Systems

A lot of universities are running a learning environment in form of a learning managements system like Moodle or WebCT/Blackboard (see Section 3.3.5). Beside course management, providing course material and several other things it is also possible to provide a range of modules to handle different kinds of assessments such as quizzes and essays (Brandl, 2005, p. 17-19). In this section the focus is on the ways of providing feedback within these modules rather than use it just for a summative purpose instead.

The use of such learning management systems in higher education are well integrated and it is unthinkable to live without them in the sector of teaching, learning and assessment but students often do complain about the missing or not appropriate feedback they get for their work and assignments. In the latest versions of LMSs the developer promote that it is possible to give feedback in several forms but what are these forms? To answer this question it is useful to show the kind of feedback divided in following two parts provided within LMSs (Brandl, 2005; Stalljohann, Altenbernd-Giani, Dyckhoff, Rohde, & Schroeder, 2009):

- **Summative Feedback:**
  Is feedback that measures students' knowledge and is much easier to give than formative feedback. In this case students get feedback about the correct answer during doing a test online so they can see what level of knowledge they have reached. This type of feedback is important but not sufficient at all.

- **Formative Feedback:**
  The popular LMSs also provide the possibility of formative assessment. In

Moodle and WebCT, for example, free text fields given to each question of a quiz or essay are possible for individual feedback and also audio files can be uploaded including an instructor's feedback in spoken format. Figure 5.1 show an example of what feedback looks like in Moodle.

Figure 5.1: Example of Possible Feedback in Moodle (Brandl, 2005, p. 20)

As described above it is possible to give detailed feedback and it is also possible to do this in different ways, but this feedback is individually regarding the student and strongly depending on who is giving the feedback - and therefore not fair and equally to all of the students. It is also notable that there is no connection between the feedback for summative and formative purpose meaning that it is not necessarily required to get good feedback for a good mark.

5.8.2 Onscreen Marking With a Plugin for PDF

Möller and Myburgh (2010) provide a solution for an effective and efficient way of marking onscreen that prepares an educational institution for a paperless assessment system. The tool developed and introduced is a plugin for PDF documents. When opening an assignment (in PDF format) different marking or feedback methodologies are implemented. So the following five strategies are provided by this plugin (Möller & Myburgh, 2010, p. 380-383):

1. Mark the assignemnt with tick marks.

2. Giving an impression mark for sections, paragraphs, pages or more aspects.

3. Constructive, pre-prepared feedback without marks including the possibility of adding individual feedback is provided by opening a so-called *commenting*

tool. This tool opens next to the assignment when used and provides a comfortable solution for adding feedback.

4. The same commenting tool as described in the previous point but including the possibility of adding marks to the feedback.

5. Using whole rubrics for assessing the assignment provided through another part of the plugin. The rubric needs to be pre-prepared and is associated with a certain assignment.

As shown in the listing above the plugin for PDF provided by Möller and Myburgh (2010) opens many possibilities in the grading process and the moderation of assignments. Disadvantages of this tool are the restrictions that the conception is just for one special file format (PDF) and in the case of using rubrics with this tool a collaboration with the other four strategies provided is not possible.

5.8.3   GradeMark

GradeMark is a commercial software solution provided by Turnitin[1] that allows teaching staff to assess assignments online and save a lot of time and effort. GradeMark is a system to assess written assignments and it is suitable for giving quick and appropriate feedback to students. The most important features of GradeMark are listed below (Turnitin, 2010b; Turnitin, 2010c):

- Real time assessment

- Consistent feedback

- Completely flexible rubrics

- Free accessible rubrics and feedback (also for students)

With GradeMark it is possible to give individual feedback and place it everywhere in a document. It is also possible to use a rubric regarding the assessment of students' work as it is shown in Figure 5.2 which is a big advantage. The created rubrics can be used for different assignments and also from different users, so there are no restrictions. Restrictions regarding the rubrics creation are that no hierarchical structures of the rubrics are possible and the rubrics always include grading scales. Thus, it is not possible to hide grading scales in the assessing

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[1] `http://turnitin.com/static/index.php`; visited on 28th December 2010

Figure 5.2: Using rubrics with GradeMark (Turnitin, 2010a)

process for more objectivity.

GradeMark, as a Turnitin service, can be easily integrated in the common learning management systems like Blackboard, WebCT or Moodle. They also provide an API integration service that opens the possibility of integrating the service in any class or university portal. In this case the tool seems to be an integrated part of the system already running.

5.8.4 Rubrics-based Systems

As described in detail in Section 4.4 rubrics can and should be used in the assessing process regarding the consistency, transparency and as a guide for fair and correct assessment. There are several online tools available that support teachers in creating rubrics. Open source tools and commercial programs are available and they all are very similar in structure, functionality and handling. Some common and interesting rubric maker tools are listed below:

- Rubistar[2]

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[2] `http://rubistar.4teachers.org/`; visited on 12th December 2010

- Rubric Maker at scholastic.com[3]

- Rubric Maker at Recipes4Success[4]

- Assessment Generators Tools at thecanadianteacher.com[5]

- iRubric at RCampus.com[6]

- Rubric Maker at TeAch-nology.com[7]

- Rubric Maker at MCAS Mentor[8]

- Rubric Machine - a collaborative rubric toolkit[9]

For a better understanding of the functionality and usability of these tools some of them are described in detail in the following subsections. Summarizing the strengths and weaknesses of the online rubric maker tools will be listed afterward.

5.8.4.1   Rubistar

Rubistar is a popular online tool to create and store rubrics for the assessing procedure and for using this rubric there is a download possibility provided (formats can be chosen between an EXCEL file or an offline browser document). Figure 5.3 shows the process of the rubrics creation with this tool. It is important to mention that there is a pre-selection regarding the type of assessment (for example essay, report, oral presentation) and according to that choice there are several categories provided (4teachers.org, 2010).

The key points of the rubrics creation within this tool are the following:

- To each category there is a limitation of four different levels of achievement and every category has to have these levels of achievement so it is not possible just to add statements for formative purposes instead of measuring all of them.

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[3]`http://teacher.scholastic.com/tools/rubric.htm`; visited on 22nd December 2010

[4]`http://myt4l.com/index.php?v=pl&page_ac=view&type=tools&tool=rubricmaker`; visited on 22nd December 2010

[5]`http://www.thecanadianteacher.com/tools/assessment/`; visited on 12th December 2010

[6]`http://www.rcampus.com/indexrubric.cfm`; visited on 22nd December 2010

[7]`http://www.teach-nology.com/platinum/samples/rubrics/`; visited on 22nd December 2010

[8]`http://www.mcasmentor.com/rubrics.htm`; visited on 28th December 2010

[9]`http://landmark-project.com/rubric_builder/index.php`; visited on 28th December 2010

Figure 5.3: Rubric Creation with Rubistar (4teachers.org, 2010)

- There is no way to build subcategories and sometimes it is also not sufficient to measure every category with the same levels of achievement but there is no possibility to proceed differently.

- It is a free tool and easy to use but limited in the creation of detailed and varying rubrics.

- The name of the categories and the detailed description of the levels of

achievement for each category are predefined and if wanted they can be changed.

- Additional feedback not included in the rubric can not be given to students and therefore it is not as flexible as it should be.

5.8.4.2   Assessment Generators Tools

This site provides a tool for the creation of different types of rubrics but the organization of the rubrics creation is almost the same as shown with Rubistar. The different types of rubrics supported are (TheCanadianTeacher.com, 2010):

- **Weighted Matrix Rubric:**
  Is a rubric with four different levels of achievement and up to five criteria can be included.

- **Matrix Rubric with Points:**
  Is also a weighted rubric with four different levels of achievement and up to five criteria. The only additional setting which can be done is that every level of achievement in every criteria can have its unique amount of points.

- **Rating Scale (from 3 up to 5 points):**
  This is a scale including up to ten criteria and instead of a informative description of the different levels of achievement points are given.

As explained in the listings above a limitation of five criteria for a rubric is very low but it is a free tool, easy to handle and for simple and small rubrics it can be used.

5.8.4.3   Rubric Maker at Recipes4Success

The rubric maker at recipes4success provides another comfortable possibility to create, store and export rubrics. Figure 5.4 shows the easy process to develop an own rubric with this tool. This free online tool, contrary to Rubistar, is not limited in the amount of categories. Additionally, a description and checklist for the better understanding of students can be provided.

Figure 5.4: Rubric creation with rubric maker at recipes4success (Recipes4Success, 2010)

5.8.5 Electronic Coursework Assessment and Feedback (e-CAF)

e-CAF[10] is a web-based tool still in the development stage that provides the possibility of detailed marking schemes to make the assessing process more consistent and transparent. At this stage of development they promote being able to create a marking scheme which is build up like a rubric but supports as many categories with subcategories as wished (Wong, Sellers, & Beaumont, 2008; University, 2008). Figure 5.5 shows the procedure of the creation of such a marking scheme with e-CAF and it seems to be not as trivial as it should be and a certain

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[10]`http://keg.cs.aston.ac.uk/proDtls/proDtls.php?id=63`; visited on 12th December 2010

technical expertise would be needed.

Figure 5.5: Flexible marking schemes with e-CAF (Wong et al., 2008, p. 2293)

5.8.6   Findings Regarding Existing Feedback Procedures

This section summarizes the findings of how feedback is treated in learning management systems and rubric tools:

- **Consistency:**
  Whereas feedback and marking in LMSs is not consistent because it is independent from each other and no pre-prepared feedback is available, rubric based systems guarantee consistency and provide a good structural scheme for both teachers and students to dispel all misunderstandings.

- **Transparency:**
  LMSs do not provide transparent feedback and marking procedures because they are not connected to each other and feedback is subjective regarding the teacher or tutor.

- **Limitations:**
  Existing LMSs and rubric tools have limitations in their possibilities of providing appropriate feedback to students as they are (i) a separation between assessment for summative and formative purposes, (ii) a maximum of categories in rubrics or (iii) difficult to understand and use.

- **Flexibility:**
  When using rubric tools it is not possible to vary between criteria including and excluding a level of achievement therefore all the feedback is also for measuring students work.

- **Objectivity:**
  Rubric based systems provide categories with levels of achievement but sometimes it is useful to concentrate only on the feedback rather than measure students. Therefore this motive of assessors always plays a significant role and is not objective regarding this concerns.

- **Positive Feedback:**
  With e-CAF or rubric tools positive feedback is given when the level of achievement is high but it can not be added without measuring a criteria.

- **Export:**
  All the rubric based systems provide a comfortable solution for exporting the whole rubric. After the export the rubric can be saved as an EXCEL file, HTML offline page, text or PDF file.

- **Comfort:**
  Within rubric based systems most of the tools provide a pre-prepared text for the different levels of achievement for several categories and if a teacher is satisfied with this description the creation of a rubric is very easy. The text can be changed if wanted and so this is no restriction of this kind of tools.

- **File Format:**
  Some of the tools provided only allow the handling of a certain file format. This is a very strict restriction and in order to provide a high flexibility it should be possible to support as many different file formats as possible. The restriction of supporting paperless work only is not desired. For example oral presentations and videos are also file formats that should be supported.

All these findings should help for defining the requirements of the project and lead to an e-Assessment system that guarantees best quality feedback which is fair, consistent and flexible.

5.9   Summary

Regarding the fact that the number of students on the universities are increasing but teaching staff stay nearly the same it is very essential to focus on e-Assessment for reducing the time to spend on assessing students work for both formative and summative purposes. A special attempt should be on formative e-Assessment as it is very important for students' progress in the educational development (for formative assessment see Section 4.3.2).

This chapter presents several motivations and rationales for using e-Assessment in higher educational institutions and provides classifications of e-Assessment. As described in Section 5.4.1 computer based assessment (CBA) and computer assisted assessment (CAA) are two different things and the focus in this thesis is on CAA especially in the fields of formative assessments.

> *"E-assessment enables feedback to be delivered instantaneously. This provides an opportunity for students to take immediate action to 'close the gap' between their current level and a reference point, and thus for the feedback to be effective"*(Jordan & Mitchell, 2009, p. 371)

In addition to the findings in Chapter 2 and 4 the quotation above completes the argument of necessity of quick feedback in order to help students for a positive progress in their learning behaviors and e-Assessment is the way which reaches exactly this goal in the educational process.

The findings of how existing software tools are handling the part of appropriate and instantaneous feedback concludes the chapter and also the theoretical part of this thesis. According to Section 5.8 common software tools dealing with summative and formative assessment have several disadvantages. Although, for example, rubric based systems offer high comfort and consistency, it is difficult to give specific feedback regarding one single assignment. Another problem is the flexibility and objectivity of existing systems concerning feedback for formative or summative purposes. If feedback is given it is obviously connected to a level of achievement and this sometimes hinders a tutor or assessor to give exactly this feedback. Because of that it should be possible to hide levels of achievement, marks, grades or whatever and just concentrate on formative assessment.

In the next chapter the practical part starts with defining the requirements for the project based on the findings from the theoretical part especially on these regarding feedback in existing e-Assessment tools as shown in Section 5.8. Aim of the practical part is to find a solution to combine formative and summative assessment and keep it fair, consistent, transparent and provide feedback as well and instantaneously as possible.

Chapter 6

Requirements and Design of the Prototype

The previous chapters form the basis for the practical part of the thesis. As shown in Chapters 2, 3 and 4 it is very important to support students in learning for a better outcome and the guarantee of quality of a higher educational institution. With the new information and communication technologies the possibilities of these support has been highly increased. Like it is discussed in Chapter 5, e-Assessment gets more and more practical not just in summative assessments but for formative purposes as well. Therefore the special focus of this thesis is on the support of teachers and tutors in giving appropriate, immediate and consistent feedback to their students about their work and performance.

> *"Assessment is not only used for measuring and judging students work [...] The use of computers facilitates the process of tracking user behavior and performing assessments as well as analyzing the results. Consequently, it is much easier to provide feedback about students work immediately or timely during courses. As a result, they can easily find their ways to success."*(AL-Smadi & Gütl, 2008)

This chapter will describe the requirements and design of the prototype developed in the course of this master thesis. *Technology Supported Assignment Assessment and Moderation (tsAAM)* is a tool which provides a solution for the difficult approach of combining feedback and assessment.

The realization of the project within this master thesis is based on a cooperation of Curtin University of Technology in Perth, Western Australia and University of Technology in Graz, Austria. The development of the prototype

has been run during an abroad semester in Australia concentrating on the needs of both, Australian and Austrian requirements for teaching and learning.

6.1   Project Idea

After the literature research and interviewing university staff including the supervisors of both, the Curtin University of Technology in Perth and the University of Technology in Graz, the project team existing of Heinz Dreher, Carl Dreher, Christian Gütl and the author of the thesis decided to concentrate on developing a software tool that combines grading, assessment moderation and formative assessment for several types of assignments.

The aim of this project is the development of a prototype that provides on the one hand a platform for teachers and tutors to assess students' submitted assignments regarding a prior created rubric including a range of feedback statements. The feedback should be useful and appropriate for the needs of students. In fact, in many higher educational institutions the focus is on grading students rather than giving them feedback that they can use to improve their learning behavior. But it should be different! Teachers and tutors should concentrate on the feedback and behind these feedback grading criteria are hidden. A better support for students in their learning progress is the goal and therefore a software tool to help teachers and tutors realizing this goal has been developed. On the other hand there should also be a platform for students to get access to this feedback immediately after assessment for concentrating and improving their future work as soon and well as possible.

6.2   Requirements of the Software Tool

As the development of the software regarding the practical part of this thesis is a cooperation of Curtin University of Technology in Perth, Western Australia, and University of Technology Graz, Austria, the requirements have been defined based on following points:

- Brainstorming with the author's supervisors from both universities and the research group of Curtin Business School.

- Several interviews with collegues from the Faculty of Humanities at Curtin University of Technology.

- Analyzing the data of the literature research presented in Chapters 2, 3, 4 and 5.

The requirements of the software tool are split into functional and non-functional requirements. Within the functional requirements there is another distinction between requirements regarding students and teaching staff. In the following two subsections those requirements are specified.

6.2.1 Functional Requirements

The functional requirements of a software systems are defined to have a specification for a system that describes the functionality of the program such as the input output behavior. This specification is a list that describes what the software should be able to do when it is correctly implemented (Versteegen, 2002, p. 19). As mentioned in Section 6.1 the tool consists of two different parts, a kind of course management and submission center for students as well as the tool for assessing and moderating the uploaded assignments for the teaching staff. Table 6.1 summarizes the functional requirements from the sight of the learner, in this case the students are meant.

Functional Requirements - Learner
Quick and Appropriate Feedback   The feedback students get should be as fast and appropriate as possible. Then they can take the gained information for improving their next assignment.
Transparent, Consistent and Fair Assessment   Clear rubrics should guarantee transparency and consistency as well as the fairness in the assessing procedure.
Formative and Summative Assessment   For students it is important to get a good mark at the end of a semester but to reach this, especially for future courses, it is important to get high quality feedback as well.

Table 6.1: Functional Requirements From Learner's Point of View

Contrary to the requirements of the students' point of view Table 6.2 shows the requirements from the perspective of the teaching staff such as lecturer, external assessors and tutors.

Functional Requirements - Teacher
Manage Courses and Assignments The creation of courses and assignments with its deadlines should be possible. Each assignment is connected to a prior created rubric and is taken for the assessment and moderation of all submissions done by students.
Rubrics Creation and Storage Step by Step creation of rubrics including detailed feedback statements. Rubrics can be saved and used for several assignments teachers want to use them.
Formative and Summative Assessment It should be possible to choose for each assignment if it should be for formative or summative purposes. Optionally, there is the feature of grading and in this case the rubric including the feedback statements are connected with percentages that are subtracted if chosen for a certain assignment.
Consistency of Assessment Caused by hidden percentage behind feedback statements the feedback itself is in the foreground and therefore the summative assessment should become more consistent.
Add Individual Feedback The system should be self-learning which means that it should be possible to add additional feedback statements during runtime which expand and refine the rubrics permanently.
Moderation and Automatically Sending or Providing the Feedback Based on the created rubric including the appropriate feedback for students the assessment of students' assignments should be done and after completion of the feedback should be automatically provided to the students.
Anonymity of Students During the whole assessing process the students should be anonymous. When assessing students' work no information about the students should be shown as well as after the assessing procedure.

Table 6.2: Functional requirements From Teacher's Point of View

6.2.2 Non-Functional Requirements

These requirements have nothing to do with the functionality of a software program but are as essential for the customer's satisfaction as functional requirements. Non-functional requirements are requirements regarding the quality of a system and are more difficult to implement because they are not easy and clear to

Non-Functional Requirements
Usability   The usability of the whole tool needs to be self-explaining and easy to handle for both, teacher and learner - a user guide should be provided.
Security and Reliability   Students' assignments and performance include sensitive data, so they need to be securely saved and treated. The assessing process needs to be reliable regarding security and correctness and therefore this is a critical requirement of the program.
Portability   It should be possible to install and set up the system (including or excluding data) on another server without troubles.
Costs   The implementation of the tool should be based on free technologies if possible, so the costumers (the higher educational institutions) have no licensing troubles.

Table 6.3: Non-Functional requirements of the prototype

define (Versteegen, 2002, p. 19-20). In Table 6.3 the non-functional requirements of the prototype are declared, well knowing that they are not a hundred percent acceptance criteria.

6.3 The Conceptual Design of the Project

In this section the conceptual design of the project is described. First, the focus is on technical considerations and main ideas regarding the design that it satisfies requirements from the previous section. After an overview of the structure of the prototype the further subsections include the sequence of events in order to reach the main features of the project.

6.4 Considerations Regarding the Design of the Project

The first consideration regarding the design of the project is that the tool has to satisfy two parties and the requirements defined in 6.2.1 show the differences of their needs. Whereas one main feature for the students' part is the ease of

user management the focus of the assessment and moderation part is on rubrics creation, quick responses from the server and graphical web page design. Therefore the question has been if the tool should be one big tool or two single tools interacting with each other. The decision for the prototype has been on splitting the project into two parts (*StudentCenter@tsAAM* and *tsAAM*) caused by the following reasons:

- Different needs for students and teaching staff are the main reasons for splitting the project into two parts.

- Frameworks that provide good approaches for the main features of each part are available.

- The part for teaching staff does not have to be online outside a university, it is enough if it is internally online. Students' area has to be online available as it is defined in the requirements above.

- Concerns regarding the security also need to be mentioned. As the data in the process of students' assessment are very sensitive it is better running both the single parts separated from each other.

- The project is flexible in this way and can be offered with or without the part for students.

Once the decision has been on splitting the project in two different parts another question has been what tools or frameworks to use for each part.

Framework for tsAAM
tsAAM should be developed as a rich internet application caused by the large number of interactions between the server and client. A framework for developing such application should be found and Java based framework is to prefer. Java is platform independent and the Apache Tomcat[1] is an open source server where the application should run on.

Framework for StudentCenter@tsAAM
For the *StudentCenter@tsAAM* it is very important to guarantee a comfortable, easy and good conception for the user management. Almost every university is running an LMS like Moodle or WebCT and therefore first thoughts have been

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[1] `http://tomcat.apache.org/`; visited on 23rd December 2010

to write a plugin for LMSs realizing the requirements for this part of the tool. The decision for the prototype then has been on extending a CMS and further development should provide interfaces that data from every LMS can be used.

6.5 Overview of the Project Design

As specified in the requirements (see Section 6.2) the software tool needs to satisfy two parties, teachers and learners. Therefore, the decision is for splitting the project into two different parts (see considerations of the previous section):

- **StudentCenter@tsAAM:**
  A platform for students to subscribe to courses, submit assignments and after assessment is completed they can also get access to their individual feedback. If the assessment is for summative purpose a mark will be provided as well. The *StudentCenter@tsAAM* should implement all the functional requirements listed in Table 6.1 and also consider the non-functional requirements from Table 6.3. As the students should get immediate feedback to their work at any place and time it is natural to implement this part of the project as an online platform where these points are guaranteed as long as an internet connection is available.

- **tsAAM (technology supported assignment assessment and moderation):**
  Another platform for teacher and tutors to create, save and modify their rubrics and use them for one or more assignments if wanted. After opening an assignment students can do their submissions and teachers and tutors are able to proceed with the moderation of the assignments. When the moderation is completed the student is notified about the result of assessment and can get access to the feedback via the *StudentCenter@tsAAM*. The aim of this part of the project is to implement all the functional requirements shown in Table 6.2. Due to the fact that the program is dealing with very sensible data it is important to have an eye on the security and other functional requirements listed in Table 6.3.

Figure 6.1 show the general structure of the project with its two separated parts for teachers and learners. As shown in the figure both parts of the project use the same database so the data are central. To avoid inconsistency between both parts of the project and to keep the data up-to-date all the time it is obvious and required to store the whole data needed in one database to be unique.
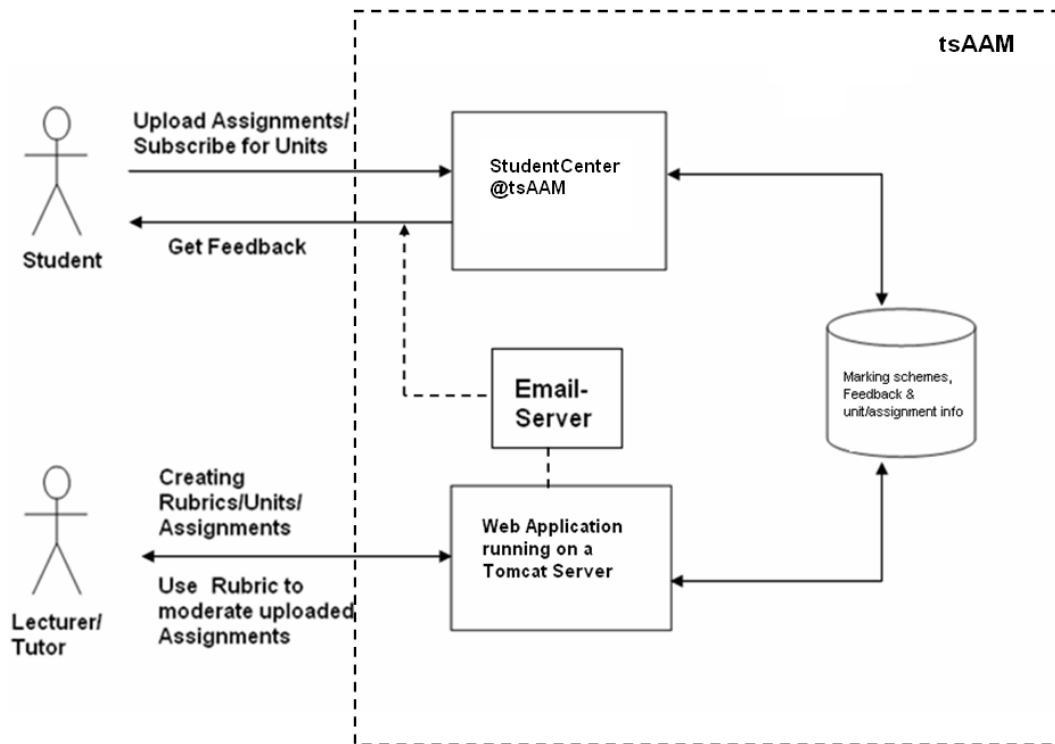
Figure 6.1: The conceptual design of the project

6.5.1   StudentCenter@tsAAM

The requirements in Table 6.1 and description above show the points of Student-Center@tsAAM that should be implemented and in this section the discussion is about the design and problems regarding this part of the project. Whereas the subscription to courses and uploading of assignments is a trivial point in e-Learning environments and therefore often discussed the focus here is on the delivery and type of feedback given to the students. The tool should handle the delivery of feedback in two steps, (i) an email for notification that a submitted assignment has been assessed and (ii) the feedback should be provided at StudentCenter@tsAAM. In a time where smart phones, iPads and Notepads are everyone's life it is necessary to notify students via email about the assessed assignments because they have access to their emails nearly everywhere. After successful login at StudentCenter@tsAAM the detailed feedback for all assignments can be accessed.

Regarding the form of feedback it is required to see the whole rubric and the

feedback statements accurate for the uploaded assignment. If the assessment is for summative purposes as well the information should include rubric and feedback statements including the percentage and therefore a detailed breakdown of the provided total percentage.

6.5.2   Rubrics Creation with tsAAM

The aim of this part of the project is to find an easy way for teaching staff to create their own flexible rubric. Flexible in this context means that the rubric should have as many categories as wished and each of these categories itself can include several subcategories. For the reason of consistency in the further document the categories are called *first level* and the subcategories *second level* of the rubric. As the development is for a prototype the concentration is on providing the possibility of two levels but not more. The important thing of the rubric is that each category can include *feedback statements* , as many as wanted and they can be both positive and negative feedback. Figure 6.2 shows such a rubric that should be able to be created by tsAAM. As shown in the figure the rubric in its form is hierarchical and includes pre-prepared feedback statements to be consistent.

```
Preliminary Work (20)
  * Research (30)
  * Organization (30)
  * Structure (40)
Design (30)
  * Structure (33)
  * Formatting (33)
  * Navigation (34)
Content (30)
  * Subject Knowledge (40)
  * Resources (60)
Presentation (20)
  * Presentation Media (50)
  * Gesture and Language (50)
    - Less eye contact to the audience, reading from the paper (20)
    - Shy appearance during the whole presentation (20)
    - Student is mumbling during the presentation (20)
    - Presentation is not fluent (40)
    + Proffessional and positive appearance
    + Appropriate eye contact to the audience
    + Presentation is fluent from beginning to the end
```

Figure 6.2: Sample rubric for presentations created within tsAAM

Rubrics including the property of grading for summative purposes:
The rubric shown above includes the property of grading and as shown there

the points in brackets sum up to hundred that is why they are interpreted as a percentage rather than points. Each level of categories and also the negative feedback of each rubric entry must sum up to hundred. Starting by a hundred percent for each assignment to assess this percentage is reduced according to the feedback statements chosen for each assignment (for example rubric above: when feedback statement "Presentation is not fluent" is chosen the total percentage is reduced by *100*0.2*0.5*0.4=4* percent). After finishing the assessment of a single assignment there is a total percentage provided and regarding the marking scheme a mark can be given.

Procedure of Rubrics Creation:
For the procedure of the creation of such a rubric the decision is to follow a step by step approach whereby the steps are (i) create the first level of the rubric, (ii) for each entry of level one create the second level and (iii) adding the feedback statements. The third step where the feedback statements will be added to the entries of the rubric should provide the rubric in form of a tree. After selection of a certain rubric entry in the tree there should be the possibility of adding positive and negative feedback statements including or excluding a percentage for the property of grading [2].

Using a Created Rubric for Assessment:
Once a rubric has been created as described above it can be stored to the database but not used for assessment. Before using it an assignment for a certain course needs to be created and opened and within this act the assessing scheme of an assignment can be associated with a special, pre-stored rubric. Based on this procedure it should also be possible to use rubrics for different courses and assignments and from different lecturers if wanted. Accordingly, teachers should profit from already created rubrics although it is created by a colleague of them.

6.5.3   Moderation of Assignments with tsAAM

The moderation or assessment of assignments should be based on the rubrics that are created before. Important hereby is that usually tutors, internal or external assessors are doing the assessment of assignments and they should do it objectivly. To guarantee objectivity they should concentrate on giving appropriate feedback rather than giving marks and therefore the weighting of each statement

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[2]In the presented form of the rubric percentages can only be given to negative statements because the principle is based on reducing the total percentage starting with a hundred percent

should be invisible to them.

Due to the fact that more than one assessors are needed for large classes the program should be designed to manage this. Accordingly, as a web based tool it should provide multi-user access and when an assignment is in progress it should be locked or be invisible for other assessors that multiple assessments or inconsistencies are avoided. After the assessing procedure it should be possible for all of them to have a look at the assessed assignments no matter who was the assessor.

As it is one of the functional requirements to allow additional feedback during the assessing process there should be a possibility to add both positive and negative feedback to the assignment and rubric. After assessing some assignments the rubric will be completed caused by storing the new feedback statements. Tutors will then profit from each other in the way that feedback statements are added to the rubric and are available to them although they probably have not thought about their necessity.

6.6   Summary

In this chapter all the requirements regarding the software tool *technology supported assignment assessment and moderation (tsAAM)* are defined. The requirements are based on the literature research presented in previous chapters, several interviews with different departments of Curtin University of Technology and brainstorming results found with the project team including the supervisors. Generally, there are three major categories of requirements: functional requirements of students, functional requirements regarding teaching staff and the non-functional requirements of the project.

From the students' point of view it is important to get quick and appropriate feedback to their submitted assignments. Another key fact is to keep assessment transparent, consistent and fair and in order to do so, clear assessing schemes should be indicated and published. These announcements should be made at the beginning of a course or at least early enough for students to react properly.

On the other side there is the teaching staff. From their point of view an easy way for the management of courses and its assignments is important. It is also essential to provide a good procedure of rubrics creation and using them for formative and summative assessments. Regarding the moderation of assignments it is important to keep the feedback consistent but the possibility of individual and additional feedback should be given. After assessment an automated notification to students should happen in order to reduce their effort.

Within this chapter decisions regarding the conceptual design of the project

are shown. One of the most important decisions has been to split the project into two different parts, one for satisfying the students' needs (StudentCenter@tsAAM) and one for the teaching staff (tsAAM). It is also described in detail how the important points of the program should work if the implementation is possible. The main focus of the conceptual design is on (i) creating rubrics, (ii) using a rubric for moderation or assessment of assignments and (iii) the procedure how students get their feedback and what it looks like. These are also the points with special attention in the implementation phase.

As the focus in this chapter is on the requirements and design of the prototype the next chapter will concentrate on how the prototype is implemented. A special attempt will be on the several technologies and softwares used with reasons for the developer's choice given. The main focus of the next chapter will be on the way of implementation to fulfill as much of the requirements as possible as a part of this thesis.

Chapter 7

Development of the Prototype

The previous chapter defines the requirements and the conceptual design of the prototype is shown. Based on these facts this chapter focuses on the development of the prototype. First the different technologies used for the prototype are explained and afterwards the detailed description of the prototype's implementation and usage is given. After a detailed description of the development process the main findings of the project are discussed. A user study evaluates functionality and usability of the tool and results are shown as a part of the findings.

As the prototype's implementation only includes the main functionalities there will be a concluding outlook for additional features regarding the further development of tsAAM.

7.1 Technologies Used

The *technology supported assignment assessment and moderation tool (tsAAM)* uses several different technologies and software. In this section those different technologies are described and it also will be argued why the developer's decision was on preferring them in comparison with other possible ones.

7.1.1 Drupal - A Content Management System

The *StudentCenter@tsAAM* as described in Sections 6.2.1 and 6.3 is an online platform. For the prototype the decision has been on using a content management system and the developer's choice regarding the kind of CMS is on Drupal[1]. Choosing Drupal has several reasons as they are: (i) Drupal is a free content

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[1] `http://www.drupal.org`; visited on 9th December 2010

management system with good and detailed documentation available, (ii) the developer is experienced with this CMS and (iii) the system requirements of Drupal are matching with the pre-installed software on both servers, at Curtin University of Technology as well as at University of Technology Graz, where the project has been developed.

The system requirements for setting up a Drupal system on a server are the following ones (Drupal, 2010b; Drupal, 2010a):

- **Web Server:**
  Drupal needs a web server but there should be no matter if Apache (on Unix or Windows) or Microsoft IIS as it is a content management system developed to be platform independent.

- **Database Server:**
  Drupal is running on several database servers but it is recommended to use MySQL as it is intensively tested. When using Drupal it is important to make sure that the web hosting service grants rights for all data manipulation, definition and control commands.

- **PHP:**
  Drupal is a content management system based on PHP and version 4.4 is required at least for running Drupal on a web server but recommendations are varying from version to version.

7.1.2   Database Management System

For the project a database for both the Drupal installation as well as the whole data regarding the project is needed and therefore the decision is on using the same database for both. As the University of Technology Graz and Curtin University have both a pre-installed MySQL[2] in version 5.1 running the decision is on using this one because there are no conflicts regarding (i) requirements for the database and (ii) knowledge and preference of the developer.

7.1.3   GWT - Google Web Toolkit

The Google Web Toolkit (GWT)[3] is an open source development toolkit for the development of rich internet applications (RIA). It was first released in 2006, from

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[2]`http://www.mysql.com/`; visited on 20th December 2010
[3]`http://code.google.com/webtoolkit/`; visited on 3rd December 2010

2007 it has been offered as an open source tool and is now available in its 2.1 version. The architecture of GWT is based on JavaScript and HTML whereas the whole application is written in Java and converted to JavaScript during runtime. The GWT library was developed to ease and speed up the development of AJAX application whereas the development of them in general is difficult and error-prone. The difficulty of the development of AJAX application is that a part of the implementation has to be done on the client side and therefore in JavaScript. But JavaScript is dependent on the kind of browser used, so additional effort in the development is needed. With GWT there is no implementation in JavaScript and the Java-to-JavaScript compiler considers the browser differences (Google, 2010a; Smeets, Boness, & Bankras, 2008; Dwyer, 2008).

Slender (2009) summarizes the most important features of the Google Web Toolkit as following:

- GWT completely supports version 5 of Java

- The Java-to-JavaScript compiler including a hosted mode simulation for full debugging

- Completely browser independent

- Variety of server communication such as JSON, RPC and XML

- Support of the basic widgets

- Browser independency

- Support of JUnit tests and international languages

GWT has been chosen in order to take a framework for developing rich internet applications. The reasons for using GWT as a framework for development of the prototype are (i) platform and browser independence, (ii) free availability, (iii) possibility of writing AJAX applications without using JavaScript and (iv) the developer's knowledge of programming in Java.

7.1.3.1 AJAX

Asynchronous JavaScript and XML (AJAX) is the conception of using asynchronous data transfer instead of synchronous data transfer for web applications.

Garrett (2005) defines AJAX as not one technology but *"several technologies that incorporate:*

- *standards-based presentation using XHTML and CSS;*

- *dynamic display and interaction using the Document Object Model;*

- *data interchange and manipulation using XML and XSLT;*

- *asynchronous data retrieval using XMLHttpRequest;*

- *and JavaScript binding everything together."*
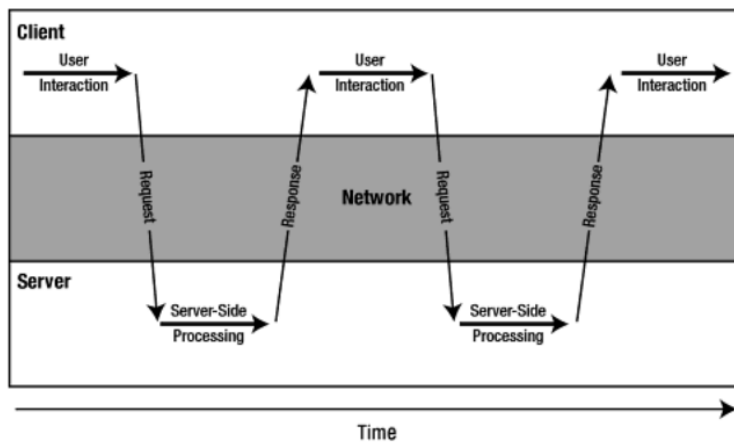
Figure 7.1: Communication Model of a Non-AJAX Web Application (Smeets et al., 2008, p. 6)

The detailed definition of AJAX above show that AJAX is not a special technology rather than a conception of asynchronous data transfer based on XHTML-Requests instead of using synchronous techniques. In Figure 7.1 the procedure of communication of a standard web application is shown. Contrary, Figure 7.2 shows the communication of an AJAX application and the differences can be seen.

7.1.3.2   Communication Between Client and Server

For the communication between the GWT application from the client to the server there are several opportunities provided but the best way to connect both
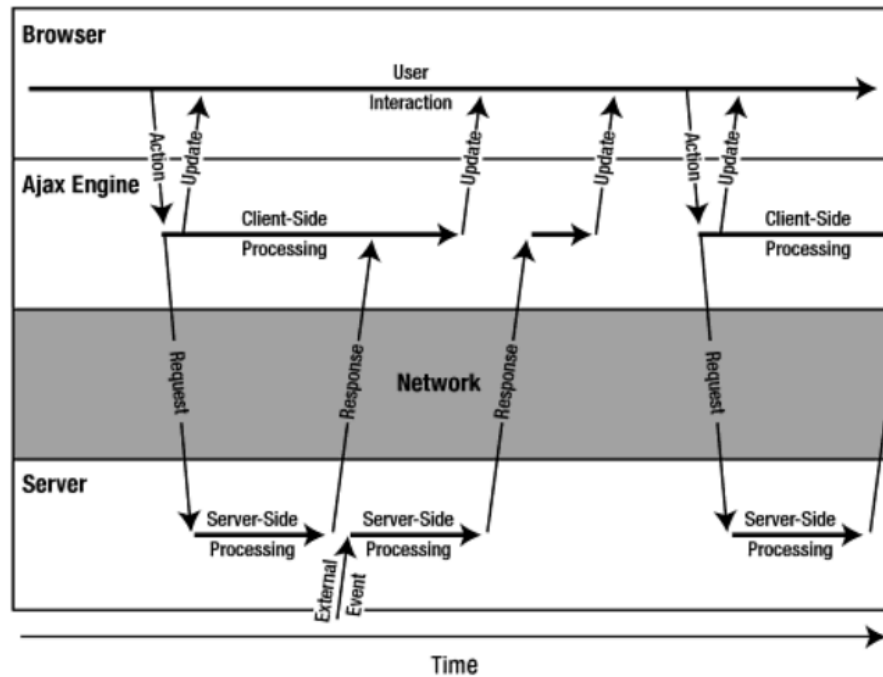
Figure 7.2: Communication Model of an AJAX Web Application (Smeets et al., 2008, p. 7)

sides is the use of the integrated mechanism called *remote procedure calls (RPC)*. To use RPC calls in GWT the first step is to create an object from type *XML-HTTPRequest* to handle the asynchronous transfer procedure. After the server has finished a so-called callback, a method on the client is executed including the return value as a result of the server call. The return value can vary and therefore consists of XML, HTML, normal text or JSON (Seeman, 2008).

Figure 7.3 shows all the components needed when implementing a remote procedure call. To define an own RPC interface within GWT there are three components (two interfaces and one class) to concentrate on (Google, 2010b):

1. **OurService:**
   Is an interface that extends *RemoteService* and includes a listing with all the provided RPC methods for the needed service.

2. **OurServiceImpl:**
   Is a Java class that extends *RemoteServiceServlet* . This Java class should implement all the methods defined in the interface *OurService* .
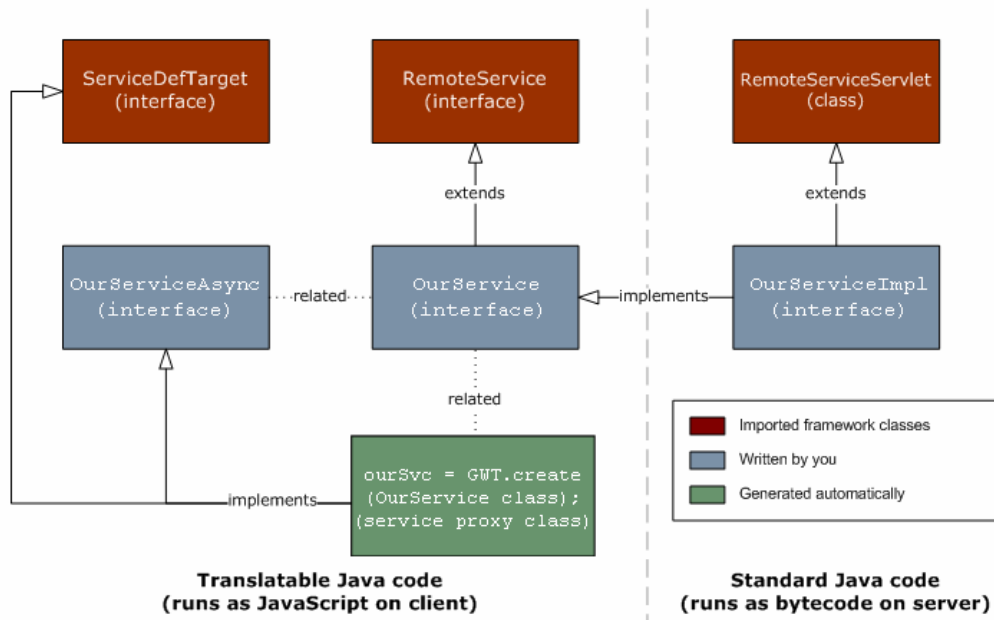
Figure 7.3: Components of a GWT RPC mechanism (adapted from Google (2010b))

3. **OurServiceAsync:**
   Should define the asynchronous interface that belongs to the implemented service. This interface is called from the code on the client-side.

7.2   Installation and Setup

For installation of the whole project consisting of the two parts StudentCenter@tsAAM and tsAAM there are following steps needed:

1. Prepare for installing the tool by providing a web server fulfilling the requirements for installing Drupal (see Section 7.1.1 for requirements). Furthermore, a Tomcat needs to be running on the server for execution of GWT applications.

2. Creation of a database on server for data needed by both the *StudentCenter@tsAAM* and *tsAAM*

3. Setup of the Drupal system: installing Drupal on the new server, duplicate the content of the site and import it on the installed system and changing the database connection to the one the new Drupal system is using

4. Adding the tsAAM specific database tables to the database which already includes all the tables regarding the Drupal installation

5. Setup of the GWT application: copy the whole content of the Web-Inf folder of the project to the Tomcat server and change the database settings

7.3 Implementation of the Prototype

The implementation of the prototype has been done in an abroad semester at *Curtin University of Technology in Perth, Western Australia* in cooperation with *University of Technology Graz, Austria* and the first version of the prototype has already been introduced at the *1st Technology Enhanced Formative Assessment (TEFA) Workshop at ECTEL 2010* on 28th September 2010 in Barcelona, Spain. Therefore a short paper (cooperation of Daniel Berger, Dr. Heinz Dreher and Dr. Christian Gütl) has been submitted (see Appendix A).

Following sections describe the prototype of the project in detail and all the findings regarding each feature of the prototype are also listed. A video of the usage of the tool is included in tsAAM and also available online[4].

7.3.1 Database for tsAAM

As described in the conceptual design in Section 6.3 the database is used for the Drupal system as well as all the other data needed caused by keeping the system consistent. The main data included in the database are the following:

- **Drupal System:**
  All the needed tables Drupal is installing, including the user management representing the students using the StudentCenter@tsAAM.

- **Submission Information:**
  Once the student has uploaded an assignment it needs to be saved on the server and the position of the file and other relevant data regarding a submission is saved in the database.

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[4]`http://129.27.200.58/cberger/tsAAM.avi`

- **User, Course and Assignment Management:**
  All the relevant data for the course management including its assignments
  (submission date, description of courses and assignments, rubrics) are stored
  in the database as well as the user information regarding teaching staff.

- **Rubrics:**
  Created rubrics are saved in the database and can be used for certain as-
  signments whenever wanted. A rubric in our system consists of a maximum
  of two levels of categories optionally including weighting and feedback state-
  ments belonging to an entry of the rubric.

- **Feedback to Students Uploaded Assignments:**
  Once a student's submission is assessed the information is stored and the
  student can access the feedback whenever wanted - the data are also a
  documentation for students about their progress.

Figure 7.4 shows the database schema excluding the system tables from the Dru-
pal installation. In this context it is important to mention that *tsaam_user* first
includes all the users working with *tsAAM*. But there is another table including
all the users from the *StudentCenter@tsAAM*, a system table from Drupal. With
the first subscription from a student to a course or uploading an assignment to a
course the user will be stored in *tsaam_user* as well. From now on the student is
recognized by the tool *tsAAM* with an attribute that shows an user account and
caused by that attribute there is no access to *tsAAM*. Summarizing to the user
management it is worth saying that:

- Data representing a student are stored in the system table of the Drupal
  system and additionally stored in *tsaam_user*. With this account the con-
  nection to courses, assignments and feedback is realized but the access to
  tsAAM is denied by an attribute (*type*).

- Teaching staff is only registered in *tsaam_user* and has no access to the
  students' platform.

7.3.2   Realization of StudentCenter@tsAAM

As defined in Table 6.1 the *StudentCenter@tsAAM* should provide transparent
and fair summative assessment as well as formative assessment which is consistent,
appropriate and quick available. Following subsections describe the tool from the
technical side and the usage of *StudentCenter@tsAAM*.

Figure 7.4: Database schema of the project

7.3.2.1 Technical View of StudentCenter@tsAAM

This part of the project is implemented within a Drupal system and Figure 7.5 shows the process of the tool from the registration of a student to accessing the feedback. Hereafter, important details about the procedure and implementation are mentioned.
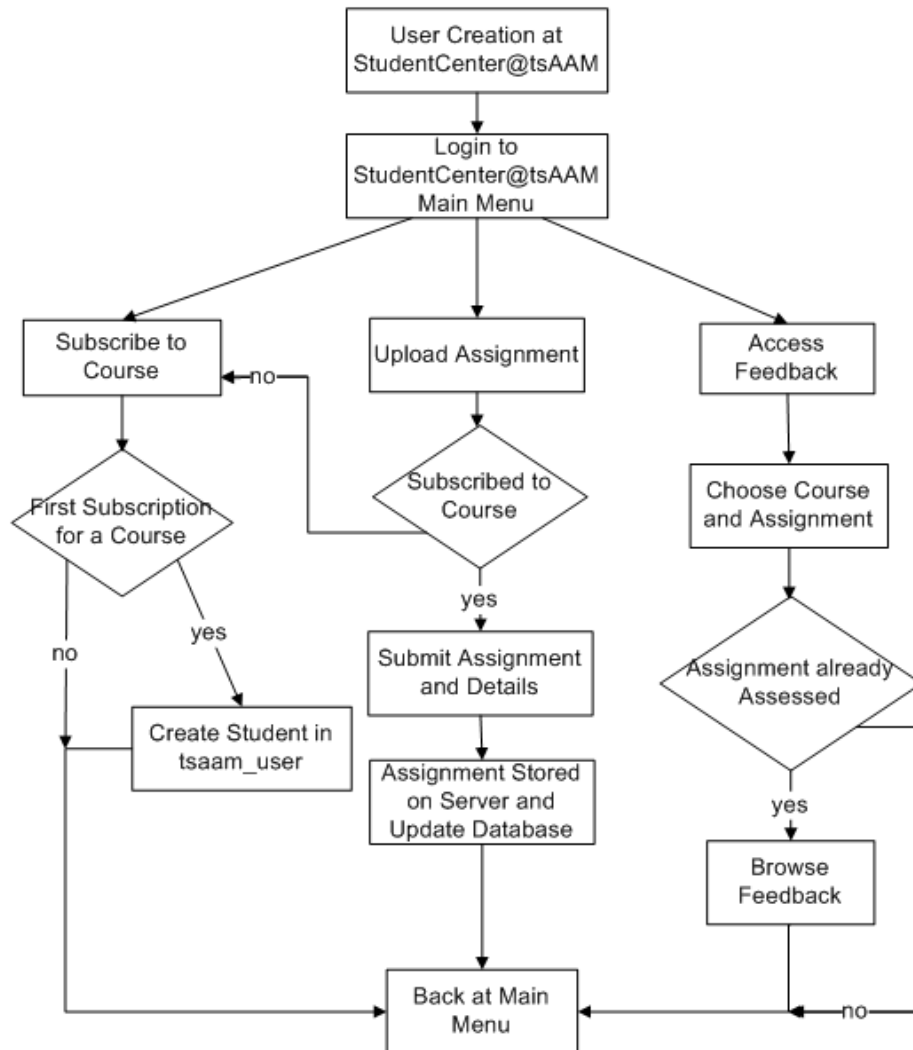
Figure 7.5: Workflow of StudentCenter@tsAAM

PHP Scripts:
The single functionalities within this system are implemented as PHP scripts embedded in the sites of the CMS. These PHP scripts handle the communication with the database and also store the submissions on a secure server. Therefore, the server has to grant the execution of PHP scripts. Another restriction for the server grants is regarding the folder where the assignments are stored. The assignments should be saved on a save place, but the system needs grants for

storing them there.

Registration of Student to StudentCenter@tsAAM:
The registration of students within the tool can be done in two different ways:

- Subscription directly at the site and the system administrator has to acknowledge the registration.

- Cron jobs[5] can be written to get user data from external sources, for example an existing LMS or other database.

After registering a student in the Drupal system the student has full access to the StudentCenter@tsAAM, but is not stored to *tsaam_user*. For subscribing to courses and uploading assignments the student needs to be stored there and the procedure is the following. As Figure 7.5 shows this step happens while the student subscribes for a course the first time. Then the account is saved to the table with an attribute identifying the type of the account. This type is essential when working with *tsAAM* and for students the access to this tool is denied.

Access to Feedback:
As soon as a submitted assignment is assessed the feedback is available. In addition to providing the feedback at StudentCenter@tsAAM the students get an eMail when the assessment is completed. On the one hand this eMail is a notification for the availability of the feedback. But on the other hand it also includes a report including the whole feedback so students can access it wherever they are and just need access to their mails.

7.3.2.2 Course Subscription and Assignment Upload

As described in Section 6.2.1 the requirements for the software from the students' viewpoint are concentrating on the feedback but the implementation also includes the points of course subscription and uploading of assignments to courses. Of course, almost every university has its online environment where these things are already provided but for the development of *tsAAM* it is not permitted to use the highly sensitive data and therefore an own system needs to be implemented.

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[5]`http://drupal.org/cron`; visited on 23rd December 2010
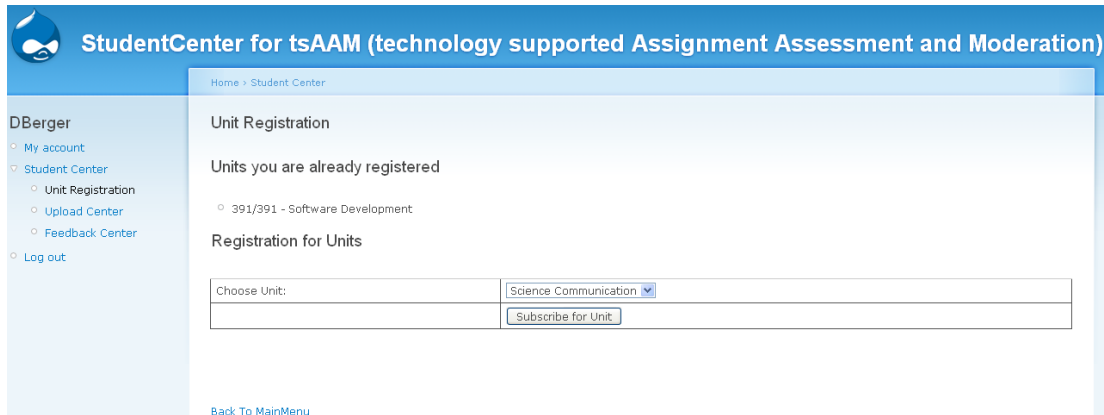
Figure 7.6: Course subscription with StudentCenter@tsAAM

Figure 7.6 show how students can subscribe to courses and in Figure 7.7 the procedure of the submission of assignments is shown.
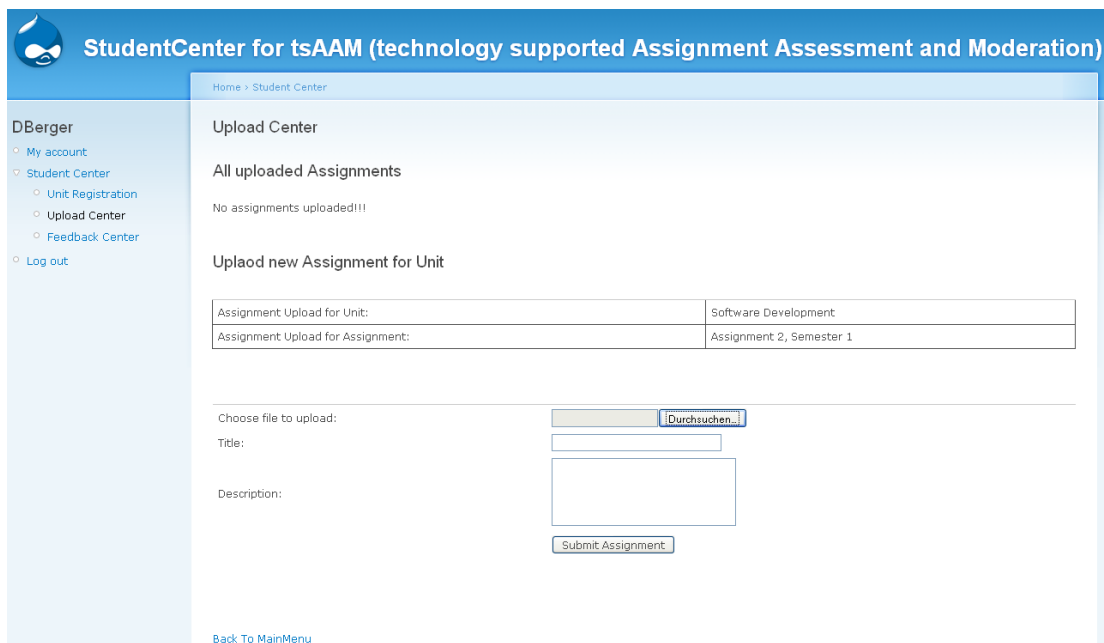
Figure 7.7: Assignment Submission with StudentCenter@tsAAM

7.3.2.3 Feedback to Submitted Assignment

According to 6.5.1 the plan has been to send a notification email to the student when an uploaded assignment is assessed and then the student can get access to the detailed feedback within *StudentCenter@tsAAM*.

During implementation the developer decided to proceed a little different. When the assessment of an assignment is completed the student gets an automatically generated email already including the detailed feedback. In cases of additionally using the tool for summative purposes also a mark will be provided. In addition the student has still the other possibility to access the feedback - the *StudentCenter@tsAAM* provides also the feedback to all submitted and assessed assignments of all subscribed courses and is therefore a good documentation of the performance of a student and can be taken for self-evaluation.

Figure 7.8: Access feedback with StudentCenter@tsAAM

Figure 7.8 shows the form of feedback this tool is providing and apparently it has the same structure as the created rubric including the distribution of percentages for each category of the rubric so the student is able to follow the procedure of

summative assessment. The transparency, consistency and fairness of assessment will be guaranteed in this way as specified in the requirements in Table 6.1.

7.3.3   Realization of tsAAM

tsAAM is the main component of the project and the main features will be described within this section. The requirements for this part of the project are shown in Table 6.2 and accordingly the main focus is on combining formative and summative assessment. The approach presented is based on the use of a flexible, well-structured and clear rubric including appropriate feedback statements that can also be for measuring students' work. The following subsections describe the technical view of the software as well as the usage of theh main features of *tsAAM*.

7.3.3.1   Technical View of *tsAAM*

tsAAM is implemented as a rich internet application using the framework GWT. The two most important features of this part of the project are (i) the management of courses and assignments, (ii) the creation of a rubric and (iii) using the created rubric for assessing an assignment. Figure 7.9 show the procedures of these parts of the tool. Hereafter, some important details regarding the implementation of *tsAAM* are described.

Remote Procedure Calls and Object Handling:
As described in Section 7.1.3, the google web toolkit allows to write the whole web application in Java (at server and client side). The comfortable side effect is the possibility to use the same objects at both sides. For using the defined complex objects at both sides and also send them with the RPC it is important that every object implements the interface *com.google.gwt.user.client.rpc.IsSerializable.* Figure 7.9 shows the principle procedure of *tsAAM.* All the server calls (remote procedure calls) are shown in the figure with *"Send ..."* and also the functions for loading data need an RPC to get the data to list.

Tree Structure of Rubric:
GWT provides a good possibility to visualize data in form of a tree. Every node of the tree can be a Widget and has a unique key. As an AJAX application the advantage from opening a node of tree is that just this part of the site will be rebuild and therefore, although a big amount of data is shown at the site, the response is very quick. One disadvantage of the tree structure is the different
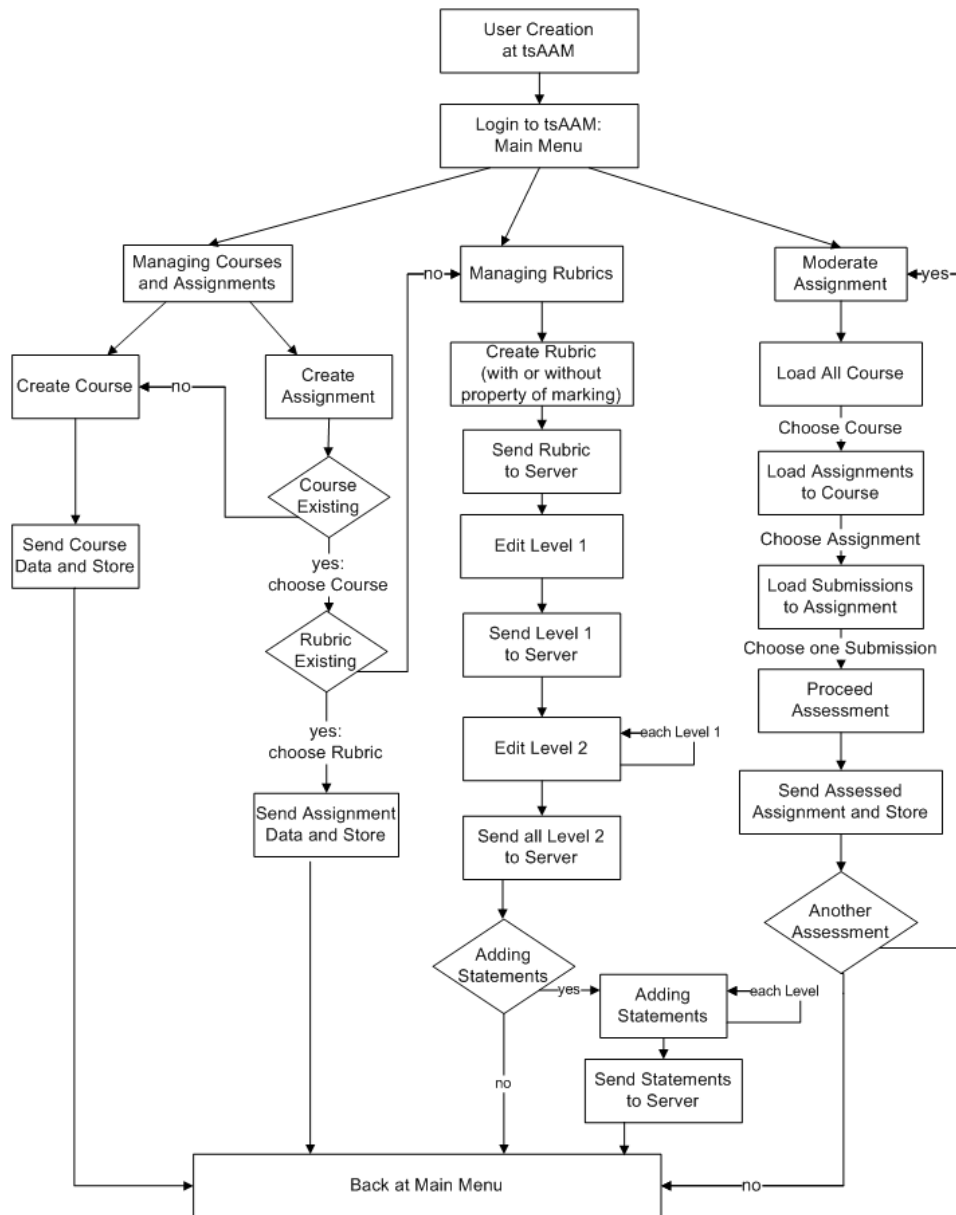
Figure 7.9: Procedure of tsAAM

handling in different browsers. Tree nodes are only highlighted in the Internet Explorer.

Percentage Distribution:
When the rubric created is with the property of grading, every level of the rubric needs to summarize to hundred percent. The program proves this fact in order to avoid inconsistency and errors in the grading process. If one level has more than hundred percent a server method calculates the new percentage regarding the weighting (reduces every entry proportionally). For the case that a level has less than hundred percent the program expects one more entry and gives a warning.

Running the GWT Application on a Client:
The prototype is running on an Apache Tomcat and is online available. To get access to the application on a client via the URL it is necessary to have internet access and any browser installed. Additionally, Java has to be installed at client side, then the application is running. But there are more refinements worth mentioning. As the concept of the software is to support any type of assignment, every file type can be uploaded by the student. To get correct access to the submission on the client it is necessary to have the matching plugin for the browser or program installed. Otherwise it is not possible to open the submission within *tsAAM*.

Some programs (like Microsoft Word or PowerPoint) can be installed on the client side but there are still exceptions. These submitted assignments open externally and not in the provided space within the tool. This is sometimes annoying because the teacher or tutor has to change windows but the functionality of the tool is not influenced.

7.3.3.2 Management of Courses and Its Assignments

The first point of the functional requirements for teaching staff as specified in Table 6.2 is to provide a clear management system where courses and assignment to these courses can be created. Essential regarding creating an assignment is to specify a deadline for submission and the connection to a prior created rubric (see Section 7.3.3.3 for procedure of a rubrics creation).

To guarantee transparency and consistency to students in the assessing procedure, it is important to them, that they know what the assignment is about before they start doing it. Therefore, a rubric is required before an assignment is opened to support students in the learning process rather than just providing a mark at the end of an assignment.

Figure 7.10: Course and Assignment Management with tsAAM

Figure 7.10 shows a screenshot of how the management of courses and assignments is done in *tsAAM*.

7.3.3.3   Creation and Storage of a Rubric

The procedure of creating a rubric including all the feedback statements is a challenging one. There are many different approaches to organize this procedure but the developer decided to follow a step by step creation of the rubric as shown in Figure 7.11.

   In this scenario the upper level is created first and followed by same procedure for every entry of the upper level to create the second level of the rubric. When the property of marking is chosen the rubric must include a percentage for every single rubric entry summing up to hundred for each level. Once the rubric is created the program leads to a site where the whole rubric is shown in a tree structure. Now the teacher has the possibility to add feedback statements for summative or formative purposes to every single node of the rubric as shown in
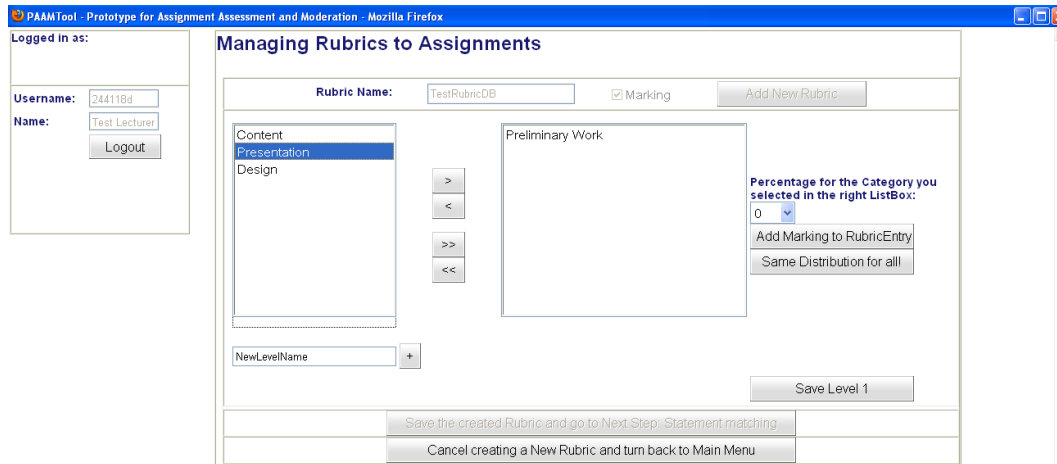
Figure 7.11: Creation of a sample rubric with tsAAM

Figure 7.12. Negative and positive feedback can be added to the rubric with the difference that negative feedback statements can include a percentage for summative purposes.

Contrary to the rubric itself the creation of feedback statements do not need to be completed because new statements can be added during the assessing procedure but the negative feedback statements essential for grading need to be added in this step.

7.3.3.4   Moderation of Submitted Assignments

In the moderation or assessing procedure several problems has been found. Adding new feedback statements turned out to be not as trivial as thought in the designing phase. Figure 7.13 show the assessing procedure of *tsAAM* and as shown it consists of a window where the assignment is opened (completely anonymous as a part of the requirements from students' side) and the rubric with its feedback statements below the assignment. Here it is possible to add feedback statements and also distinct between positive and negative ones but it is not possible to add a percentage to the negative statements caused by the reasons of concentrating on feedback rather than marks discussed in Section 6.5.3. The problem is that the assessor should not know the measure of a feedback statement and therefore is not in a position to add feedback statements including a percentage for marking.

Figure 7.12: Adding of feedback statements to the created sample rubric

7.4 General Findings Regarding the Prototype

This chapter summarizes all the findings of the development of the project and is split up into two sections representing two different points of view: *Developer's Point of View* and *User's Point of View*. Whereas the first section is based on the developer's impressions the second section is based on a usability study done for evaluating the first prototype.
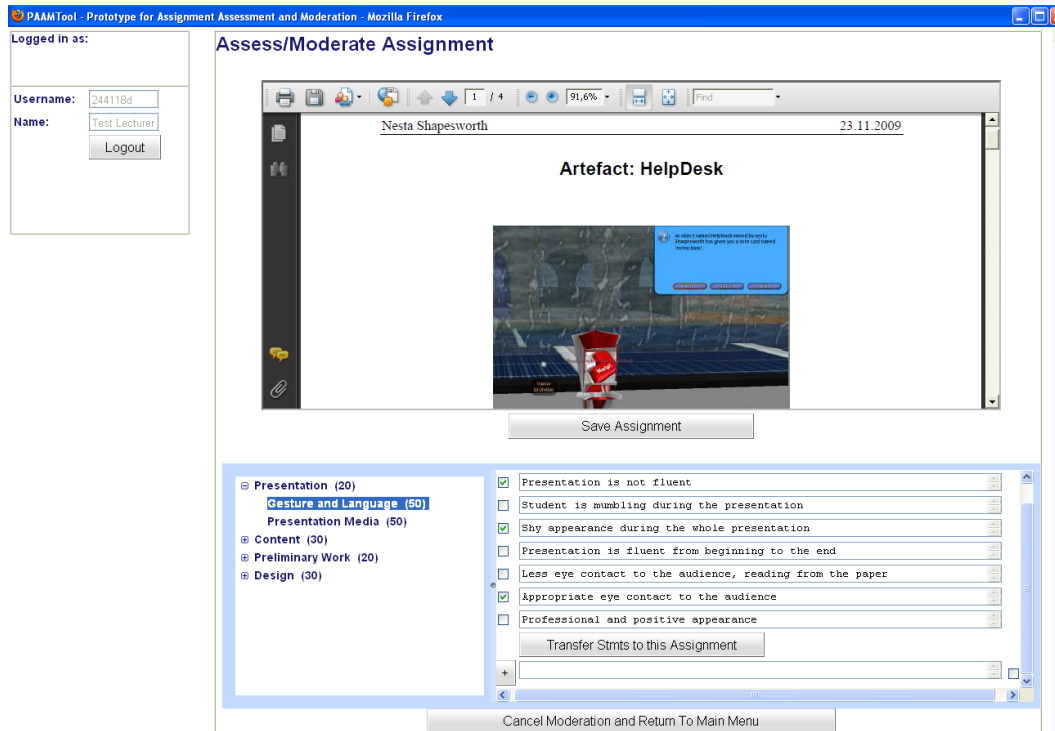
Figure 7.13: Moderation of an assignment with tsAAM

7.4.1   Developer's Point of View

This section discusses the positive and negative aspects of the prototype regarding usability but especially development from the developer's viewpoint. Following listing will summarize those findings:

- **Google Web Toolkit:**
  The development of web applications is very convenient and simple if someone is familiar with the programming language Java. The advantage of writing the whole application in Java and not needing to change between different programming languages and technologies is a big one. But there have also been unexpected troubles regarding GWT. GWT promotes the browser independence but there are troubles with style (too big boxes, bad layout) regarding different browsers. One of the most striking styling problems regarding the use of different browsers is the behavior of a tree structure. Whereas the Internet Explorer highlights a selected node of the tree

the user has no clue if a node is selected in other browsers. But overall the positive things while using GWT are dominating.

- **Offline Development of GWT application:**
  From the developer's side it is very positive that there are no problems transfering and running the GWT application on different servers. The tool has been developed offline and transfered to two different servers (at Curtin University of Technology and University of Technology in Graz) and the result is the same as it can not always be expected to be.

- **Rubrics:**
  They are a very useful tool for formative and summative assessment but to combine both the design of such a GUI is very challenging.

- **External Programs:**
  as long as a program is needed for opening an assignment that is not available as a plugin for the browser the assignment will open externally and this is confusing and not appropriate.

The following two subsection show the findings from the developer's point of view regarding *StudentCenter@tsAAM* and *tsAAM* .

7.4.1.1 Findings Regarding StudentCenter@tsAAM

This section presents the findings made during the development of the *StudentCenter@tsAAM*. The project is still in a prototype phase and this part of the project is necessary but does not include the main functionalities of the project. Findings regarding the first part of the project are listed below:

- The course subscription at *StudentCenter@tsAAM* has to be done two times due to the fact that nearly every higher educational institution is already running a system that is responsible for these actions.

- First the procedure of informing the student about the feedback has been divided in a notification email and the online available feedback but then the decision has been revised in order to get the feedback directly per email as well as provided within *StudentCenter@tsAAM*.

- The user management within Drupal is easy to handle and security of private data is achieved by providing every student an own account with password protection.

7.4.1.2   Findings Regarding tsAAM

This section presents the findings made during the development of *tsAAM* and are listed below:

- The procedure of rubrics creation as it has been often discussed in the designing phase of the prototype is very challenging. Step by step creation, changing an existing rubric in tree structure or other methods have been discussed and in this prototype the decision was on concentrating on a step by step procedure.

- During assessment only feedback can be added but not the kind of feedback that is used for summative purposes. For this case no clear procedure has been found and will be topic of future work. Reasons for problems regarding this procedure are that (i) assessor should concentrate on giving feedback and do not know about connection to summative purposes, (ii) how to weight a feedback statement when there is no knowledge about other weightings and (iii) consistency not guaranteed when every assessor can add weighted feedback of different measure.

- The type of submission (for example .pdf, .ppt, .avi, .mp3) are supported depending on the plugins of the web browser and the programs installed on the computer the program is executed from. If there is no Adobe Acrobat Reader installed it is also not possible to view submissions regarding this type and use the program properly.

- Microsoft documents such as ppt- or doc-files are opened external during assessment procedure and not within the provided place within the program. This is annoying and sometimes confusing as well.

- GWT should provide appropriate CSS for different browsers to represent the UI correctly without additional work for the programmer. Testing of this fact ended up in something different as expected and guaranteed by Google (2010a).

- The more detailed a rubric including its feedback statements should be the more time will be needed for creating this rubric and it can also be challenging. Once a rubric is created it saves a lot of time in the assessing procedure and guarantees consistency and fairness regarding the anonymity.

7.4.2 User's Point of View

The user's point of view has been evaluated by running a usability study. Research questions, termination and results regarding this study are presented within this section.

Research Questions:

- Is the tool suitable for real use?

- What are the impressions about the usability and functionality of the tool?

7.4.2.1 Design of User Study

The user study has been performed with five test persons in form of a thinking aloud test which is an often used method for testing the usability of programs or websites (Waes, 2000). Intention of this user study is the qualitative analysis of the functionality and key features of prototype rather than a quantitative evaluation. Using this method of usability test allows to figure out how users who are not well into the project are using the program and trying to do some tasks they are given to solve. The termination of the user study performed for evaluating tsAAM consists of the following points:

1. **Introduction About tsAAM:**
   First the test person gets a short introduction of what to do (pre-survey, usability test and post-survey), a consent to sign that the data stored can be used for research purposes. To understand how the program works, the test users have been told the opportunity to watch the introductory movie presented in the main menu of the tool.

2. **Pre-Survey:**
   A short survey before the usability test starts should collect demographical data, data regarding the expertise and some information about prior knowledge regarding assessment, e-Assessment including expectations and experiences in this field. The full pre-survey is attached in Appendix B.1.

3. **Usability Test:**
   Within this phase of the evaluation the user has to fulfill two different tasks
   (i) creation of a rubric including the property of grading and adding feedback statements to the rubric
   (ii) assessment of some sample assignments using the rubric created in the previous task

4. **Post-Survey:**
   After the usability test the experimentee gets another survey with questions regarding the tasks and impressions of the project

Demographical Data of the Test Persons from the User Study:

- Two female and three male test persons mainly between 25 and 35 years old.

- All of them are students working as a tutor, three of them additionally as research staff no longer than two years at university.

- Three of them are professionals regarding computer expertise and the others are beginner and intermediate.

7.4.2.2   Findings From the User Study

The findings from the user study need to be put together from the pre-survey and post-survey (full results of pre- and post-survey are attached in Appendix B.3 and B.4) as well as the thinking aloud test. For a better understanding they are split up in the two listings below.

Findings from Thinking Aloud Test:

- Test persons who had not watched the introductory movie had some problems with the usability of the program caused by missing hints. After explanation they had no problems but some interesting ideas regarding the style of the tool:
  - adding new level should directly go to selected levels.
  - positive feedback statements could be automatically selected at assessment.

- Level one and two of the rubric was not clear to all of the test persons. The hierarchical structure of the rubric could be previously explained.

- Error messages are missing or not enough but if provided they should be in a status line rather than in pop-ups.

- As already mentioned in the developer's findings in Section 7.4.1 the selection of a node in the tree is not clear because no highlighting of the node is done.

- Test persons appreciate that the assessing procedure is anonymous and therefore objective.

- One question often asked is if more than one assessor could assess the same assignment and a mean value will be provided. This is a feature not implemented yet.

- The test persons complained about the fact already mentioned in Section 7.4.1 and 7.4.1.2 that the ppt-file is opening externally and not as the pdf-file within the browser.

Important Findings from Pre- and Post-Survey:

- All the test persons are experienced with assessment in higher education as they are all tutors or research members in this area and everyone of the test persons see it as a necessity for improving students' outcome to give regular and detailed feedback rather than measure the performance.

- All the test persons agree regarding e-Assessment as a tool that can make teaching easier, save a lot of time in the assessing procedure but they also think that it is time-consuming to get familiar with e-Assessment tools.

- When speaking about rubrics only one test person knows what this is but after a short explanation they all know it just under another word and they do think that rubrics should be used recording students performance as well as informing students about how the assessment is done.

- Regarding the expectations for an e-Assessment tool all agree that it should reduce time for assessment, automatically inform students after assessment and make assessment consistent and fair.

- The majority see the benefits of *tsAAM* for teachers and tutors in reducing time for students' assessment and they would use it if it was for free.

- The benefits for students are an appropriate, quick and consistent feedback and three of the five test persons think that it could be very useful to do peer assessment because it saves assessing time of teaching staff and empowers students. Others think that peer assessment is not objective and will lead to a fairness problem

In order to answer the research questions of the user study it is important to mention that the test users think the tool could save a lot of time in the assessing process. They also think the tool could help students in their learning progress and the fairness of assessment will be guaranteed. Regarding the usability of the tool the test persons had some suggestions for graphical improvements but they where satisfied about the functionality.

7.5 Summary

Based on the requirements and design described in Chapter 6 a first prototype has been developed and this chapter discusses the development of the prototype in detail.

Beginning with an overview of the used software and technologies this chapter also discussed the reasons for using these. In this context it is important to argue the decision regarding the framework for development of the web application, the google web toolkit (GWT). This is caused by the simplicity and convenience of writing rich internet applications just using one programming language (for code on server and client side) rather than working around using JavaScript and other things. Another important decision is on using the CMS Drupal as an environment for fulfilling the students' requirements.

The prototype aimed to provide a methodology for the combination of formative and summative assessment and support students in learning with appropriate and quick feedback. Regarding the conceptual design the project is split into two parts, for students and teachers. The platform for students to subscribe to courses, upload assignment to courses and access the detailed feedback is realized as a Drupal system. Contrary, the part of the project teaching staff is using is realized as a GWT application. Within this part of the tool teaching staff can (i) manage courses and its assignments, (ii) create rubrics for assessment and (iii) view and moderate students' submissions. Important to mention is, that all data types for assignments are supported as long as the client has installed a suitable plugin for the browser or external program.

The main findings regarding the development of the prototype are discussed from the developer's point of view as well as the viewpoint of users. From the developer's sight the main findings are that (i) the decision for using GWT and Drupal has been a good one, (ii) the creation of a rubric combining formative and summative assessment is very challenging and (iii) the browser independence of GWT is not always guaranteed.

The user's viewpoint regarding the functionality and usability of the prototype

has been evaluated through a user study in form of a thinking aloud test including a pre- and post-survey (survey and survey results are attached in Appendix B). Findings gained from the user study are going from general experiences and expectations of e-Assessment to the usability of *tsAAM*. Hereby, several improvements in the navigation and styling of the prototype are found as well as some interesting features for future development. Major findings are that (i) users want to work with technology supported tools to reduce time and effort in the assessing procedure, (ii) users appreciate the anonymity of assessment and (iii) the opportunity of more than one assessors for one assignment should be given.

As a result of the development of the prototype it can be said that the tool provides a new approach to combine formative and summative assessment but as described in the findings there are borders to deal with regarding this process. Concluding it can be said that this tool can save a lot of time in the assessing process and also meets the needs of students regarding *consistency*, *fairness* and *transparency* of *assessment* as well as *quick* and *appropriate feedback* in order to make improvement within the learning process.

Chapter 8

Lessons learned

The author of this master thesis has improved his knowledge in many ways and the benefit of doing a project together with a university of a foreign country is indescribable.

The start of the master thesis has been very challenging caused by an independent literature research to get familiar with a new topic. Well-organized online libraries and access to libraries through both universities (University of Technology Graz and Curtin University) have eased the still time consuming research process. Anyway, the research done during the thesis improved the author's knowledge regarding how to proceed in future research tasks.

Teaching, learning and assessment are important fields in higher education. The author improved his knowledge in these complex areas enormously and understands the importance and necessity of quality assurance in higher educational institutions. Technology enhances almost everything in everyone's life and the educational sector is no exception to this fact. Therefore, it is important to use every technology available to support teachers and students in their doing.

   The increasing amount of students and nearly continuous amount of teaching staff leads to an increasing workload of teaching staff and this fact has been the reason for the development of a new tool. This tool should support teachers in the assessment and moderation process, whereas the quality of feedback should improve in the context of consistence, appropriateness and promptness.

Another valuable experience worth mentioning is the knowledge gained while designing and developing the prototype for the thesis. Writing rich internet applications has always been challenging, but using GWT as a framework provides

a lot of convenience in the developing process. Prior knowledge of the author regarding the programming language Java has been used combined with all the possibilites GWT provides. If selectable, the author would prefer GWT in order to write web applications from now on.

In order to evaluate a software tool the author improved his knowledge by performing a user study in form of a thinking aloud test. In this case the thinking aloud test has been for the qualitative analysis of the prototype and a lot of interesting findings have been made.

Furthermore, it has been a wonderful experience to work on the thesis in a foreign country in cooperation with the Curtin University of Technology. To be a member of an international research group has been a challenging but interesting and motivating experience. The value of doing a part of the master thesis is indescribable for the author's experience and development and will characterize the personality.

Chapter 9

Conclusion and Future Work

The aim of this master thesis was the design and implementation of a prototype for combining summative and formative assessment in the educational process. To assure the quality in teaching, learning and assessment it is essential to focus on giving appropriate, quick and consistent feedback to students and also provide consistent and fair marking schemes. The main goal of the project was the development of a tool that guarantees and supports teachers in the assessing process by concentrating on feedback rather than marking or grading students. As a result detailed feedback should result in a consistent and fair mark.

The theoretical part formed the basis with a detailed literature research in the fields of quality assurance in higher education and technology enhanced learning. As assessment should be seen as an integrated part of learning, the main focus of the research was on assessment and e-Assessment. Approaches of existing e-Assessment systems were the groundwork for defining the requirements of a software tool that enables quick and valuable feedback to students in order to support a positive learning progress. Behind the feedback, that is for formative purposes, a marking scheme is connected and students' work can be automatically graded based on the given feedback.

The framework chosen for developing the prototype was GWT caused by the fact that it provides an easy and comfortable way to implement rich internet applications using one and the same programming language at both sides, server and client. Usage and technical aspects of the development of the prototype are shown as a part of the thesis. Together with the results of a user study performed during the thesis, they result in findings regarding the development, usability and functionality of the prototype.

The development of the prototype within this thesis includes the major func-

tionalities, but can be enhanced in many ways. Within this thesis the focus of the development was based on the requirements specified, but there are many additional features for supporting students and teaching staff imaginable.

A first challenge would be to open the tool for students as well. Different assessment strategies such as peer-, self- and group-assessment could be practiced and the benefit for using the tool for these then needs to be evaluated. The next focus should be on providing the opportunity to allow more than one assessors in the assessing procedure of one assignment. In this case the student gets more feedback (sometimes the same) and the grade could be based on the average of all assessors to be even more objective. Another feature that could be provided is the offer of statistical analysis of several data regarding the development and progress of students and courses.

In addition, the possibility of using the tool as a plugin for existing learning management systems should be proved.

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Appendix A

Short Paper for 1st TEFA Workshop at ECTEL 2010

Technology Supported Assignment Assessment & Moderation

Conception of a software tool combining formative assessment and grading

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Abstract — a very important part of the education process is the feedback learners get from their teachers and tutors. Sometimes the feedback is not adequate because the concentration of educators is on grading. In this paper we report the development of the new software tool *tsAAM* (technology supported Assignment Assessment & Moderation), which combines grading, assessment moderation, and formative assessment for different formats of assignments.

Keywords - e-assessment; formative assessment; feedback; grading; summative assessment

I.   INTRODUCTION

Students are not satisfied with the feedback they get. The feedback is not in time and it is also not clear enough so it does not support the improvement of students learning behavior. The National Student Survey 2009 of Great Britain showed a minimal improvement but it is still alarming that approximately 40% of the students in higher education institutions are unhappy. Another fact that turned out was that about 30 % do not agree in terms of clear assessing criteria and fair assessment arrangements and marking (NSS, 2009).

According to these facts this project concentrates on the development of a system which supports clear and prompt feedback and guarantees that feedback is directly connected to the assessment criteria.

II.   MOTIVATION AND RELATED WORK

Assessment in higher education is a large and important part of teaching and learning, especially in regards to formative assessments (Boston, 2002; Chappuis & Chappuis, 2007).

Computer supported learning environments like WebCT and Blackboard (Blackboard, 2010) or Moodle (Moodle, 2010) do not usually support the specific assessment and feedback requirements, generally merely providing the possibility to give an overall mark and a comment to two for every student submission. The one positive aspect about these environments is that they are web-based and therefore accessible for students and tutors at any time from any place via an Internet connection.

Based on these facts our *tsAAM* system is a web-based application which combines summative assessment and detailed feedback. Moreover, *tsAAM* supports tutors in assessing large classes by concentrating on supporting detailed feedback rather than grading. The feedback statements are directly linked to a grade which is crucial for a transparent and consistent assment process.

III.   SYSTEM STRUCTURE AND COMPONENTS

Feedback is essential in the educational process and should be available for students as detailed and specific commentary on their work in relation to the standard published in the assignment assessment rubric. Also, feedback which is provided soon after assignment submission is more useful and valuable than delayed feedback. We have not found a pre-existing system to meet our requirements and therefore constructed a prototype which tutors have the possibility of using at any time they want and students can access their assessed work as soon as it is assessed. The turnaround time of feedback to students is substantially reduced which helps students closing the gap between the actual level and the level expected in an efficient way (Baroudi, 2007).

For the implementation of the system a web-based technology was chosen due to flexibility, time, and place considerations. The project is split into two parts, the main web application for moderation and assessment for lecturers and tutors called *Assessment & Moderation Tool (A&MT)* and the *Student Center* for course subscription and feedback access.

The needs of an efficient and flexible application in the sense of user interface and stability led to the development of the tool with GWT (Google Web Toolkit) (Google, 2010), an open source framework for flexible development of AJAX applications. The main features of the *Assessment & Moderation Tool* for lecturers and tutors are:

> ➢ Flexible assignment assessment rubric creation for lecturers including (suggested) feedback statements linked to the marking criteria
> ➢ Reuse of existing rubrics with possibility for extension, amendment, and adaptation
> ➢ Moderate assignments using existing rubrics
> ➢ Expand an existing rubric with extra feedback statements during the assessment process
> ➢ Easy organization of courses (teaching-learning units), assignments, feedback, assessment, and moderation reports

The second part of the project, the *Student Centre*, is built within a Drupal environment, a common content management system (Drupal, 2010), where students have the opportunity to create an account for course registration, assignment upload and the most important part, accessing the assessed assignments and related feedback. After the tutor has finished assessing an assignment students get an automatically generated email with the confirmation that feedback for their work is available. Students then can access the feedback and improve learning behaviors based on this information, and if necessary via a meeting with their tutor.

Both, the *Assessing & Moderation Tool* and the *Student Centre* use the same database so the needed data are consistent and up to date at any time. The relationship of the system components and the user environment is shown in Figure 1.
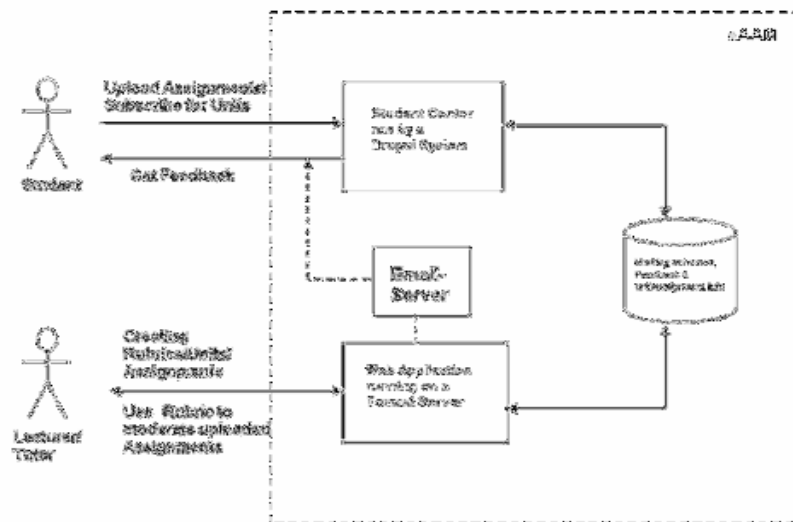
Figure 1: *tsAAM* schematic depicting *Student Centre*, *Assessing & Moderation Tool,* and *User Environment*

IV.   CONCLUSION AND FUTURE WORK

Feedback in the assessing process is very important to students for improving the learning behavior. If students know what is essential for reaching a better level and they get prompt feedback on their work it is easier for them to react on poor.

Actually, *tsAAM* is designed to cover the needs of feedback for every kind of assignment with an opportunity of grading based on the feedback given. Lecturers need to construct a comprehensive assessment rubric with sample feedback for given performance levels according to the rating scale in operation. Future development will include statistical features based on former assessments and courses.

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Appendix B

User Study

B.1 Pre-Survey

- **Demographical Questions**

➢ Gender: male   female

➢ Age
  ○ <25
  ○ 25-34
  ○ 34-45
  ○ >45)

➢ What kind of academic staff are you?
  ○ Lecturer
  ○ research staff
  ○ tutor
  ○ other

➢ How long have you been working at university?
  ○ < 6 Months
  ○ 6 Months – 2 Years
  ○ 2 Years – 5 Years
  ○ > 5 Years

➢ Do you pursue any other activity while working at university?   Yes   No
  If Yes:
  What kind of other activity do you pursue?
  ○ Student
  ○ self-employed person
  ○ company employee
  ○ other

➢ What is your mother language?
  ○ German
  ○ English
  ○ Other

➢ What is your level of computer expertise?
  ○ absolute beginner
  ○ beginner
  ○ intermediate
  ○ professional
  ○ other

- **General experience with assessment**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I have experience with assessment in higher education.	○	○	○	○	○
I give regular feedback to my students.	○	○	○	○	○
I give timely feedback to my students.	○	○	○	○	○
It is sufficient if students get a mark at the end of the semester rather than getting regular feedback.	○	○	○	○	○
It is necessary for students to know exactly why a mark is given.	○	○	○	○	○

- **Personal attitude to e-Assessment**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
E-Assessment tools can make teaching easier.	○	○	○	○	○
E-Assessment tools can safe a lot of time in assessing.	○	○	○	○	○
It is time-consuming to get familiar with E-Assessment tools.	○	○	○	○	○
I prefer traditional assessment with pen and paper.	○	○	○	○	○
I do not trust e-Assessment.	○	○	○	○	○

- **Prior knowledge about rubrics**
    - ➢ Do you know what rubrics are?   Yes   No
    - ➢ I have already worked with rubrics. Yes   No
      If No: Why don't you work with rubrics?

If Yes:

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I am always assessing my students based on rubrics.	○	○	○	○	○
I use rubrics to inform students how I am assessing.	○	○	○	○	○
I use rubrics to record students' performance	○	○	○	○	○

Additional note why using rubrics:

- **Expectations for an e-Assessment tool?**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The tool should reduce time needed for assessment.	○	○	○	○	○
The tool should record data and provide statistics.	○	○	○	○	○
The tool should inform students automatically after assessment.	○	○	○	○	○
The tool should make the assessing procedure consistent.	○	○	○	○	○
Timely feedback to students can be given.	○	○	○	○	○
The tool should be easy to handle.	○	○	○	○	○

What other expectations would you have for such a software tool?

What features should the tool have? (open ended)

B.2 Post-Survey

- **General Questions regarding Task 1**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The exercise was clear to my understanding.	○	○	○	○	○
I had no problems to complete the task.	○	○	○	○	○

I had stopped doing the exercise because

- **General Questions regarding Task 2**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The exercise was clear to my understanding.	○	○	○	○	○
I had no problems to complete the task.	○	○	○	○	○

I had stopped doing the exercise because

- **Benefits for teacher/tutor**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The tool would reduce the time in assessing students.	○	○	○	○	○
The tool is easy to handle.	○	○	○	○	○
There is no need of prior knowledge to use the tool.	○	○	○	○	○
I would use the tool if it was for free access.	○	○	○	○	○
I would buy the tool and use it.	○	○	○	○	○

I would use the tool to give timely feedback to my students.	○	○	○	○	○
I would use the tool to grade students.	○	○	○	○	○

I could not use the tool because

I would not use the tool for grading because

- **Benefits for students from the teacher's viewpoint**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I think students will benefit from the feedback.	○	○	○	○	○

If agree or strongly agree: How would they benefit?

If neither/nor or less: Why do you see no sense in giving students feedback with this tool?

Students should also work with the tool to assess peers.   Yes   No
        Why or why not?

Students would benefit from assessing peers with the tool.   Yes   No
        If Yes: How would they benefit?

        If No: Why do you see no benefit for students when practicing peer-assessment with this tool?

- **Advantages and disadvantages of the tool in general**

  o   What are the disadvantages of the tool?

  o   What are the advantages of the tool?

  o   What have you liked most?

  o   What have you disliked most?

  o   Do you have any suggestions for additional features for the tool?

B.3   Answers: Pre-Survey

- **Demographical Questions**

  ➢ Gender: male   female
                    60%   40%

  ➢ Age
  - ○ <25   20%
  - ○ 25-34   80%
  - ○ 34-45
  - ○ >45)

  ➢ What kind of academic staff are you?
  - ○ Lecturer   0%
  - ○ research staff   60%
  - ○ tutor   100%
  - ○ other

  ➢ How long have you been working at university?
  - ○ < 6 Months   20%
  - ○ 6 Months – 2 Years   80%
  - ○ 2 Years – 5 Years
  - ○ > 5 Years

  ➢ Do you pursue any other activity while working at university?   Yes   No
                80%   20%

     If Yes:
     What kind of other activity do you pursue?
  - ○ Student   100%
  - ○ self-employed person
  - ○ company employee
  - ○ other

  ➢ What is your mother language?
  - ○ German   80%
  - ○ English
  - ○ Other   20% (Arabic)

  ➢ What is your level of computer expertise?
  - ○ absolute beginner
  - ○ beginner   20%
  - ○ intermediate   20%
  - ○ professional   60%
  - ○ other

- **General experience with assessment**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I have experience with assessment in higher education.			20%	60%	20%
I give regular feedback to my students.			40%	40%	20%
I give timely feedback to my students.		20%	40%	20%	20%
It is sufficient if students get a mark at the end of the semester rather than getting regular feedback.	40%	60%			
It is necessary for students to know exactly why a mark is given.				60%	40%

- **Personal attitude to e-Assessment**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
E-Assessment tools can make teaching easier.				60%	40%
E-Assessment tools can safe a lot of time in assessing.				60%	40%
It is time-consuming to get familiar with E-Assessment tools.			40%	60%	
I prefer traditional assessment with pen and paper.	20%		60%		20%
I do not trust e-Assessment.	20%	80%			

- **Prior knowledge about rubrics**
  - ➢ Do you know what rubrics are?   Yes   No
                                                      40%   60% (after explanation 100% yes)
  - ➢ I have already worked with rubrics. Yes   No
                                                      60%   40%

    If No: Why don't you work with rubrics?

If Yes:

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I am always assessing my students based on rubrics.			40%	20%	40%
I use rubrics to inform students how I am assessing.			20%	60%	20%
I use rubrics to record students' performance			40%	20%	40%

Additional note why using rubrics:

- **Expectations for an e-Assessment tool?**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The tool should reduce time needed for assessment.					100%
The tool should record data and provide statistics.				20%	80%
The tool should inform students automatically after assessment.			20%		80%
The tool should make the assessing procedure consistent.					100%
Timely feedback to students can be given.				40%	60%
The tool should be easy to handle.				40%	60%

What other expectations would you have for such a software tool?
    - fair and consistent assessment scheme can be used
    - import and export of results/reports and items/tests

What features should the tool have? (open ended)

B.4   Answers: Post-Survey

- **General Questions regarding Task 1**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The exercise was clear to my understanding.		20%		80%	
I had no problems to complete the task.	20%		20%	40%	20%

I had stopped doing the exercise because

- **General Questions regarding Task 2**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The exercise was clear to my understanding.	20%			80%	
I had no problems to complete the task.		20%	20%	40%	20%

I had stopped doing the exercise because

- **Benefits for teacher/tutor**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
The tool would reduce the time in assessing students.				40%	60%
The tool is easy to handle.		20%	20%	40%	20%
There is no need of prior knowledge to use the tool.	20%			60%	20%
I would use the tool if it was for free access.		20%		40%	40%
I would buy the tool and use it.	20%	20%	40%	20%	

I would use the tool to give timely feedback to my students.		20%	20%		60%
I would use the tool to grade students.			20%	40%	40%

I could not use the tool because
    The procedure is not clear to me.

I would not use the tool for grading because

- **Benefits for students from the teacher's viewpoint**

	I strongly disagree	I disagree	Neither/ nor	I agree	I strongly agree
I think students will benefit from the feedback.				40%	60%

If agree or strongly agree: How would they benefit?
        - usual feedback and additional feedback at runtime
        - quicker feedback and assessment
        - saves time and clear assessment
        - no influence by personal reasons – anonymous
If neither/nor or less: Why do you see no sense in giving students feedback with this tool?

Students should also work with the tool to assess peers.   Yes   No
                                                             60%   40%
    Why?
        - save time, student empowerment, learn by assessment, group assessment
    Why not?
        - do not like peer assessment, not fair

Students would benefit from assessing peers with the tool.   Yes   No
                                                               40%   60%
    If Yes: How would they benefit?
        - save time, student empowerment, learn by assessment, group assessment
        - more feedback also from students view (the more feedback the better)

If No: Why do you see no benefit for students when practicing peer-assessment with this tool?
   - not objective
   - fairness problem

- **Advantages and disadvantages of the tool in general**

   o What are the disadvantages of the tool?
      - usability
      - ppt-file opens in extra window, confusing
      - no internet no work

   o What are the advantages of the tool?
      - saves time
      - online grading
      - easy to handle
      - personal influence gets extinguished when evaluation work

   o What have you liked most?
      - possibility to arrange own rubrics
      - runtime feedback (adding of positive and negative statements during runtime)

   o What have you disliked most?
      - visual style
      - no help, explanation
      - users have to be familiar with the tool

   o Do you have any suggestions for additional features for the tool?
      - enhanced feedback/ result visualization
      - charts reports
      - one assignment can be assessed by more than one assessor
      - assessment pausing and continuing

Appendix C

CD-ROM

- Source code of *StudentCenter@tsAAM*

- Source code of *tsAAM*

- Screenshots of *StudentCenter@tsAAM* and *tsAAM*

- Video to show the functions of the project

- Scanned documents of the user study (consent, pre- and post survey, thinking aloud results)

- Short Paper presented at 1st Technology Enhanced Formative Assessment (TEFA) Workshop at ECTEL 2010 on 28th September 2010 in Barcelona, Spain

- Copies of literature used in order to write the thesis