Education for Sustainable Development within the Engineering Sciences
Design of Learning Outcomes and a Subsequent Course Evaluation

vorgelegt von

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Perception-Based Test - Data Collection
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Comparative Self Assessment Test - Data Collection
Comparative Self Assessment Test - Data Analysis

List of Abbreviations

ASIIN e.V.	Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e. V.
CSA	Comparative Self-Assessment
DeSeCo	Definition and selection of competences: theoretical and conceptual foundations
EHEA	European Higher Education Area
ENAEE	European Network for Engineering Accreditation
ESOEPE	European Standing Observatory for the Engineering Profession and Education
EURACE®	EURopean-ACcredited Engineer
OECD	Organisation for Economic Co-operation and Development
TINS-D	Technology, Individual, Nature, Society - Democracy

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1 - Introduction

The student initiative *Blue Engineering - Engineering with Social and Ecological Responsibility*, commonly shortened to *Blue Engineering* was the starting point for the design and conduction of a student-driven course at *Technische Universität Berlin.* A group of students clearly saw the need for a course that covers the social and ecological responsibility of engineers (Baier 2012). However, in 2009 the university was not offering any particular course on this topic, so they decided to create a course on their own. So, they set off to design a course that they would like to attend themselves. Since engineering education is dominated ex-cathedra lectures and summative assessments at the end of a semester, they disregarded any teacher-centered form of education. Instead, they opted for a student-centered approach, so that engineering students actively engage in unveiling the complex interdependency of their social, political, ecological and economic surroundings. It is important that the participants themselves do this analysis so that they start to grasp their personal responsibility as well as the collective responsibility of engineers (Baier and Pongratz 2013). This also required that the participants would learn to consider the different values, interests and needs from a global perspective as well as within one class(room) (Pongratz and Baier 2015). The student group further called for a course design which encourages democratic decision-making and the corresponding action to not only solve, but also to define problems within the course itself as well as outside of the classroom. By designing the *Blue Engineering Course* in such a way, it has become not only a student-driven course with respect to its genesis (Baier 2013), but also in regard to its implementation as the participants acquire valuable competences to co-create their environment.

The development of the *Blue Engineering Course* did not follow any structured curriculum design principles. Instead, its development was based primarily on a combination of intuition, improvisation, and trial and error that continually shaped the course over time and as such improved the course. This was a highly agile design process where the need and the want to change were equal driving forces. The guiding principles hereby were 1) to foster discussion about social and ecological responsibility within engineering which is different on the individual level than on the societal level; 2) to understand and analyse the reciprocal relations of technology, individuals, nature and society; 3) to maintain the student-driven character by encouraging democratic co-conduction and co-creation of the course.

Self-contained learning and teaching units form the core of the *Blue Engineering Course*. They provide all the necessary information with respect to content and methods in order to conduct a demanding student-centered lesson. With a first set of 13 teaching/learning units, called building blocks (Baier 2011), four student tutors conducted a course in the winter semester 2011/2012. In this first semester, 25 students participated in the course. This number continually rose to around 75 students per semester.

It is only since winter semester 2015/2016, that the course design is fairly stable (Baier and Pongratz 2016), which freed resources to properly describe the learning outcomes of the course (Baier and Meyer 2015) and to evaluate it accordingly (Baier 2017a).

This is an educational design research project (Plomp 2013) which follows the classical research steps: *research clarification*, *description of a problem area*, *analysis*, *design* and *evaluation*. Each step is described in a separate chapter and the research project is concluded with the formulation of a set of design principles:

Research Clarification - This chapter describes the research function along with the characteristics of an educational design research project. The concrete research design is a two-step process. First, to describe the learning outcomes for the existing *Blue Engineering Course* at the *Technische*

Universität Berlin and second, to use these learning outcomes in order to evaluate the course on module level.

Problem Area - Course Design of the Blue Engineering Course - This chapter describes the genesis of the student-initiated and student-driven *Blue Engineering Course* at *Technische Universität Berlin* along with its focus on content methods. The general conditions of the course as well the course plan are outlined with regard to the students' activities and assessments.

Analysis - Outcome-Based Education, Frameworks of Learning Outcomes and Competences of an Education for Sustainable Development - The analysis chapter is divided into three parts. First, the genesis and current status of an outcome-based education are described. Second, five different frameworks for learning outcomes are presented. Four of these frameworks stand in the same historical line so that the description of these frameworks will unveil an evolution over time. Third, a description of the concept of competences, especially of key competences generally associated with an education for sustainable development, is given. It is shown that the various concepts of key competences converge. Therefore, this description focuses on the 12 sub-competences of *Gestaltungskompetenz* [shaping competence, design competence] (Haan 2010) as this is a comprehensive framework which is suitable for a course-specific adaptation.

Designing Down and Describing the Learning Outcomes for the Blue Engineering Course - This chapter starts off with an introduction to the overall design down process. Next, the regulatory framework is presented that affects the *Blue Engineering Course*: the relevant state law, guidelines of the responsible accreditation agency and the regulations at *Technische Universität Berlin*. The overall characteristics of the *Blue Engineering Course* are then described by two general learning outcomes. As part of the design down process, these two learning outcomes on general level are then merged with the 12 sub-competences of *Gestaltungskompetenz* which results in a set of 12 learning outcomes on module level. These are further designed down in order to describe the learning outcomes on block level as well as activity level. Each step is a precisioning of the learning outcomes so that they become not only more and more course-specific but also describe more and more accurately domain-specific competences which contrast the broad and abstract key competences of an education for sustainable development.

Evaluation of the Blue Engineering Course - The primary focus of this chapter will lie on the evaluation of the *Blue Engineering Course* according to its 12 learning outcomes on module level which have been described in the preceding chapter. This course evaluation consists of the following components: 1) a quantitative analysis shows who participated in the course; 2) a qualitative evaluation gives an overview which learning activities and learning assessments contribute to reaching the 12 learning outcomes on module level; 3) a triangulation shows how and to what extent three selected core building blocks contribute to the 12 learning outcomes on module level; 4) a quantitative evaluation through a comparative self-assessment test shows how the students rate their competence level at the beginning and at the end of a course.

In the context of the *Blue Engineering Course* a set of concrete terms is used, which are clarified here for the remainder of this research project:

- *module* - the module *Blue Engineering - Sustainability in Engineering Sciences* is offered at *Technische Universität Berlin*; several modules constitute a study program
- *compulsory elective module* - a module that is included in a list of modules where one or several of the modules need to be chosen by the student
- *course* - the *Blue Engineering Course* is offered as the sole course within the respective module; other modules may consist of several courses or lectures
- *lesson* - a four hour long teaching/learning unit which is offered weekly over the course of one semester; around 15 lessons make one course and respectively one semester

- *block* - one concrete teaching/learning unit, typically one lesson consists of one to four building blocks; block also refers to rather complex assessments, such as the keeping of a learning journal, the conduction of a building block or the semester project
- *building blocks* - 15-minute to 90-minute long teaching/learning unit comprising several activities; the content and the method are well documented, so anybody with a reasonable preparation may conduct this teaching/learning unit
- activity - concrete activities that the students do within a building block or as part of the assessment of the course
- semester project - the design, conduction and documentation of a newly created building block by a group of students; this is a part of the assessment of the *Blue Engineering Course*
- learning journal - a diary that the students need to keep after each lesson of the *Blue Engineering Course*; this is a part of the assessment of the course

2 - Research Clarification

The *Blue Engineering Course* can be considered as a contribution to an education for sustainable development, as it is intended that the participants acquire competences that are essential to participate in a sustainable development (Haan 2010). This research project was conducted as an educational design research, since there is neither an existing description of course-specific learning outcomes within the field of an engineering education for sustainable development, nor are there currently design principles that can be used to describe these learning outcomes. In addition, there seem to be no studies that analyze and evaluate an existing course within an engineering education for sustainable development according to its predefined learning outcomes. Therefore, besides describing the learning outcomes alone, a suitable method to evaluate a course based on these learning outcomes is conceived through this educational design research project.

This chapter on research clarification, first, 2.1) describes the educational design research methodology by Plomp (2013) which is used to undertake this research project. Building upon this concept 2.2) the concrete research design for this project is presented. The focus here lies on the description of the two research questions along with the research functions. In addition, a brief outlook is given on the following steps of the research project.

2.1 - Abstract Research Design

Plomp (2013) identifies the search for *understanding* and *knowing* as the primary aims of scientific research. To a lesser extent, scientific research may also aim at improving practice, providing the necessary information for a decision-making or contributing to a policy development. To adequately address the broad range of these aims, Plomp (2013, 13) identifies five different research functions: 1) *to describe*; 2) *to compare*; 3) *to evaluate*; 4) *to explain or to predict* and 5) *to design and to develop*. These research functions also apply for educational design research.

Apart from the aims and functions of an educational design research, Shavelson et al. (2003) state that educational research should abide the guiding principles of all scientific research:

- pose significant questions that can be investigated
- link research to relevant theory
- use methods that permit direct investigation of the question
- provide a coherent and explicit chain of reasoning
- replicate and generalize across studies
- disclose research to encourage professional scrutiny and critique

To encourage this within the field of an educational design research, various methodologies have been conceived over the past 15 years by a series of authors (Van den Akker et al. 1999; Design-Based Research Collective 2003; Shavelson et al. 2003; Akker et al. 2006a). Their aim was to address a lack of grounded research within the educational sector that is able to bridge the gap between educational theory and educational practice. This point is explicitly argued by the Design-Based Research Collective (2003) which states that

> “educational research is often divorced from the problems and issues of everyday practice - a split that resulted in a credibility gap and creates a need for new research approaches that speak directly to problems of practice and that lead to the development of ‘usable knowledge'.”

The general framework of such a research design is already widely implemented at primary and secondary level education (Plomp and Nieveen 2013). In addition, there are also several projects that make use of this general framework to undertake an educational design research at higher education institutes as well (Dowse and Howie 2013; Kouwenhoven 2013; Nieveen 2013). Generally speaking, there is a growing interest in grounding design research on explicit methodologies and methods not only within the educational sciences but also among others that do research within the field of general engineering design (Blessing and Chakrabarti 2009; Ehrlenspiel and Meerkamm 2013). This further justifies the choice of this research design as the research question links educational research with engineering (education) research.

There is still an ongoing debate within the field of educational design research as questions of methodology and terminology have not been settled yet (Cobb et al. 2003; Shavelson et al. 2003; Burckhardt 2006). However, the general characteristics of an educational design research are shared by most of the authors in this field. Van den Akker et al. (2006b) sum up the current debate as follows: Educational design research is generally seen as interventionist, iterative, process-oriented, utility oriented and theory oriented. Additionally, van den Akker (2006b) points out the involvement of practitioners as well as a multilevel approach (Shavelson et al. 2003) as characteristics of an educational design research. Furthermore, educational design research is, like all design projects, a unique endeavour that is specific to a concrete context (Plomp 2013). Therefore, the generalizability of design research is limited, however, it is safe to assume an analytical generalizability (Yin 2013) if replications show that the products of the research, especially design interventions and/or design processes, can be applied in various contexts.

Despite all difference in detail, educational design processes are based on the same steps as any systematic design process. First comes a *problem definition*, which is followed by an iterative three-step process of *analysis*, *design/development of a prototype* and *evaluation*. The iteration may stop if the set of predetermined objectives are sufficiently met. For the use in the context of an educational design research project, Plomp (2013) adapts and describes these three phases as *preliminary research*, *development or prototyping phase* and *assessment phase*. Surprisingly, Plomp (2013) does not specify the *problem area phase*, however, it can be said that in this phase the context as well as the need for the research project is described. According to Plomp (2013), the *preliminary research* comprises a context analysis, a literature review and the development of a conceptual or theoretical framework for the research study. The *development or prototyping phase* comprises an iterative design phase which is guided by a formative evaluation that leads to a gradual improvement and refinement of the design intervention. The iterative and formative evaluation may comprise methods such as expert reviews, focus groups, one-to-one evaluations, walkthroughs and field tests (Tessmer 1993). An educational design research project is concluded with the *assessment phase* during which the design intervention is evaluated according to the predetermined specifications and criteria.

With reference to Nieveen (1999) and Nieveen and Folmer (2013), Plomp (2013) describes a set of four quality criteria that educational design research has to meet. These are *relevance*, *consistency*, *practicality* and *effectiveness*. Accordingly, the criterion of *relevance,* which is also referred to as *content validity*, is met if there is an apparent need for the design intervention and its design is based on state-of-the-art (scientific) knowledge. The second identified criterion is *consistency*, which is also referred to as *construct validity*, and it is met if the intervention is logically designed. The third criterion, *practicality,* is divided into two parts; *expected practicality* and *actual practicality* which are met if the design intervention is expected to be usable or it is actually usable in the given context. The fourth criterion is also divided into two parts: *expected effectiveness* and an *actual effectiveness*. This last criterion is met if it is expected that the desired outcomes are met and if using the design intervention results in the desired outcomes when used.

Plomp explicitly sets off to describe a research methodology that considers the above-mentioned guiding principles of scientific research but which still is able to address the particularities found in the field of education in general and within the field of educational (design) research in particular. Therefore, Plomp provides the following definition for (educational) design research:

> “to design and develop an intervention (such as programs, teaching-learning strategies and materials, products and systems) as a solution to a complex educational problem as well as to advance our knowledge about the characteristics of these interventions and the processes to design and develop them, or alternatively to design and develop educational interventions (about for example, learning processes, learning environments and the like) with the purpose to develop or validate theories.” (2013, 15)

Overall, this leads to the following design research model by Plomp (2013). Starting off with a research question in the following format (Plomp 2013, 27):

> What are the characteristics of an *intervention X* for the *purpose/outcome Y* in *context Z*?

Accordingly, the design research results in a twofold outcome. First, the design intervention results in the desired outcomes. However, because the focus is also research, this also leads to a second outcome, that is the “understanding of the ‘how and why‘ of the functioning of the intervention in the particular context within which it was developed.” (Plomp 2013, 32). This understanding is described as design principles or as a (local) intervention theory. These research findings typically are described in the following format (Plomp 2013, 33):

> in *context Z* the *intervention X* (with certain characteristics) leads to *outcomes Y1, Y2*, …, *Yn*.

In the definition of design research provided above, Plomp (2013, 16) argues for two types of educational design research. One can be defined as a development study which results in research-based solutions that address complex problems within educational practice. These *development studies* result in either procedural design principles or substantive design principles which describes the characteristics of the design approach or respectively the characteristics of a design (intervention) itself (Akker 1999). The other type of educational design research can be defined as *validation studies* that aim at developing or validating design principles that are typically stated as micro theories, local instruction theories or at a maximum domain-specific instruction theories. Therefore, the result of *validation studies* are not closed academic theories, but they can be considered rather as “empirically-grounded prototypical learning trajectories that may be adopted and adapted by others” (Plomp 2013, 26). In practice, many research projects are a mixture of *development studies* and *validation studies*, where the one builds upon the other.

Plomp (2013) also explicitly addresses the potential conflicts that arise if the designing researcher and the researching designer are also charged with the evaluation and implementation of the design. With reference to McKenney et al. (2006), Plomp (2013) suggests a set of measures in order to deal with this conflict. These measures are in line with the principles of sound scientific research (Shavelson et al. 2003) which have been introduced at the beginning of this sub-chapter. This calls for a systematic analysis, documentation and reflection of the whole research project which is made open to professional scrutiny and critique. In addition, the research project should be built upon a strong chain of reasoning and if applicable triangulation as well as empirical testing.

2.2 - Concrete Research Design

This research project is conducted as a development study within the framework of an educational design research outlined by Plomp (2013), see sub-chapter 2.1. Plomp (2013) explicitly states that designing and developing an educational intervention is not yet educational design research. Instead, he lists several characteristics that have to be met in order to conduct scientifically grounded design research in comparison to design. The first and foremost characteristic is the formulation of a research question that is to guide the whole research project. The general structure of a sound research question was given in the preceding sub-chapter 2.1. The key term *intervention* in this general research question is specified by Plomp (2013, 27) as a container term that refers to all entities that can be designed and developed, among others these are learning processes and teaching/learning materials. The other two key terms *purpose/outcome* and *context* are not further specified.

Building upon the general structure of formulating a research question, this research project aims at answering the following two research questions:

> *What are the characteristics of a design process that results in a set of learning outcomes which describe the competences that shall be acquired by attending the* Blue Engineering Course *at* Technische Universität Berlin?
>
> *What are the characteristics of an evaluation that evaluates the* Blue Engineering Course *on module level according to its learning outcomes?*

The two research questions already clearly state the primary research function (Plomp 2013, 13) of this research project, which is first *to design* a set of learning outcomes for an existing course and second *to evaluate* the course accordingly. In addition, based on the design and description of the learning outcomes this research project also *describes* to what extent the participants work on these learning outcomes and to what degree they reach these learning outcomes. This description serves as the basis *to evaluate* the overall course design on module level.

As described in the preceding section, an educational design research yields a two-fold outcome. Therefore, the answering of these two questions results, first, in a set of learning outcomes for the *Blue Engineering Course* and an evaluation of it on module level according to these newly designed learning outcomes. Second, this research project will provide a set of design principles to inform others who also want to describe a set of learning outcomes for a similar course and who want to evaluate their course accordingly. Therefore, the research questions comprise the research functions of describing, evaluating and designing, while the latter two will be the primary functions.

Consequently, the focus of this research project lies in the process of describing learning outcomes for an existing course and the evaluation of the course with regard to these learning outcomes. Therefore, this research project does not discuss in detail other relevant factors of an existing course such as the description of learning/teaching activities or the corresponding assessment of the participants. Despite a growing number of authors that call for a strong linkage between outcomes, activities and assessment, this research project focuses only on one factor, that is the description of the learning outcomes. Due to this restriction, it provides a sound basis in the future to continue an educational design research that might lead to a constructive alignment (Biggs 2003) of the outcomes, activities and assessments of the *Blue Engineering Course*. Nonetheless, the design of the *Blue Engineering Course* along with its activities and assessments are of relevance for this research project. Therefore, activities and assessments as well as the general design of the course need to be considered when describing the learning outcomes and when evaluating the course accordingly.

After this research clarification, the following steps are undertaken as part of this educational design research, where each step corresponds to one of the steps of the educational design process. Chapter 3) describes the *problem area* of this research project, that is the design and conduction of the *Blue Engineering Course*. In chapter 4) an *analysis* is conducted through a comprehensive literature review. The topics are the concept of an outcome-based education, frameworks for learning outcomes and competences of an education for sustainable development. This analysis provides the basis for chapter 5), where the *design* and design down of the learning outcomes of the course are described. These learning outcomes on module level are then used in chapter 6) to *evaluate* the course accordingly. Finally, this research project is *concluded* in chapter 7) with a brief summary and the description of two design principles.

This research project is conducted by one of the former students who participated in the *Blue Engineering Initiative* almost from the beginning in 2009. In 2012 he took over a lecturer position for the course which he still holds. As suggested at the end of the preceding chapter 2.1, the following measures have been taken to adequately address the double-role of designing researcher and researching designer:

- *Systematic analysis*: Following the educational design research methodology provides a systematic approach for the general research project. The analysis chapter provides a comprehensive and systematic overview on three selected topics.
- *Documentation*: This text is the documentation of this research project. In addition, articles, handbooks, conference proceedings and other texts (Baier 2011; 2012; 2013; 2015; 2017a, 2017b; Baier and Meyer 2015; Baier and Pongratz 2013; 2016; Pongratz 2015) have been published.
- *Reflection of the whole research process*: The design research process was continually reflected and adjustments were made accordingly, see chapter 5. Part of the reflection were a series of publications and conferences, see above, as well as a regular meetings with experts. In addition, the development of the *Blue Engineering Course* has been a highly iterative process.
- *Professional scrutiny and critique*: See documentation and see reflection.
- Strong chain of reasoning: A clear and structured design of the whole documentation as well as for each chapter and sub-chapter hopefully supports a strong chain of reasoning.
- *Triangulation*: Neither the (design down of) learning outcomes, nor the subsequent evaluation have been part of a triangulation as this clearly surpasses the limits of this research project, which is handed in as a thesis.
- *Empirical testing*: The effectiveness and effectivity of the learning outcomes on module level have been empirically tested.

3 - Problem Area - Course Design of the Blue Engineering Course

The research clarification in the previous chapter set out a twofold research question for this research project. The next step in the educational design research process is the description of the problem area, which basically consists of a description of the design and implementation of the *Blue Engineering Course* at *Technische Universität Berlin*. At first, sub-chapter 3.1) describes the genesis of the *Blue Engineering Course* which explains some characteristics of the course such as its student-driven character. In the next sub-chapter 3.2) the theoretical background of the course is presented. This includes a short introduction to the concept of society-nature relations as well as the understanding of social and ecological responsibility and democracy in the context of the course. The latter is further described through the introduction of the *Betzavta* pedagogy of democracy which is incorporated into the course. In sub-chapter 3.3), the design of the *Blue Engineering Course* is presented in detail.

3.1 - Genesis of the Blue Engineering Course

The idea of *Blue Engineering* dates back to the winter semester of 2008/2009 and was basically created by a group of four students. They were all engineering students and felt the need to strengthen social and ecological responsibility within their university education as well as to enhance the conditions of their professional work. The student group presented their idea in a 15-minute presentation to the participants of the course Sociology of the Engineering Profession at Technische Universität Berlin. In the subsequent discussion, some participants as well as the lecturer and the student tutor of the course agreed that there is a strong need for this idea at the university as well as in the society.

As *Blue Engineering* was not intended as a mere theoretical discussion, but about exploring and expanding one's liberties at university and at work, a student initiative was founded. Its goal is to promote social and ecological responsibility of engineers. This initiative was established at the *Chair of Machinery Systems Design* at the *Technische Universität Berlin*.

The iterative process of creating a common understanding of social and ecological responsibility showed that the student group did not want to focus on neither the individual engineer nor the collective of engineers (Baier 2012). In addition, everyone participating in the process shared the understanding that society as a whole must take up specific forms of responsibility and to act accordingly. Therefore, the student group adhered to a joint understanding that responsibility for nature and society must be shared by individuals, collectives and society alike.

As the personal scope of action of the students was within the *Technische Universität Berlin*, they started to develop a course which was to be offered to their fellow students. They wanted to provide a space where engineering students could meet to discuss among peers various topics around the theme of engineering responsibility, as this would encourage them to do so later on in their personal and professional lives. The guiding principles of the course design can be summarized as these: 1) to foster discussion about social and ecological responsibility of engineering which is different on the individual level than on the societal level; 2) to understand and analyze the reciprocal relations of technology, individuals, nature, society and democracy; 3) to maintain the student-driven character by encouraging democratic co-conduction and co-creation of the course.

To realize this concept, the student group came up with an course design based on building blocks, which is explained in detail in chapter 3.4. In short, building blocks are interactive teaching/learning units of about 60 to 90 minutes in length which contain all necessary content and the methods used in this particular building block. At first, the student group developed 13 building blocks to span a whole semester of 15 weeks, where the first week was reserved for an introduction and the last week for a wrap-up. The course was to be realized as a four-hour course, where the students participate in a building block conducted by a student tutor for the first two hours. After a break, the second two hours are used to support the students to create new building blocks as a semester project. This newly created building block is tested at the end of the semester. Furthermore, students are required to carefully document their newly created building blocks in order to make them usable in the coming semesters.

The first *Blue Engineering Course* based on this initial design was offered in the winter semester 2011/12. A group of four student tutors was responsible for conducting the course while the overall responsibility lay with the *Chair of Machinery Systems Design*. The course was credited with 6 ECTS points and 24 students successfully participated in the course. Most of the students studied *Mechanical Engineering* or *Computational Engineering Sciences* where the course was offered as a compulsory elective in the master programs. The *Blue Engineering Course* was evaluated as part of the evaluation of all course offered by the faculty. This evaluation by the faculty ranked this course in all items better than the faculty's average. Additionally, at the end of each lesson, the participants as a group were asked to give feedback to ensure a continuous improvement of the course. Overall, the participants supported the variety of teaching methods and the mix of topics. It was seen as especially motivating, that the newly created building blocks may be used by others in the following semesters. Some participants asked for more thorough discussions and a better grounding in scientific facts and findings.

As the feedback from the participants was overall good, the next *Blue Engineering Course* was offered in the following summer semester 2012. The course design was just slightly adapted according to the feedback. Three tutors had to quit working due to their own studies and the high additional workload through the course. They were replaced by three participants of the first course. They mastered this challenge successfully and the course with 25 students was a similar success with regard to the faculty evaluation as well as with regard to the oral feedback by the participants after each course. This proved that the quality of the course was not depending on one particular person or expert to be conducted. Instead, the documentation of the building blocks was already sufficient to offer highly interactive teaching and learning units.

As the conduction and development of the whole course were very time consuming the student group applied for a funding of one full lecturer position and three student tutors. This funding was granted initially for two years and later on renewed for two more years. The objective hereby was to ensure the further conduction and development of the course as well as to improve its overall quality. In addition, they agreed to increase the capacity from initially 25 students to 100 students at the end of the funding period without requiring additional faculty personnel. As a consequence, the course had to be designed in such a way that it could be run only by student tutors that are supervised at the *Chair of Machinery Systems Design.*

In winter semester 2012/2013 two lecturers and three student tutors started their work. They ensured a continuous development of the course over the following semesters as well as a steady increase of its capacity. To keep the student-driven design of the course, the student tutors are only responsible for seven out of 15 lessons. At the beginning of a semester, the student tutors conduct a set of core building blocks to give the students an idea of what is expected from them and to create a common foundation of knowledge and methods. The remaining weeks are run entirely by the students. In teams of three to six students, they first conduct existing building blocks and then they test their own building blocks which they have created since the beginning of the semester.

Since the winter semester 2015/2016, the design of the *Blue Engineering Course* has only experienced fine-tuning modifications as the design of the course is seen already strong enough in itself. Any changes would not necessarily lead to better results but simply to different results. This stable course design allowed that the course is now run fully by three student tutors, where each is responsible for 25 students which makes a total of 75 students attending the course each semester. As of summer semester 2016, only one half position of a lecturer is still provided by the faculty. This is taken up only by one lecturer who coordinates the *Blue Engineering Course*, guides the student tutors in their work and ensures a further development.

3.2 - Theoretical Background of the Blue Engineering Course

The development of the *Blue Engineering Course* took place through a student group where the members mostly recalled their own experiences as well as knowledge. If differences arose, they were jointly worked out within the group. A strong theoretical grounding of the course design was not in their intention, instead they primarily wanted to create a good interactive course that they themselves would like to attend. Therefore, there is no set theoretical background of the course. However, the course design was considerably influenced by the concept of *society-nature relations*, the concept of *democracy* and the *Betzavta* pedagogy of democracy. In addition, there was the need to clarify the term *social and ecological responsibility*.

3.2.1 - Social and Ecological Responsibility

Soon after the *Blue Engineering* initiative was founded, the group formulated few central but not final statements aimed at providing a common understanding of social and ecological responsibility. The consensus-driven process of finding and agreeing on this common ground was based on the general knowledge and the common sense of everyone participating. After an extensive iterative process, the student group agreed upon a set of statements that would represent their current understanding of social responsibility and of ecological responsibility respectively. Ecologically responsible engineering aims at a development and use of technology that involves a gentle and sustainable use of earth's finite resources, e.g. the reduction of transportation and the prevention of toxic substance use. Technologies need to be durable, repairable and recyclable. Socially responsible engineering means respecting the rights and opportunities of all people through a democratic decision-making. At the workplace, this includes good working conditions, participation, freedom of association as well as reflecting and acting in teams, even across organizational borders. Building upon this, the concept of society-nature relations and a call for a comprehensive democratization of society were seen as the two best theoretical anchor points, which will be addressed in the two subsequent paragraphs.

3.2.3 - Society-Nature Relations

Linking the social responsibility of engineers and engineering with an ecological responsibility helps to consider the ecological crisis, not as a crisis of nature itself, but of how societies appropriate nature through specific forms of politics, economy and technology (Jahn and Wehling 1998, 81). The concept of society-nature relations (Jahn and Wehling 1998) advocates this perspective and stands in the tradition of Critical Theory (Becker and Jahn 2005) as well political ecology (O'Connor 1998). Here, society and nature are interpreted as "structures of mediation" that underline their reciprocal relations (Becker and Jahn 2005, 8). This helps to perceive social-ecological problems that are social problems and ecological problems at the same time, without separating them in either a social crisis or an ecological problem (Becker and Jahn 2005, 12). Instead of perceiving nature in crisis, conflicts among people and the domination over nature are identified as the primary cause for the interconnected social-ecological problems. Any sincere attempt to solve these problems may not only take into view the broader ecological surroundings, instead, the societal relationships need to change at their core.

3.2.4 - Democracy

The combination of the concept of society-nature relations with a call to democratize them stresses the individual scope of action to induce social change, while at the same time reminding that individual influence is restricted by structural factors on a societal level that also need to be changed. Therefore, only a full shift towards a democratic organization warrants the chance to vanquish suppressive and exploitative societal relationships including the domination of men over nature (Demirović 2012). In this sense, democracy may not be reduced to its well-established form of parliamentary democracy in the Global North. Societal relationships need to be based on a broader implementation of democracy instead. People must have the same prospects to participate in the actual decision-making process comprising everyone who is affected by the decisions taken. For this to happen, the decision-making process needs to be as inclusive and as transparent as possible. The execution of decisions must be controllable through the public, even up to the point of reverting any decision through a new decision-making process (Demirović 2007, 11). It may even be necessary to suspend decisions involving great uncertainty, where the impact on nature and society cannot be reversed. Bearing reversibility in mind may help to reduce the path dependencies for future generations which cannot participate in the decision-making process of today (Demirović 2012). In addition, global social justice is crucial to any democratic process, thus an expansion beyond the equality before the law is needed. Among other requirements, equal educational opportunities and just access to natural resources are central to ensure equal political participation. Based on that a more equal distribution of wealth, that is the resources of the planet, that we all share, must be distributed evenly and through democratic decision-making (Demirović 2012).

3.2.5 - Betzavta

The *Betzavta* pedagogy of democracy was developed by Maroshek-Klarman (1995; 1997) Maroshek-Klarman and Raber (2015). *Betzavta*, Hebrew for togetherness, is a comprehensive set of over 100 different exercises through which group processes are unveiled. The focus here is the recognition of the equal right of all people to free development. *Betzavta* does not grasp democracy exclusively as a form of government, but the educational concept understands democracy as a form of decision-making that takes into account both the process and the result. This brings everyday situations into focus, as they always arise when people come into contact with each other and especially when they make decisions together. *Betzavta* thus helps to unveil power relations and shows how people participate in decision-making processes or how they are excluded respectively. In this sense, *Betzavta* stands in the tradition of John Dewey, who stresses democracy as a way of living and thereby advocates a close connection between democracy and education. *Betzavta* exercises are widely used in school and extracurricular educational work as well as in anti-racism and diversity training. In individual and group work as well as in playful exercises, the participants enter situations through which social conflicts are pointed out. Important issues are: inclusion/exclusion, majority/minority, fundamental rights and democratic principles, freedom, equality, justice, race and gender. Derived from the concrete actions in the exercises, parallels to everyday life are reflected upon and one's own behavior patterns can be experienced. Through the perception of one's own and others' needs, self-reflection and empathy are promoted and social skills for a respectful togetherness are strengthened. Before this background, the pedagogy of democracy does not only provide ideas to create a meaningful course design that may help to democratize education but it also helps to grasp approaches to an overall democratization of the society-nature relations.

3.2.6 - TINS-D Constellation

Overall, this led to the joint recognition that the *Blue Engineering Course* must not only address technology but also individuals, nature, society and democracy (*TINS-D*) and the reciprocal relations among these concepts. At first, this was just a general understanding, but eventually, in 2015 this was developed into the concept of *TINS-D Constellation*. Technology and nature, as well as individual and society, are placed on opposing poles of two intersecting axes, see Figure 1. At the intersection rests democracy, to call for a democratization of the other four concepts. The five concepts are seen as being set to construct each other as they are bounded by reciprocal relations. Subsequently, if one dimension changes, it has an effect on all four other dimensions. As described above, the theoretical concept of this *TINS-D Constellation* is based mainly on the Critical Theory of the early Frankfurt School (Horkheimer 1974; Horkheimer and Adorno 1972) and its recent developments (Demirović 2007; 2012; Köhler and Wissen 2010; Brand and Wissen 2013). Overall, there is not yet a theoretical description of the *TINS-D Constellation*, however, it is successfully implemented and tested within the course as an educational method.

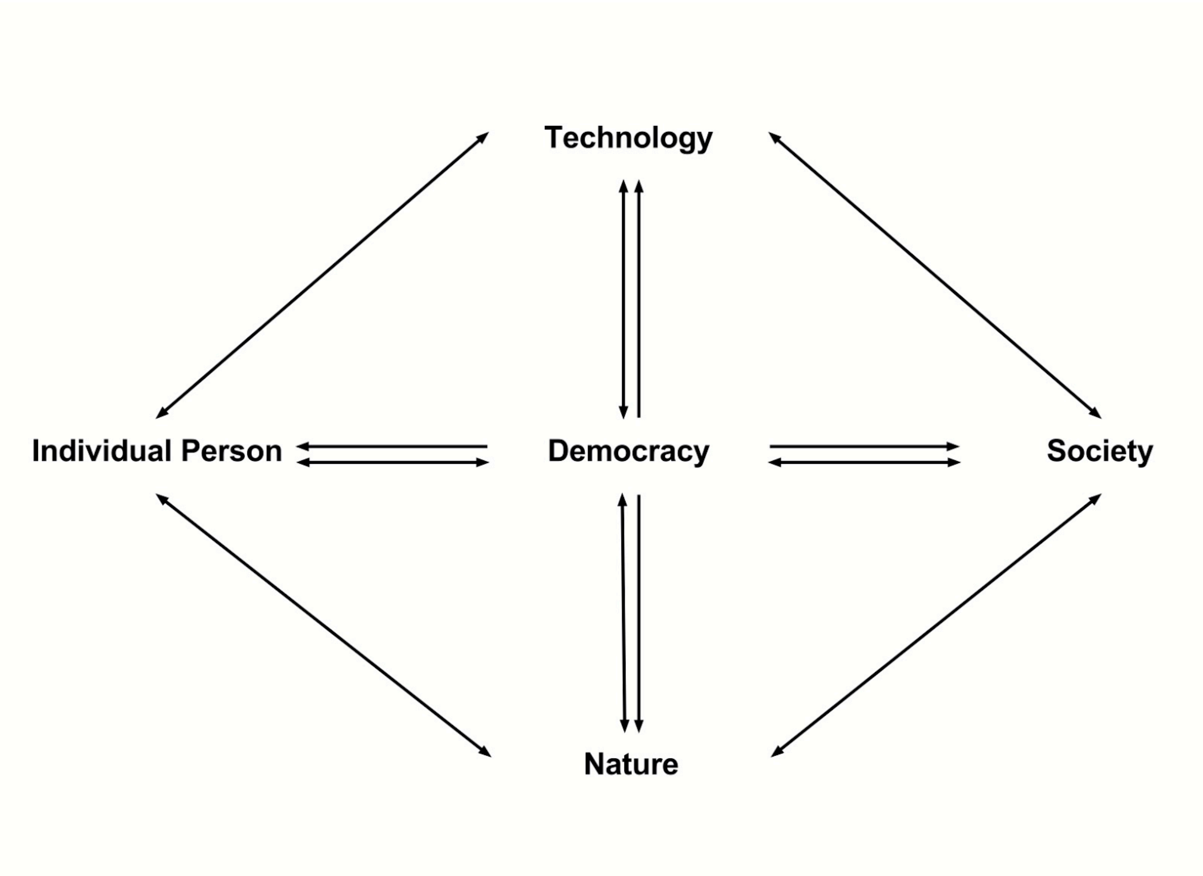

Figure 1 - TINS-D Constellation

3.3 - Design of the Blue Engineering Course

This sub-chapter briefly summarizes the key characteristics of the current design and implementation of the *Blue Engineering Course* at *Technische Universität Berlin*. The first section 3.4.1) gives an overview of the *Blue Engineering Course* while each of the succeeding sections discusses one aspect in detail.

As a result, there may be redundancy within this sub-chapter as well as with regard to the previous sub-chapters on the genesis and the theoretical background of the course. This redundancy is intended in order to gradually familiarize the reader with the design of the course, which is rather complex. In addition, this is also deemed necessary as the course transcends classical engineering education.

3.3.1 - Overview of the Blue Engineering Course at Technische Universität Berlin

The *Blue Engineering Course* at *Technische Universität Berlin* is offered by the *Chair of Machinery Systems Design*. Responsible for the course is the head of chair Prof. Dr.-Ing. Henning Meyer. The course is coordinated by a person holding one half lecturer position who mostly coaches and supervises the student tutors. The course itself is conducted by three student tutors with a total of 120 monthly hours.

The course is credited with 6 ECTS points and a total of four course hours per week. A semester typically spans 13 to 15 weeks.

The *Blue Engineering Course* started a compulsory elective course in three master study programs: *Mechanical Engineering*, *Industrial Engineering* and *Computational Engineering Sciences*. As of winter semester 2017/2018 the *Blue Engineering Course* is established as a compulsory elective in the bachelor programs of *Mechanical Engineering*, *Industrial Engineering*, *Transport Systems Engineering*, *Sustainable Management* and a *STEM Orientation Study Program*. Every other student may take this course as an elective in order to receive credit points or participate without a final assessment.

The course takes places in three rooms. All of these rooms have moveable chairs and tables as well as a projector. One of these rooms has a capacity of 100 persons. The other two rooms have a capacity of 40 persons.

The *Blue Engineering Course* has a capacity of about 75 students. According to the course plan, there are several joint lessons, where all 75 students will be in one room, as well as several lessons where the participants are split into three sub-groups of equal size..

The course plan itself is split up into three parts where one builds upon the other: 1) The tutors conduct a set of core building blocks which are offered every semester. 2) The students conduct a set of existing building blocks. These have been created by student groups in preceding semesters. 3) The students conduct a building block that they have created.

For a successful completion, the students have to fulfil three assignments: 1) keeping of a learning journal; 2) conduction of an existing building block to their fellow students; 3) the semester projects consists of the conduction and documentation of a new building block. The learning journal and the conduction of an existing building block each make up 25 % of the final grade and are each assessed through five criteria. The semester project makes up the other 50 % of the final grade and are assessed through ten assessment criteria.

3.3.1 - Student-Driven Course Design

The very idea that a group of students engages in the creation of a meaningful course underlines the shift from teaching to learning (Barr and Tagg 1995). In this case, the student group not only initiated a student-centered course but they created a student-driven course by expecting that the participants co-conduct the course during their own semester and co-develop the course for the following semesters (Baier 2013). Thus, the *Blue Engineering Course* is itself the product of a student-driven initiative, but it also has a student-driven character.

This student-driven character is realized through a course concept that is not primarily about teaching but about creating a common space where students from different disciplines with diverse perspectives come into contact to jointly analyze the relations of various topics and to jointly learn from each other and act together. Thus, the participants are not confronted with postulated truths but are requested to be open for discussion as well as to cherish the diversity of opinions and backgrounds of everyone present. This is an interdisciplinary approach that considers the complexity of society and aims at providing a space where students can engage in order to make a difference. Therefore, no experts were needed but rather facilitators of group- and learning-processes. Their responsibility is to facilitate a joint critical reflection on the reciprocal relations of technology, individuals, nature, society and democracy through a set of methods. The facilitators create a setting where the participants may not work alone but have to cooperate with others in order to take collective action at least by co-conducting the course as well as by co-developing the course with respect to the coming semesters.

3.3.2 - Building Blocks

Key element of this student-driven design is the concept of building blocks, that is 15 to 90 minute long teaching/learning units. Each building block must provide an appropriate set of methods to enable any generally interested group with a maximum of 25 persons to acquire a certain insight into the ecological and social dimensions of technology. In order to reach this goal, building blocks are self-contained teaching/learning units that cover one specific topic and that provide different methods that engage the participants in co-conducting a lesson more or less by themselves. Therefore, the person conducting the building block does not function as an expert that simply conveys knowledge but as a facilitator that organizes a complex group process.

The over 150 existing building blocks cover a broad range of topics within the field of social and ecological engineering. Some of these building blocks help to thoroughly analyze single technologies, e.g. fracking, preimplantation diagnostics, while others address the general effects of technology on society or nature. There are a number of building blocks which address the individual sphere, e.g. food and living preferences, while other building blocks address the global sphere, e.g. agricultural industry, capitalism, climate change. Several building blocks particularly address the work-life of engineers and the concept of work in general.

Along with the wide variety of topics, every single building block uses a specific set of teaching formats such as case studies, storytelling and station learning. Most building blocks, however, rely on a specific adaptation and new combination of known methods, e.g. learning cascades, court trials and educational games.

Building blocks generally consist of a well-documented, easy-to-use manual that provides all relevant information about the specific content, respective sources, external partners and clear methodological instructions along with a timetable. They provide clear instructions to facilitate the respective building block as well as compact background information, that consider multiple perspectives. All existing building blocks are published under a Creative Commons License (2009), which allows the use of these building blocks if the derived work is licensed with the same license and if attribution is given. The building blocks are publicly available on the *Blue Engineering* website (2018).

Typically one or two building blocks are conducted in each lesson of the *Blue Engineering Course*. The following section will present an exemplary course plan to provide an overview how building blocks are used in the course. Concrete examples of building blocks are then presented in the succeeding sections.

3.3.3 - Exemplary Course Plan of the Blue Engineering Course

Generally speaking, the *Blue Engineering Course* can be divided into three parts:

- In the first part, student tutors conduct a fixed set of building blocks in order to give the participants a concrete idea of what is expected of them later on. These fixed building blocks are called core building blocks and they remain the same across all semesters.
- In the second part, groups of three to six students conduct already existing building blocks for their fellow students of the course.
- In the third part, the student groups conduct a building block which they have newly developed over the course of the whole semester.

This division into three parts guarantees a step by step process where the students first get to know the concept of building blocks, while, second, they conduct an existing building block and, third, they have gained the competences necessary to develop a demanding building block on their own and conduct it to their fellow students..

The following Table 1 gives an exemplary course plan for the *Blue Engineering Course*. The three parts of the course, discussed above, are highlighted.

Table 1
Exemplary Course Plan of the Blue Engineering Course

Week/ Lesson	Room - A	Room - B	Room - C
		Conducted by Tutors	
1	Introduction - all in room A		
2	Plastics - common start for all in room A including knowledge chest		
	Plastics Role-Play	Plastics Role-Play	Plastics Role-Play
3	Topic- and Group Finding as well as TINS-D Constellation		
4	Technology as Problem-Solver!?	Responsibility and Ethical Codes	The Productivist Worldview
5	The Productivist Worldview	Technology as Problem-Solver!?	Responsibility and Ethical Codes
6	Responsibility and Ethical Codes	The Productivist Worldview	Technology as Problem-Solver!?

Conducted Solely by Students and Created by former Students			
7	Work, Society and Labour Unions all in room A including external expert		
8	Global Village 25 Questions by Frisch	Automation vs. Good Jobs CO2 Usage	Climate Trial Phoneblocks
9	Microplastics Peak Everything	Democratization of Work Greenwashing	Blue Stories Prisoner's Dilemma
10	Gender, Diversity and Technology common start for all in room A including external expert		
	Anti-Discrimination Exercise	Anti-Discrimination Exercise	Anti-Discrimination Exercise
Created and Conducted Solely by Students			
11	2 Student's Building Blocks	2 Student's Building Blocks	2 Student's Building Blocks
12	2 Student's Building Blocks	2 Student's Building Blocks	2 Student's Building Blocks
13	2 Student's Building Blocks	2 Student's Building Blocks	2 Student's Building Blocks
14	Final Lesson with Market of all Newly Created Building Blocks in Room A		

3.3.4 - Core Building Blocks

The first part of the *Blue Engineering Course* consists of a fixed set of core building blocks that are conducted every semester. This first part of the course is entirely conducted by the student tutors and covers the first six weeks of a semester. The basic idea of this phase is to let the students familiarize themselves with the educational concept as they most likely have not yet participated in a similar course during their education. Consequently, the first weeks of the course are mostly about giving them the space to get to know each other as well as to explore the different opinions and values present in the group. This is done in order to unveil different perspectives on various topics and to help the participants to value these perspectives as an asset in order to take proper action as an individual and within a group. Additionally, the participants work regularly in smaller groups that continually change within one lesson and across multiple lessons in order to build up the various competences that are necessary to act in groups. At last, they start to work together on their semester project in small groups of three to six students.

The core set has been stable since winter semester 2015/2016 and comprises the following building blocks (Baier and Pongratz 2016): *Introductory Building Block, Plastics, Team-/Topic-Finding and TINS-D Constellation, Technology as Problem-Solver!?, Responsibility and Ethical Codes, The Productivistic Worldview* and a *Closing Building Block* for the last session of a semester.

Each of the following paragraphs describes one of the core building blocks. in addition, as all of the core building blocks are only published in German (Baier and Pongratz 2016), there is a fact sheet in English for each building block which provides some basic information about the topic, methods and design of the building block as well as required materials and the competences that are addressed through the building block, see Appendix - Building Blocks.

The *Introductory Building Block* starts off in one room for all of the participants of the course. Each participant is welcomed at the door and is assigned a seat in a circle of five chairs. Here the participants are asked first to answer two questions and then exchange with the other participants in their circle. Accordingly, the participants are active from the very beginning of the course and start exploring other perspectives. After that start, the students participate in two small and very interactive building blocks on responsibility as well as on the complexity of modern technology. After each building block, the small groups are broken up and new ones are created so that the participants get to know several more participants. In addition, they are given three 15-minute presentations on the idea of *Blue Engineering*, the course design as well as on responsible engineering. As the presentations are kept very brief, the students spend over two thirds of the class time interacting with others, reflecting on values, technology and society and getting to know other participants while exploring their opinions and perspectives.

The building block *Plastics* contains the following elements in that order: 1) a preparatory e-learning unit; 2) a short building block on the relevant factors of technology development; 3) a short presentation that analyzes the reciprocal relations of plastics with the help of the *TINS-D Constellation*; 4) a group building for four sub-groups with about 20-30 members on the commonalities and differences within the sub-group; 5) an exhibition on plastics that provides a general overview and especially highlights the role of plastics as a pollutant with heavy local and global effects; 6) a comprehensive role play of 90 minutes length for the four sub-groups on the topic of Bisphenol A. Here, the participants prepare and simulate a TV talk show with different roles on the perceived dangers and the possible ban of Bisphenol A. The general outtake of this is the actual or wished for neutrality of the sciences as well as the relation of science and politics. The insights are then transferred to other debates ranging from the opposition towards nuclear power plants to the ongoing discussion on Glyphosate. Overall, this comprehensive building block *Plastics* consists of several elements in order to give the participants a broad overview of what they can expect in the coming weeks as well as to heighten their awareness for the complexity of an everyday product such as plastic.

The third lesson of the *Blue Engineering Course* is split into two halves: *Team-/Topic-Finding* and *TINS-D Constellation*. During the first part, the participants have the chance to propose topics for their semester projects and to find fellow students for these projects. In total, 24 slots for semester projects are provided and each student group should consist of three to six students. The concept of the semester projects is presented in detail in section 3.4.7. The second half of the third lesson consists of a 75-minute introduction to the concept of *TINS-D Constellation*. First, the participants tap into their own understanding of the five involved terms, that is technology, individuals, nature, society and democracy. Next, there is a short lecture on these five terms that sketches their terminological backgrounds as well as their relationships with each other, thus leading to the concept of the reciprocal relations of these five concepts and the following *TINS-D Constellation*. Next, the participants discuss the *TINS-D Constellation* in groups of five. This building block is concluded with a general discussion of the *TINS-D constellation*.

For the fourth through the seventh lesson, the participants are divided into four groups and attend four different building blocks. Each group stays the same for these lessons. This is done for two reasons. First, the participants experienced several group changes in the previous lessons and have met most of the participants for brief talks, discussions and group works. Focusing on fixed groups for four weeks creates some stability in the group processes. Here, the participants get to know each other more deeply and actively create a shared space of fixed rules, open discussion and joint group work. As this is not created through one lesson alone, the participants are given the chance to learn this in a stable environment over four weeks in total. The second reason or stable groups is, that the student tutors specialize in one building block and rotate.

Initially, this was done, in order to minimize the workload of the student tutors as otherwise, they would need to prepare three different building blocks. However, this also gives the student tutors the chance to build up an expert knowledge on the topic and the facilitation of the building block. The following three paragraphs briefly introduce these three rotating core building blocks.

The building block *Technology as Problem-Solver!?* addresses how society has dealt with a sudden pollution of drinking water in different ages of mankind (Baier 2017b). The participants are divided into six groups and each must solve the same problem of sudden drinking water contamination but in another human age, i.e. Stone Age, Roman Empire, Middle Ages, Industrialization, Present and Future. The groups must then depict their solutions through small skits. After each skit, there is a short discussion and at the end, a concluding discussion aims at pointing out the commonalities and differences between the centuries. This building block helps to realize that technology increasingly becomes a future cause for possible contaminations of water and nature while creating congruent solutions. Thus, the participants realize how society is shaping technology and how technology is shaped by society in return. This includes notably the spatial and temporal effects of technology.

The participants of the building block *Responsibility and Ethical Codes* work on several case studies that working engineers have to face. These cases cover the micro level, meso level and macro level. In addition, ethical codes for the engineering profession are given to the participants. All cases have multiple arguable solutions, requiring participants of the *Blue Engineering Course* to come up with a decision on how they would act despite an overly complex situation with an uncertain outcome. Here, the participants have to deal with conflicting values and have to come up with a decision that considers their personal values and beliefs as well as the values and beliefs of the group. In addition, the participants are introduced to the concept of the square of values (Schulz von Thun 1989) as well as to the concept of dilemmas within the *Betzavta* pedagogy of democracy (Maroshek-Klarman 1995; Maroshek-Klarman 1997; Maroshek-Klarman and Raber 2015).

The building block *The Productivistic Worldview* is the only text required to be read in the course. This 50-page essay by Otto Ullrich (Ullrich n.d.) is generally based on Marxist thinking and analyzes the development and the effects of technology from the beginning of the industrialization until the present. With respect to the language, it is not an academic text but rather a text for a general audience. Nevertheless, this text makes reference to numerous academic authors, which shows that it is not just stating an opinion but properly analyzing the state of society with respect to technology and nature. This text was chosen because it uses an accessible language in order to guarantee that a broad majority may read it. Methodologically, this building block is not very groundbreaking as the participants first reconstruct the major arguments of Otto Ullrich. Each reconstruction of a major argument is followed by a small round of discussion. Overall, the building block is concluded with a big round of discussion. This rather simple method is chosen in order to acquaint engineering students with classical text work as it is done in the humanities.

The *Closing Building Block* at the end of a semester is basically divided into three parts. In the first third, the students reflect on what has happened during the past weeks and try to establish connections between the broad range of topics and methods that were raised during the 14 lessons. This is assisted by the use of a *TINS-D Constellation*. In the second third, the student groups present their semester projects in an open market scenery. As there were always several parallel running sessions where the newly created building blocks have been conducted, this open market creates the chance to at least get an impression on what has happened in the other sessions. In the last third of the closing session, the students present issues that they want to work on after the completion of the course or also to present issues that they are already working on or volunteering projects that need further support. This space is provided in order to foster the opportunity to take collective action with fellow students.

3.3.5 - Conduction of Building Blocks by Students - Assessment

During the first seven weeks the participants of the *Blue Engineering Course* get to know the basic character of the course, especially with regard to how the lessons are generally organized. In addition, the first part of the course aims to create an environment where the participants get in contact with each other through working on relevant topics. The participants are supposed to keep this general setup once they take over by conducting existing building blocks and preparing their semester projects. They do these two assignments within a working group of three to six students that is formed during lesson three. The role of the student tutors is now changed to a general facilitator whose core responsibility is it to set a common start and end of the lesson as well as to function as contact person the students. When the student groups conduct their building blocks, the tutors take up the role of a regular participant who is not overly engaged in order not to dominate the group process.

The second part of the *Blue Engineering Course* covers four lessons: eight through eleven, see Table 1. Here, the student groups that were formed in lesson three conduct an existing building block to about 20 to 25 fellow students. By doing this, the students experience first hand how it is to conduct a demanding teaching/learning unit on a specific topic that makes use of a broad set of methods in order to create a meaningful learning environment. The building blocks that the student groups are to conduct are chosen by them from a provided list on a first come, first serve basis.

Beforehand, the student tutors are available for consultation for the student groups in case of questions and the need for help in order to prepare the conduction of the building blocks. Immediately after the conduction, a round of peer-to-peer-feedback is conducted by the fellow students and student tutors. This is done in order to appreciate the conduction and to provide some general advice for the student groups that will conduct their building block in the future and for the creation as well as conduction of the semester projects in the third third of a semester.

The conduction of the building blocks is one of three assessments of the *Blue Engineering Course*. Each small group that conducts one existing building block is graded and it counts 25 % of the final grade. The following set of five assessment criteria is applied and each criterion is equally weighted:

1) time management:
2) facilitation, presence, clarity and guidance of the group;
3) involvement and activation of participants;
4) familiarization, revision, updating and renewal of the existing module;
5) documentation of own experiences/changes for future groups

This set of criteria is broad enough to include all of the relevant aspects of the conduction of building blocks while still being narrow enough in order to reliably assess the different performances by the students.

In the eighth and eleventh lesson, each parallel session consists of two different building blocks that are conducted by two student groups each, that is in total 16 different building blocks. The building blocks for these sessions are chosen at the beginning of each semester by the student tutors in order to incorporate newly created building blocks, add arising topics to the course plan as well as to create some variety. There is no fixed set of criteria on how to choose from the over 150 existing building blocks, but generally speaking, a broad span of topics and methods is preferred and it is tried to equally address issues related social and ecological responsibility.

In the ninth and tenth lesson, two fixed topics are addressed each semester, that is gender and diversity as well as work and labour unions. These two lessons start with a general assembly of all participants of the course in one room. Here, the students participate for about 80 to 90 minutes in a session that is facilitated by the student tutors. The key part here is rather a conventional setting that starts of with a short presentation by a specific external speaker for the two topics and which is followed by a round of questions from students and the subsequent answers by the speakers as well as a general discussion. After that, the students are split up into three different subgroups and they continue the lesson in three separate rooms. In each room one student group conducts an existing building block that is related to the topic of the overall lesson. The two lessons are briefly presented in the following two paragraphs. in addition, as these two building blocks have only been published in German (Baier and Pongratz 2016), there is a fact sheet for each building block which provides some basic information, see Appendix - Building Blocks.

The lesson on *Gender, Diversity and Technology* introduces, in general, the concept of gender and diversity and highlights its presence in the field of natural sciences and technology. Moreover, it stimulates the critical reflection of one's own person and behavior while facing social inequalities and discrimination. The invited expert for this lesson has continually changed over the last semesters, however, it was always a woman who was either a women's representative in a public or private institution or a female scientist who worked on gender issues. For example, in summer semester 2017 a post-doc in the field of history of technology facilitated an explorative session on the differences of razors designed for either men or women. The subsequent building block is based on an activity from a workbook on intersectional pedagogy (Migrationsrat Berlin Brandenburg e.V. 2015). This activity was adapted to the *Blue Engineering Course* by a lecturer in summer semester 2016. This activity is basically an anti-discrimination exercise that raises awareness for the social inequalities that different sub-groups of society such as women, elderly, migrants, queers and not formally educated people are constantly facing. The experiences from this activity are then linked back to the personal experiences of the students as well as to the social structures that dominate the education system as well as the design, production and use of technology.

The building block *Work, Society and Labour Unions* addresses the basic issues related to these three topics. Since engineers usually work as salary-dependent employees, it is deemed essential that they are familiar with the basic ideas of work, aspects of wage labour and working time. In addition, labour law entails various obligations for employees and, above all, rights arising from the Entgeltfortzahlungsgesetz [Continuation Remuneration Act], the Betriebsverfassungsgesetz [Works Constitution Act] and the Koalitionsfreiheit [freedom to form a coalition] that is guaranteed by the Grundgesetz [German Constitution]. In this lesson which is conducted together with a labour union representative, these aspects of work are imparted successively through short presentations by participants. After each short presentation, the trade union secretary supplements and comments on the presentation and then leads to an open question/discussion round. This lesson is concluded in three separate rooms. In each room, one student group conducts the building block *A Short History of Time* which is a picture book based on Charles Dickens' Christmas story where the topic of working hours versus leisure time is presented and discussed. The original building block as well as the picture book were designed as a semester project by student group.

3.3.6 - Semester Project: Conduction and Documentation of a New Building Block - Assessment

During lesson three of the *Blue Engineering Course*, the participants choose a group of three to six students with whom they continually work with over the course of the semester. After familiarizing with the course design and its educational concept during the first seven weeks, the participants conduct an existing building block with their small group to their fellow students in the following four weeks. Parallel to these first two parts of the course, they use these experiences in order to create new building blocks that they will conduct and document during the third and last part of the *Blue Engineering Course*. This third part stretches over four lessons and for each lesson, there are three parallel sessions with two slots for the conduction of the newly created building blocks. The term semester project covers the whole process that ranges from the idea generation, the forming of the small student groups, the development of a new building block along with its subsequent conduction, review and documentation.

The semester project is a group assignment that counts 50 % of the final grade. There is a total of ten criteria that are applied to assess the semester project with equal weighting of each criterion. These ten criteria are divided into three sub-groups, that is four general criteria as well as three criteria for the conduction and three criteria for the documentation:

- General Criteria for the New Building Block
    1) social and ecological relevance with a clear link to technology, nature, individual and/or society;
    2) originality;
    3) scientific research and references;
    4) clarity of learning outcomes and stringency.
- Criteria for the Conduction of the New Building Block
    1) methods and format;
    2) moderation, motivation, presence, clarity and guidance of the group;
    3) time management.
- Criteria for the Documentation of the New Building Block
    1) reusability and completeness;
    2) care and neatness;
    3) graphic design and aesthetics

This set of criteria is broad enough to include all of the relevant aspects of the semester project while still being narrow enough in order to reliably assess the different performances by the students.

The student groups are deliberately given as little as justifiable information on what kind of new building blocks are expected of them. Instead, they are encouraged to explore new topics and new methods of facilitating a meaningful teaching/learning unit. Generally, they are expected to come up with a topic of their interest that relates to the field of social and ecological responsible engineering. In addition, they are expected to arrange their building block in such a way as that it requires as little time as possible for preparation so that it is easily conductible by anyone in the future and that it involves the participants to a very high degree. Consequently, mere presentations, term papers and similar formats are not accepted. Instead, the students have to combine their specific topic with various methods and formats, e.g. newly constructed or refurbished building blocks, exhibitions, card-/board games, encyclopedic treasure chests, picture books and e-learning-units. The length of the newly created building blocks should not exceed 60 minutes.

Already during the first and second lesson of the course the participants are requested to come up with their own topics for a semester project. If they have a topic, they are encouraged to talk with their fellow students about these topics in order to arrange groups. In addition, the student tutors prepare a set of 10 to 20 ideas for possible topics. These suggestions consist of a title as well as of a short description of about 150 words. This is done in order to give the participants a first overview of which topics and methods they could work on. The third lesson of the *Blue Engineering Course* centres on *Team-/Topic-Finding*. This lesson is arranged in such a way so that the participants who have identified a topic are given one minute of talking time each. In that time, they can promote their topic and invite their fellow students to work with them on that topic. Next, all the participants may float freely in the room in order to form groups of three to six persons. This means that not necessarily every proposed topic might be chosen and that may even result in the formation of new topics. After the formation of the student groups, each one is assigned one student tutor as their primary contact person for everything that is related to the organization, creation and conduction of their semester project.

From the third lesson onwards most of the work on these semester projects is done outside of class. Therefore, the members of these small groups are expected to work out their on working plan and to realize their own project management. During the development and the implementation of the course design, it has previously been discussed in different variants if the student tutors or lecturers should take a more active role in these group processes. However, this idea was always quickly dropped due to the high extra workload. Instead, a formative assessment and feedback culture were installed where the student groups are expected to present one time individually their ideas to their assigned student tutor during office hours. After that, they are free to consult their assigned student tutors any time after class or during office hours. In addition, during the fifth, sixth and seventh lesson a 30-minute time-slot is provided, where each group has to present their idea one time to their fellow students in order to receive their feedback. Lastly, after the conduction of an existing building block during the second phase of the *Blue Engineering Course* the student tutors as well as the students give feedback not only on the conduction of the building block but also on the design of this existing building. Therefore, these rounds of feedback may also help the student groups to design their new building block.

These newly created building blocks are conducted during the twelfth through the fourteenth lesson. Each lesson is split into three parallel running sessions. Each session provides two slots for the new building blocks. The general character of these lessons is supposed to be a mixture between dress rehearsal and the premiere as the building blocks are conducted for the first time but still, feedback is welcomed. These lessons are generally facilitated by the student tutors who organize an intensive round of feedback after the conduction of one new building block. This is done in order appreciate the effort of the students as well as to provide suggestions on how to change certain parts for the documentation of the building block. To increase the student's motivation for these lessons they are encouraged to invite family members and friends. Besides the regular participants of the course, these lessons are attended by the responsible professor and the responsible lecturer as well as other members of the academic staff and other interested persons. They all take up the roles of participants and can freely choose where to attend according to what topic interests them most.

A first draft of the complete documentation of the newly created building block is due one day prior to its initial conduction. This makes it possible to also include the documentation into feedback by the student tutors that takes place right after the conduction. The student groups then have the chance to incorporate the relevant feedback into the document and if necessary to revise and to rework the whole building block. The final documentation is due three weeks after the last lesson of the course. This final version needs to include all necessary data in an editable format so that for instance playing cards can be reprinted or adapted in the future. This final documentation is entirely handed in online on the website of the *Blue Engineering Course* (2018).

3.3.7 - Learning Journal - Assessment

The conduction of an existing building block and the semester project set a strong focus on collective action as they are done by small groups of three to six students. The keeping of a learning journal throughout the whole course is the only individual assessment that takes place and for that, every student is responsible for him_herself. The intention of the learning journal is to give the students the opportunity to individually reflect on what has happened during the lesson as well as to lay open possible connections between the lessons and to things that take place outside of the lessons. As a side effect, they create a personal document that they can come back to after the completion of the course.

The students are expected to prepare one entry for each lesson before the next lesson. A general suggestion is given that one entry should be around one or two pages. Learning journals can be kept analogue and/or digital. Alternative formats with their own content/methodical objectives are possible and welcomed after consultation with the student tutors, e. g. an inner dialogue, picture story, fairy tale narrative, drama/comedy or comic strip.

The learning journals are presented by the students a first time in an analogue or a digital form in the sixth lesson. Here, the student tutors use the learning journals to provide feedback to all of the students. They exemplify their rather general comments by referring to individual learning journals. This is done primarily to provide a formative assessment which goes along with the necessity on the side of the student to continuously keep the learning journal.

The learning journals are due for their final assessment at the lesson before the last lesson. Here, all learning journals need to be submitted in an analogue format, so that the students who previously kept them in a digital format can print them out. Between the second last and last lessons, the learning journals are assessed so that they can be given back during the last lesson. This is done in the hope that every student keeps a physical copy of her_his personal learning journal which they can consult long after the completion of the course.

Besides these general guidelines for keeping the learning journal for the *Blue Engineering Course*, it is clearly communicated to the students that the primary intention of the learning journal is to grant a space for their individual reflection and that they are expected to keep the learning journals for their own benefit. They are expressly encouraged to freely state their opinion without the fear of being judged or graded according to their opinion. Instead of judging opinions, the learning journals are only assessed according to the following set of criteria and if they have been fulfilled, partially fulfilled or not:

1) completeness, that is one entry for each lesson;
2) resume of what has happened in each lesson;
3) transfer, that is connecting the lesson for example with newspaper articles or conversation with friends and to analyze the topic through the *TINS-D Constellation*;
4) creativity, that is enriching each entry for example with drawings, photos, collages, poems, theatrical dialogue or other artistic confrontations;
5) conclusion and reflection - The last entry in the learning journal is to summarizes the whole course as well as the journey one has taken through the course.

The learning journal counts 25 % towards the final grade and each criterion is equally weighted. This set of criteria is broad enough to include all of the relevant aspects of a learning journals while still being narrow enough in order to reliably assess the different performances by the students.

3.4 - Other Student-Driven Courses in the Field of Engineering Education for Sustainable Development

Overall, the *Blue Engineering Course* contributes to the general aim of an education for sustainable development as it transcends classical environmental studies by setting “it in the broader context of socio-cultural factors and the socio-political issues of equity, poverty, democracy and quality of life (Venkataraman 2009).” This kind of education aims to provide students with the means to solve complex societal problems such as global warming, poverty or exploitation, which are too often approached with overly simplistic solutions. This, however, is upheld through classic engineering education which teaches students to create ‘quick fix’ technical solutions to complex problems with little thought of societal or future impacts (Brand 2012). As engineers play a prominent role in solving the world’s complex problems, they must therefore consider the social, technical and economic backgrounds of technical solutions to be effective. In addition, the *Blue Engineering Course* is organized in such a way so that its participants may become social change leaders by encouraging them to take up their responsibility and to contribute to a general sustainable development, first and foremost within the class setting. However, as they acquire a broad range of relevant competences through the class they contribute to a sustainable development after finishing the course.

Two similar student-driven initiatives fostered sustainability in regular engineering courses. The University of Uppsala and the *University of Agricultural Sciences in Uppsala* founded the *Centre for Environment and Development Studies* (*CEMUS*) in 1995 due to a student initiative (Hald 2011). Up until today, this student-run university centre offers each semester various courses on many different topics. In 2002 a research school with a clear interdisciplinary focus was added to CEMUS to provide a regular forum for PhD students. The second student-driven initiative was implemented within the democratic education program at the University of California. This program gives students the opportunity to offer courses to their fellow students on subjects which are usually not found in a regular curriculum. In the spring term of 2013 students offered the first engineering ethics course in this program (Sunderland 2013). The task in this course was to develop materials which would inspire others to reflect on the ethical implications of their actions as engineers and which might be used in educational contexts. The *Blue Engineering* initiative has drawn much inspiration from these two student-driven approaches and may develop further in their respective directions, e.g. providing students with the chance of offering their own courses and taking PhD students in a stronger consideration.

In addition, it has to be noted that the concept of the *Blue Engineering Course* is taken up at two universities in Germany. In both cases, students took the initiative to establish their own local adaptation of the *Blue Engineering Course* at their university. In general, these courses follow the basic design principles of the *Blue Engineering Course*, however, they are still rather independent courses as each university has their specific rules and traditions. The *Blue Engineering Course* at *Technische Universität Hamburg-Harburg* runs continuously since winter semester 2012/2013. There it is offered as a 2 point ECTS block course in the free elective area for all bachelor’s degree programs, as a combination of block seminars and a series of evening events in the master’s programs. Since 2016, a *Blue Engineering Course* has been offered at *Hochschule Düsseldorf* as a 5 point ECTS course in the compulsory elective area. The course takes place every week in the first half of a semester and concludes with a weekend block in the middle of the semester. All in all, the three different course types show that the *Blue Engineering* concept can be flexibly adapted to the respective conditions at a university. Due to its modular character, which is designed for the re-use of all elements, the course concept can be safely implemented at other universities.

4 - Analysis - Outcome-Based Education, Frameworks of Learning Outcomes and Competences of an Education for Sustainable Development

The previous two chapters describe the research design and the problem area which is constituted by the *Blue Engineering Course* itself as it is conducted at *Technische Universität Berlin*. Due to the overall principles, the course can be placed in the broad context of an education for sustainable development as well as within the context of an outcome-based education. Therefore the various concepts of key competences deemed necessary for a sustainable development may function as a reference point to describe the learning outcomes of the course. This chapter is the third step of this educational research design process, which analyzes the scientific and educational context of the *Blue Engineering Course* through an extensive literature review. This review provides a broad understanding of conceptual frameworks through which the description of learning outcomes of the course may be achieved. The basis for the description of the learning outcomes is a set of relevant competences of an education for sustainable development. This analysis chapter is divided into three parts:

4.1) describes the genesis and current status of an outcome-based education. For this, the confusing terminology in the educational context of objectives and outcomes is clarified. This helps to identify and describe six principles that are generally linked to an outcome-based education.

4.2) describes five different frameworks for learning outcomes. This literature review shows that a broad majority of existing frameworks for learning outcomes originate from a single framework, that is Bloom's Taxonomy (Bloom et al. 1956). However, these differentiations over time are valuable, since they extend the overall structure and add missing categories with regard the content dimension and procedural dimension of education.

4.3) This analysis chapter concludes with a description of the concept of competences, especially key competences generally associated with an education for sustainable development. In contrast to the various frameworks of learning outcomes, this literature review shows that the selection and description of key competences are converging which leads to a broad general description of those key competences in the literature. One particularly prominent set of key competences of an education for sustainable development is then selected and described in detail. It is argued that the 12 sub-competences of *Gestaltungskompetenz* (Haan 2010) is comprehensive and robust enough that only a course specific adaptation is needed.

4.1 - Outcome-Based Education

The formal educational sector is usually based on predefined input instead of outcomes (Spady 1994b, 31). The content for a certain semester, a concrete course or a lecture is often predefined through tradition or legislation and remains unchanged over decades and centuries. This content needed to be taught regardless of what the students would learn from this teaching or what the learner would need later on for her_his work or private life. This input is then divided into smaller segments which are taught in strict time intervals, such as 90-minutes lectures or within the 15 weeks of an academic semester. The assessment in return is usually a purely summative assessment at the end of a learning process and (Spady 1994b, pp 43). Therefore, it seems that the primary purpose of education is the ranking and selection of students according to their grades (Spady 1994b, pp 43). Thus, the role of the teacher is to address segmented content in set intervals in a strict class setting while also selecting students that would advance in education or not (Spady 1994b, 31).

This widespread input-based education is contrasted by an outcome-based education. Here, a set of outcomes is described beforehand, such as knowledge, skills or competences, which learners shall acquire through a process of learning. The educational structure, such as activities, assessment and the setting where the learning takes place, are than designed according to these predefined outcomes. This alignment is done to ensure that a learner successfully reaches the previously defined outcomes. Therefore, the two key aspects of an outcome-based education are a clear description of outcomes as well as the establishment of conditions and opportunities that enables all students to achieve these outcomes through a learning process (Spady 1994b, 1).

Examples of this type of education are the craft guilds in the Middle Ages as well as the apprenticeship training of today (Spady 1994b). Girl Scouts of the United States of America (2018) and Boy Scouts of America (2018) who acquire badges of learning or the different kyu and dan levels in the martial arts (Rielly 2011, 215) are other examples that are based on a clear description of outcomes which need to be reached at the end of a learning process. The last two examples make it apparent how closely learning outcomes, learning activities and forms of assessments can be linked or aligned to ensure a successful learning (Spady 1994b, 4). Overall, this form of education is practiced nowadays widely outside of schools and universities. There are even tentative initiatives that try to adapt the system of scout badges to the demands of higher education (Goligoski 2012; Gibson et al. 2013; Ostashewski and Reid 2014).

The concept of an outcome-based education is also gradually changing the European Higher Education Area as the Bologna Process (EHEA - Ministerial Conference 1999) enforces the description of learning outcomes in order to allow for easily readable degrees and credits (European Communities 2009). This aspect is further stressed as the goal of education is shifting from providing a basis for selection to actually educating people (Darling-Hammond 1994).

4.1.1 - Terminology: Objectives and Outcomes

The educational concepts that are based on outcomes vary greatly in detail and have seen a constant evolution of the terminology in its use as well as an evolution of the guiding principles. So it is not surprising that dissimilar concepts make use of similar terminology while similar concepts may use different terms to describe the same specific approach (Willis and Kissane 1997, 5). The terms *outcome* and *objective* lie at the center of this debate and have seen many different definitions over the past 100 years. This led to the point that neither of the two terms is used unambiguously in the educational discourse (Norman 2006; Morcke, Dornan and Eika 2013). Some authors have tried to further specify one or both terms by adding an adjective like *educational* (Bloom et al. 1956; Krathwohl, Bloom and Masia 1964), *instructional* (Mager and Peatt 1962; Popham 1970), *behavioral* (MacDonald-Ross 1973), *performative* (Sullivan 1968), *non-behavioral* (Cohen and Manion 1977), *teaching* (Cohen and Manion 1977), *expressive* (Eisner 2005), *exit* (Spady 1994b) as well as (*student*) *learning* (Gagné and Briggs 1974; Trigwell and Prosser 1991; European Commission 2008) in front of the noun. However, this has also added to the general confusion as the chosen adjectives hardly ever reflect the described intentions of the authors (Allan 1996). Indeed, there is not even a general agreement whether outcomes are a subgroup of objectives (Melton 2014, 29) or whether outcomes subsume objectives (Allan 1996).

Albeit this rich collection of specified terms, even the *Encyclopedia of the Sciences of Learning* published by Springer does not provide a clear definition for any of them (Seel 2011). In fact, if they are referenced then most of them are listed as synonyms under the lemma *Outcomes of Learning.* There is an additional lemma *Learning Objectives* which is also listed as a synonym with almost the same content and which obviously uses the words learning objective and learning outcome interchangeably even within the lemma. Moreover, there is a lemma on *Learning Criteria, Learning Outcomes and Assessment Criteria* which has little to do with the other two lemmas, but instead, it refers to new aspects of outcomes which have not been addressed in the other two. Apart from the *Encyclopedia of the Sciences of Learning* (Seel 2011), there are other authors which would argue, that the terms are used interchangeably and may be used interchangeably without any further consideration or that even a clear distinction is unnecessary (Prideaux 2000).

Joanna Allan (1997; Allan 1996) traces the development of the terms objectives and outcomes from their common origin in the seminal work of Ralph Tyler down to her own definition of outcomes in 1994. Although it misses the recent development (Spady 1994b, Biggs 2011, Tuning Project 2008, European Commission 2008, European Communities 2009), it remains the most profound historical analysis yet. Allan makes it clear that there are fundamental and unbridgeable differences between the concepts. A detailed discussion lies outside of the limits of this research project. However, some differences in the terms become apparent when five concrete concepts and frameworks of an outcome-based education are discussed below.

Despite the diversity of concepts, for pragmatic reasons, the term *learning outcome* or commonly shortened to *outcome* are used as the generic and comprehensive terms for the remainder of this research project. The definition of *outcomes* by William G. Spady may be comprehensive enough to include most of the other definitions:

> "Outcomes: Learning results that are clearly demonstrated at or after the end of an instructional experience. Outcomes can take many forms (from simple to complex) depending on the content, competencies, performance contexts and consequences embodied in their definition." (Spady 1994b, 194)

This definition by Spady suffices for the purpose here. If other terms are used in subsequent section, this is done in order to refer to specific educational concepts and the particular choice of an author whose concept is being described.

Likewise, there is sufficient confusion about the terms *goals* and *aims* within education which expands to the terms learning goals and learning aims. Generally speaking, *goals* can be understood as the "philosophical base of a curriculum" which may provide an orientation as well as long-term *aims* (Willis and Kissane 1997). However, it should be noted, that in the German-speaking context the term *Lernziel* [*learning goal*] is in widespread use. Its definitions are usually related to the provided definition of *learning outcomes* (Hochschuldidaktik 2013, 1-3; Schaper, Hilkenmeier and Bender 2013, 13). The terms *goal* and *aim* are not further considered as they are no further relevance for this research project.

4.1.2 - Education Based on Learning Outcomes

The different terminology of objectives and outcomes already indicates that there are also varying concepts of education that are based on either of these two terms. As with the term *outcome*, the term *outcome-based education* is used here as a comprehensive term for the remainder of this research project. It is again the comprehensive definition of Spady which is used for this research project:

> "Outcome-Based Education: A comprehensive approach to organizing and operating an education system that is focused on and defined by the successful demonstrations of learning sought from each student." (Spady 1994b, 194)

Ralph Tyler (1949) was the first major proponent of this form of education and is responsible for a global breakthrough of the rational planning of curricula. He advocates a curricular design that first identifies the educational objectives of a learning process and that chooses activities and assessments based on these objectives (1949, 3):

> “...[E]ducational objectives become the criteria by which materials are selected, content is outlined, instructional procedures are developed and tests and examinations are prepared. All aspects of the educational program are really means to accomplish basic educational purposes. Hence, if we are to study an educational program systematically and intelligently we must first be sure as to the educational objectives aimed at.” (Tyler 1949, 3)

The seminal book on the *Basic Principles of Curriculum and Instruction* by Ralph Tyler (1949) was the starting point for the development of a wide variety of educational concepts. All of these base education on predefined products which is the result of a learning process. Depending on the concrete concept, this means, that the outcome may be a very specific behavior, a simple or a complex performance as well as specific or general forms of knowledge, skills or competences. However, all of these concepts predefine first the change that takes place on side of the learner as a result of her_his engagement in an educational process. Furthermore, this process is designed in all of the varying concepts to facilitate the successful acquisition of the outcomes, which might lead to a strengthening of the role of the learner. Overall, the implementation of outcomes has led to a fundamental shift in the educational philosophy and educational practice (Willis and Kissane 1997) over the last 50 years. This resulted in six major changes which are subsequently explained:

4.1.3 - Outcomes Specify the Purpose of Education - Stating outcomes of learning is a comprehensive task that calls for an answer to the question what the purpose of education is before engaging in an educational process (Tyler 1949, 1). Once this purpose is identified on one level, the learning outcomes must be designed own to the lower level, in order to ensure a coherent educational experience.

4.1.4 - Outcome-Based Education Overcomes an Input-Driven Education - An input-driven education is abandoned in favor of an outcome-driven education which focuses not on mere content but on behavior, performances or competences on the side of the learner.

4.1.5 - A Shift From Teaching to Learning - The consideration of the outcomes led to a shift from teaching to learning (Barr and Tagg 1995) in a sense that teaching is only successful if the learner learns, that is achieving the predefined outcomes.

4.1.6 - A Shift From a Teacher-Centered Education to a Student-Centered Education - An increasing complexity of outcomes called for a further shift towards strong collaboration between students and teachers (Biggs 2011, 16), that is from a teacher-centered education to a student-centered education (Wright 2011).

4.1.7 - Alignment of Outcomes, Activities and Assessment - The outcomes determine the educational process, which needs to provide the conditions and opportunities for every learner to achieve the outcomes (Spady 1994b, 2). This generally leads to an alignment of outcomes, activities and assessment (Biggs 1996).

4.1.8 - Outcome-Based Education Strengthens Social Justice - An outcome-based education strengthens the role of social justice in public education as it is about providing favorable learning opportunities to any learner. Depending on the concrete outcome, the learner might even acquire relevant competences to act responsibly or autonomously (European Commission 2008, 11).

4.1.3 - Outcomes Specify the Purpose of Education

Setting up outcomes of an educational process addresses the question of what should be passed on through education (Lawton 1982, 2). So, outcomes clarify the intent of education (Biggs 2011, 113). Thus description of the outcomes inevitably also involves value judgements of those who decide upon the final learning outcomes (Tyler 1949, 4). To reduce arbitrariness and the bias of the people involved in the decision-making about outcomes, Tyler (1949, 4) calls to study the interests and needs of the learners themselves (Tyler 1949, 5). This would also require a study of contemporary life outside of the educational setting as this holds particular opportunities and problems that learners need to face effectively (Tyler 1949, 16). Other than that, subject specialists should be consulted (Tyler 1949, 25) in order to answer what their respective subject might "contribute to the education of young people who are not to specialize in it" (Tyler 1949, 27). In addition, the description of outcomes should further consider the vast knowledge embodied in cultural heritage (Tyler 1949, 5) as well the basic values of life that are transmitted from one generation to the next through education (Tyler 1949, 25). Consequently, the creation of outcomes of any educational process is not a task one person alone can handle. Instead, it is broadly acknowledged that a multi-stakeholder process is needed as this holds the chance that aforementioned factors are considered.

According to Tyler (1949, 128), the description of outcomes and the implementation of an outcome-based education can be undertaken on any level for a whole school district or one school, a specific subject or grade, but also for a single course of one particular teacher. To ensure a coherent educational experience (Tyler 1949, 41), outcomes might need to be designed down (Spady 1994b, 18; Glatthorn 1993; R. M. Harden 1999). This means, that once the outcomes are identified for one level, the outcomes on the lower levels need to be derived from these. Among others Anderson and Krathwohl et al. (2001, 16) identify the following three levels which need specific outcomes: 1) *Global Objectives* have a broad scope and usually cover at least one year. 2) *Educational Objectives* have a moderate scope and can be achieved within weeks or months. 3) *Instructional objectives* have a narrow scope and can typically be learned within hours or days.

4.1.4 - Outcome-Based Education Overcomes an Input-Driven Education

Tyler (Tyler 1949, 44) clearly rejects the formulation of outcomes in a format that describes what the teacher is to do in class. Outcomes in this format may result in an adequate description of the learning activities on side of the learner, nonetheless, these outcomes fail in stating what changes are expected to take place within the learner. Therefore, they are teaching outcomes instead of learning outcomes. This argument equally counts for outcomes that only state topics or content. A teacher may easily cover all of the necessary content in class but it remains uncertain if the learners have learned anything at all (Tyler 1949, 45). Tyler (1949, 46) also rejects the description of outcomes by naming generalized patterns or behavior like critical thinking, social attitudes or broad interests. According to him, this format lacks a reference to content as well as to the problems and concrete areas of life where these may be applied.

Tyler (1949, 46) suggests to describe outcomes by identifying the behavior and the content or the area in which this behavior is to take place. In this sense, the product of any educational process should be a change of behavior patterns on the side of the learner (Tyler 1949, 5). It should be noted that Tyler (1949, 6) uses the term behavior in a very general way which included thinking, feeling and action as well as values (1949, 10, 34). From this common starting point there was a general consensus that outcomes of a learning process consist of a verb and a noun that would specify the verb as well as the general context. However, as the various concepts evolved, a fundamental disagreement arose whether the verb should state an observable behavior (Bloom et al. 1956), a "behavioristic" behavior (MacDonald-Ross 1973), a performance (Spady 1994b), a competence (European Commission 2008) or even a concrete transformative action (Spady 1994b). Despite this disagreement on the exact nature of the verb, this focus on what the learner does is a more reliable source to assess successful learning than to assess what the teacher is doing in class (Shuell 1986).

4.1.5 - A Shift From Teaching to Learning

Along with the change from input to outcome, teachers become more and more accountable for the success of the learners which equally strengthened the role and responsibility of the learners (Allan 1996; Biggs 2011, 11). Instead of blindly teaching what is written down in the curriculum plan, teachers are required to assist the learners in reaching the outcomes. This resulted in the creation of more favorable learning environments. These changes are generally referred to as the educational shift from teaching to learning (Barr and Tagg 1995). However, along the edges of this shift, the question of the specificity of outcomes arose (Anderson et al. 2001, 20), that is whether they ought to describe very concrete and observable outcomes (Bloom et al. 1956) or whether they just should just give a general idea of what is to be learned and leave the rest open for autonomous interpretation by teachers and learners (Spady 1994b).

The former easily results in hundreds of outcomes for one course alone which might be too much, unrealistic or impractical to teach as well as to learn (Tyler 1988, xiii; Harden 2002). This educational concept would produce a very strict learning environment that reduces the responsibility of the teachers and constrains their autonomy as everything needs to be arranged beforehand in such a way as that the learner achieves almost inevitably the outcome. Curriculum designers advocate this approach as this gives them observable behaviors in order to evaluate the efficiency and effectivity of a curriculum (Bloom et al. 1956; Allan 1996). Due to this general setup, cognitive outcomes might be preferred over non-cognitive objectives, such as attitudes and skills, since they are more difficult to define and harder to validate (Shephard 2008).

The latter position in the disagreement over the generality/specificity of outcomes results in a learning environment where not even the teacher knows the exact result of a learning process (Spady 1994a). This grants autonomy on the side of the teacher as well as on the side of the learner (Spady 1994a). Albeit the description of outcomes in rather broad terms, this should not lead to unclear outcomes since the *clarity of focus* should be apparent at all times (Spady 1994b, 11). Otherwise, neither teacher nor learner know what the outcome of a learning process is to be. However, this approach to an outcome-based education is harder to validate, which is what accounts for most of this concept’s criticism (Rees 2004; Morcke, Dornan and Eika 2013).

4.1.6 - A Shift From a Teacher-Centered Education to a Student-Centered Education

A further result of the gradual development and implementation of various concepts of an outcome-based education is the shift from a teacher-centered education to a student-centered education (Wright 2011). Tyler (1949) as well as Bloom et al. (1956) have mainly advanced the description of outcomes with a clear focus on their use for assessment purposes. In practice, this resulted in the formulation of very specific outcomes that called for an equally specific behavioral response of the learner during the assessment. However, their use of the term “behavior” was not as rigid as further developments that resulted in the description of hundreds of outcomes for one single course (Harden 2002). These outcomes are typically termed *behavioral objectives* (MacDonald-Ross 1973), which describe observable behaviors of learners in detail and the success criteria for an assessment in detail (Mager and Peatt 1962). Overall, they are very specific in nature and usually only call for rather simple and concrete forms of behaviors, since more complex forms of behaviors should be split into separate parts in order to allow for an accurate assessment. This approach strengthens a teacher-centered education, where successful learning is highly depended on the teacher who creates a very narrow learning environment that inevitably leads the learner to show a specific behavior upon assessment (MacDonald-Ross 1973). Nonetheless, this teacher-centered approach dominated for decades the debate of an outcome-based education as this supports in a specific and fairly narrow sense the shift from teaching to successful learning.

However, this underlying dissonance was resolved with the abandonment of strict *behavioral objectives* (MacDonald-Ross 1973) in favor of *outcomes of significance* (Spady 1994b, 50). These outcomes refer to a complex combination of knowledge, skills and competences (European Commission 2008) which students may continually need in their private and professional lives even after the successful completion of a particular learning process such as a course or study program (Spady 1994b, 51). Consequently, a rather complex student-centered education is necessary where students collaborate with each other as well as with teachers (Biggs 2011, 16) to able to define a relevant problem on their own, create and select possible solutions and put that solution into action (Spady and Marshall 1991; Harden 1998). Due to an eventual political accord, this student-centered approach of education has become nowadays the central educational paradigm in higher education In Europe (EHEA - Ministerial Conference 2009; European Union 2015, 7).

4.1.7 - Alignment of Outcomes, Activities and Assessment

This double shift from the teacher perspective to the perspective of the learner has also led to a gradual change to incorporate more and more formative assessment along with a continued use of summative assessment (Biggs 2011, 191). As pointed out earlier, the description of outcomes implies that learners are expected to achieve these outcomes, so these eventually need to be assessed at the end of a learning process. However, continuous feedback along the learning process better ensures that students reach the learning outcomes successfully as they always know where they stand and how they might improve. Therefore, education has changed as it is no longer about selection alone, but about providing adequate opportunities for learning (Darling-Hammond 1994) as well as assessing.

Appropriate assessment is necessary since this is the crucial part of education from the learner's point of view (Ramsden 2003, 67). Therefore, if outcomes are to be met by the learners the assessment needs to be chosen accordingly as well as the corresponding activities that eventually would prepare for the assessment. This is generally called alignment and has already been part of the early writings on an outcome-based education (Tyler 1949; Bloom et al. 1956, 2), although it focused mostly on assessment of the outcomes.

The question of alignment in its own right was first addressed by Biggs (1996; Biggs 2011, 95) who claims to link constructivist educational philosophy with an outcome-based education. It remains questionable, if his writings helped to free outcome-based education from a perceived behavioristic underlining (Jervis and Jervis 2005; Morcke, Dornan and Eika 2013). Nonetheless, his advocacy of a strong alignment of outcomes with activities and assessment has been widely picked up and is generally incorporated into an outcome-based education (Anderson et al. 2001; Anderson 2002; Schaper, Hilkenmeier and Bender 2013, 21).

4.1.8 - Outcome-Based Education Strengthens Social Justice

Outcome-based education is about identifying relevant outcomes and to design a learning process which enables every learner to achieve these outcomes (Spady 1994b, 1). With respect to public education on school and university level, this implies a strengthening of social justice (Willis and Kissane 1997, 6). This includes a democratization of education (Lawton 1982) as what is important enough to be learned through formal education may only be decided upon by a broad range of stakeholders (Rees 2004; Spady 1994b, 3; Willis and Kissane 1997, 6). In addition, this aspect was also discussed when the question of the purpose of education was addressed in section 4.1.3

Social justice is further strengthened in an outcome-based education as this educational concept is about providing a learning environment where learners “regardless of their class, gender, race, ethnicity, physical ‘ableness’ and so on, are expected to achieve at high levels on a common curriculum” (Willis and Kissane 1997, 6).

4.1.9 - Educational Research on an Outcome-Based Education

The concept of an outcome-based education has a strong appeal (Harden 1999) and critics state it has been adopted by consensus and political decree despite weak empirical evidence (Morcke, Dornan and Eika 2013). However, even a more traditional implementation of an outcome-based education (Spady and Marshall 1991) lacks scientific data. This is mostly due to the fact, that it is particularly difficult to create a rigorous test-setting with a control group within education. The implementation of an outcome-based education within the higher education is most advanced within the medical education (Harden 1999; Harden 2007; Cumming, Cumming and Ross 2007). Therefore, almost all studies have been undertaken within medical education. The most comprehensive review of existing studies was conducted by Morcke et al. (2013) within the medical education of undergraduates. They identified eight studies and concluded that there is enough information to triangulate the following findings: students are better prepared (Waydhas et al. 2004) and self-evaluate as more confident and competent (Brody, Jacobs and Lai 2004). This might lead to better test results (Kuo and Slavin 1999) but they need not necessarily have above-average test-scores (McLaughlin et al. 2005). Albeit these shallow findings and studies Morcke et al. point out that there is no strong evidence that would invalidate outcome-based education. In addition, there are newer studies that support these findings (Raupach et al. 2011; Schiekirka et al. 2013; Schiekirka, Anders and Raupach 2014). Within engineering education, there is a slowly growing body of research which generally also backs the aforementioned findings (Lattuca, Terenzini and Volkwein 2006; Spelt et al. 2014; Spelt et al. 2016).

4.1.10 - Critics of an Outcome-Based Education

The critics of an outcome-based education can be divided into four major groups, apart from the group that points out the lack of scientific research. A first group has already been mentioned above and opposed outcome-based education along with all other educational reforms, e.g. the use of computers in school, that were put into place within the United States of Americas in the 1980s and 1990s (Spady 1994b, 141; Wilson 1994). This conservative and traditionalistic critique clearly lies outside of the scope of this research project, however, it shows again, that education is a contested field.

A second group addresses the point, that albeit all clarity of focus and a high specificity, outcomes remain ambiguous (Hussey and Smith 2002). Despite a comprehensive description of an outcome and a subsequent alignment of supportive activities and assessment, learners might not reach all of the intended outcomes. In return, they also achieve other outcomes that are not intended (Hussey and Smith 2003; Hussey and Smith 2008).

A third group addresses the restrictions of outcomes as they are generally to state forms of behaviors, performances or competences. On this ground, it is pointed out that values, responsibility and humanism cannot be addressed through outcomes (Cooke, Irby and O’Brien 2010; Stenhouse 1975) although they are generally seen as part of education. This critic has been partially resolved over time as the strict behavioral objectives were more and more dropped in favor of competences which imply values to a certain extent. Moreover, values, beliefs and attitudes are readily implemented in one of the frameworks which is presented below (Schaper, Hilkenmeier and Bender 2013).

A fourth group of critics addresses the implementation of managerial methods within education. This critic is raising a central point as the origin of an outcome-based education dates back to 1918 when Bobbit (1918) suggested transfering rational planning models into the educational sector. Education was to be organized according to the industrial processes of that time (Callahan 1962). As a result, educational administrators identified a series of procedural steps which one would need to take in order to ensure a rational design of the curriculum (Adams 1988). The key aspect of this rational planning is the specification of a product: what the learner will have learned. The whole learning process consisting of activities, assessments and settings then needs to be organized in such a way as to ensure that the learner learns what is expected (Adams 1988). Therefore, education and moreover the educational structure it produces are no longer seen as a mean to an end but as a mean to support learners in acquiring relevant knowledge, skills and competences to eventually tackle life's problems (Willis and Kissane 1997, 5) and if not then at least to pass the final assessment. Hussey and Smith (2002) provide a comprehensive overview of this fourth group of critics with regard to higher education. A driving factor for an outcome-based education is the increase of autonomy and responsibility of universities while on the other hand they are bound more and more by specific contracts, the success rate of students and other quantifiable factors (Bowles and Gintis 1987; Salter and Tapper 2013). Overall, universities act within a neoliberal environment which further advances a commodification of higher education (Barnett 1994; Winter 1995; Shore and Selwyn 1998). Thus, higher education institutes become service providers which offer "products" to their "customers" which are "divided into distinct, measurable quantities or modules each capable of being 'bought' by prescribed units of assessment" (Hussey and Smith 2002; Tsoukas 1997). This critical overview by Hussey and Smith (Hussey and Smith 2002) is supported by others even for German universities (Plehwe and Walpen 1999; Albrecht 2009; Dörre and Neis 2010; Demirović 2015). Here again, this critic addresses mostly an education based on behavioristic outcomes, while *outcomes of significance* (Spady 1994b, 50) have a clear transitional or transformational character that calls for autonomous teaching and learning.

4.2 - Frameworks for Learning Outcomes

Learning outcomes generally refer to what students are expected to be capable of after a learning process. Due to this open structure, it is possible to write almost an infinite number of learning outcomes as there is a huge variety of behavior and performances that integrate different content, particular competences and varying degrees of confidence. As with the differences between objectives, outcomes and the variations in between, the authors of frameworks for learning outcomes usually agree on the general use, intention and benefit which are presented here. In the following sections five individual frameworks were selected to be presented as they vary considerably.

4.2.1 - Commonalities of Most Frameworks for Learning Outcomes

The use of a framework of reference such as a classification or taxonomy helps to group the multitude of possible learning outcomes. This may further help to reveal how the outcomes relate to each other as well as to ensure a certain consistency in writing outcomes. In the case of a classification, the outcomes would be grouped based on one or more criteria. A taxonomy would be an orderly classification, that is the systematic arrangement of outcomes in a hierarchy based on one or more criteria. There are a considerable number of classifications and taxonomies available.

Spady identifies six criteria which could be used for a grouping (Spady 1994b, 59):

1) Outcomes may be grouped based on content: for instance the different scientific disciplines and sub-disciplines.
2) A grouping based on time would identify for instance the outcomes to be reached upon completion of secondary schooling or at the end of the second semester at university.
3) Outcomes could be grouped by the curriculum scope where they are of relevance, for instance, study program level or lesson level.
4) The jurisdictional domain, such as supra-national agreements or faculty rulings, could also be used as criteria for grouping.

All these aforementioned criteria do not consider behavior or performance, therefore, they do not seem suitable to be used in an outcome-based education and are not further addressed here. Instead, frameworks that use the intended behavior, performance or competence as the sole or primary criteria are discussed here. For this reason, Spady identified two more criteria:

5) The specificity or generality of competences might be used, for instance, to differentiate discrete skills and complex role performances (Spady 1994b, 59).
6) A similar criterion is a grouping based on the operational function of the outcome. This would allow for the forming of hierarchies from discrete outcomes to culminating outcomes (Spady 1994b, 59).

The use of a framework does not imply a one solution fits all approach that would relieve anyone concerned with education from describing and selecting outcomes and providing a corresponding learning environment. Instead, the major purpose of frameworks of learning outcomes is to foster communication between everyone who is involved in education (Bloom et al. 1956, 11). Potential stakeholders in that respect are students, teachers, administrators, researchers as well as people from the local community, employees and employers to name a few (Rees 2004; Spady 1994b, 3; Willis and Kissane 1997, 6). Overall, frameworks may help to cluster existing outcomes and to harmonize their description. A framework may also help to make comparisons between outcomes or to place them relative to learning activities and assessments (Bloom et al. 1956, 5). To a certain extent, a framework may also be used to define new learning outcomes.

According to Bloom et al. (1956, 11), the creation of such a common framework is a three-step process that starts off with the selection of appropriate symbols which are used to differentiate the learning outcomes. Second, these symbols need to be defined with sufficient precision to allow for a consistent and reliable use. Frameworks of learning outcomes, therefore, also help to clarify the different notions and terms in education, which would further facilitate communication (Anderson et al. 2001, 36). Third, everyone who is to use the framework needs to agree upon the selected symbols as well as their definition. The group's consensus needs to be ensured not only in the initial testing but also during the continued use, which explains the revisions and extensions of some frameworks as the predecessors were no longer considered appropriate (Anderson et al. 2001; Schaper, Hilkenmeier and Bender 2013). This three-step-process might allow people who work with outcomes to easily group them after an initial training phase (Krathwohl, Bloom and Masia 1964, 10). Overall, the creation of such a framework requires an intense process of communication which might in the long run further facilitate communication about learning outcomes and education in general (Bloom et al. 1956, 21; Anderson et al. 2001, 95). In, addition, since the main purpose of a framework is communication about education, all major proponents encourage to not blindly adopt a framework but to adapt it to one's own purpose (Anderson et al. 2001, XXVII, 301, 306; Bloom et al. 1956, 6) or to even create a framework from scratch (Tyler 1949, 49).

Outcomes commonly consist of a verb referring to the intended behavior, performance or competence and a noun, referring to content, subject matter or context. Therefore, there are basically two parts of an outcome that can be used to define criteria for grouping and ordering. A grouping of outcomes based on observable behaviors (Bloom et al. 1956, 12) or performances (Spady 1994b, 54) would ascertain a degree of neutrality towards subjects, educational levels and educational philosophies (Bloom et al. 1956, 6, 12). In fact, all but one of the discussed frameworks of learning outcomes (Tyler 1949) refrain from a grouping based on topics or content and use as primary criteria the expected behavior, performance or competence of the learner. Instead of a grouping based on specific content, some frameworks propose variants of knowledge, such as factual and procedural knowledge, to further cluster outcomes (Anderson et al. 2001; Schaper, Hilkenmeier and Bender 2013). Hence, a framework of outcomes may help to cross the borders not only between individual schools and universities but also across scientific disciplines, educational levels and even across states (Tuning Project 2005).

The primary use of a framework is to cluster already existing learning outcomes, however, the framework is also useful to consider and design new learning outcomes (Tyler 1949, 55). The initial grouping helps to quickly grasp to what extent which group of intended behavior or performance is expected from the learner. This simple quantified analysis reveals which kind of learning outcome is over- or underrepresented. Hence, gaps in the curriculum are easily identified. This may foster a discussion determining which concrete learning outcomes are needed and need to be included (Bloom et al. 1956, 2; Anderson et al. 2001, 7; Tyler 1949, 55). In addition, this initial grouping can be used to compare concrete learning outcomes of a course or study program with the learning outcomes from one of the higher levels, such as the intended learning outcomes of a study program or university. This comparison may foster a discussion which could lead to a further expansion of the existing set of learning outcomes. Therefore, the use of a framework to cluster learning outcomes open up one's own scope for other relevant learning outcomes and by doing so it helps to facilitate a discussion about the particular type of desired education (Anderson 2005).

Criteria for a framework that are based on intended behavior or performances can be used to not only cluster learning outcomes, but also to cluster learning activities or corresponding assessments (Anderson et al. 2001, 95). Therefore, it becomes even clearer why the most relevant frameworks base their criteria primarily on the verb component of learning outcomes, that is how the learners behave or act. A clustering of learning outcomes as well as of the learning activities and assessments within the same framework allow furher for a clear alignment revealing at a glance how outcomes, activities and assessment relate to each other (Anderson 2002). As with the clustering of learning outcomes, this helps to identify potential gaps and spark a discussion about these. This might result in the integration of other types of activities or assessments in order to cover the whole spectrum. Moreover, the clustering assists to reveal the mutual dependencies of outcomes, activities and assessments (Bloom et al. 1956, 5). This results in the creation of meaningful, complex activities that help to reach different learning outcomes at once or respectively demanding assessments that test various learning outcomes.

In the following sub-chapters, five concepts are discussed in detail with respect to

1) the exact terms they use
2) their initial intention,
3) the criteria used to group or to order outcomes in a framework
4) the relation of the criteria towards each other and
5) other particularities of the framework.

The first framework by Tyler (1949) is a simple differentiation between the verb and the content component of educational objectives in form of a table. The *Taxonomy of Educational Objectives* by Bloom (1956) is the seminal taxonomy that has considerably influenced all future work on educational objectives and their systematic arrangement notably in the cognitive dimension. Anderson and Krathwohl et al. (2001) have revised Bloom's Taxonomy almost 50 years later and created a taxonomy table that sets the cognitive process dimension in relation with four types of knowledge (Anderson et al. 2001, 27). This taxonomy table is further expanded by Schaper et al. (2013) to better reflect the variety of competences taught and learned nowadays in higher education, which would need to include values as well as social aspects. The fifth and last presented framework was created by Spady (1994b), who differentiates learning outcomes according to how close the actual performances are to real life situations.

A yet more comprehensive analysis of 19 different frameworks of learning outcomes is provided by Anderson et al. (Anderson et al. 2001, 257), who use this analysis to put their own taxonomy table into perspective. The number of dimensions is used as the main criterion for the grouping of the frameworks. They identified 11 unidimensional frameworks of which only four frameworks (Gagné and Briggs 1974; Williams 1977; Stahl and Murphy 1981; Biggs and Collis 1982) do not build upon the *Taxonomy of Educational Objectives* by Bloom et al. (Bloom et al. 1956). The eight remaining frameworks separate content from behavior, thus forming at least two dimensions. Four of these eight frameworks make use of three dimensions and one framework makes use of five dimensions. In addition, to a detailed description of these frameworks Anderson and Krathwohl et al. (Anderson et al. 2001, 257) compare the 19 frameworks in relation to *Bloom's Taxonomy* as well as their own taxonomy table (Anderson et al. 2001). Generally speaking, they conclude that all of these frameworks have a similar approach and address comparable aspects so that the particular frameworks differ mostly with respect to detail or by which aspects are addressed.

4.2.2 - Tyler - Basic Principles of Curriculum and Instruction - 1949

With his seminal book Tyler (1949) intends to provide some guiding *Basic Principles of Curriculum and Instruction*. For him, this implies that curriculum planners and instructors are not given one solution fits all to their problems. Instead, they receive some general procedures in order to encourage them to come up with their own learning outcomes as well as learning activities and possible forms of assessment (Tyler 1949, 1). Tyler devotes equal attention to these three factors of education, however, it becomes apparent that he is especially concerned with the creation of meaningful learning experiences and their subsequent assessment.

Tyler is the most important precursor of an outcome-based education without calling it as such (Tyler 1988, XI). Although it was not him who first advocated the use of learning outcomes, it is due to his relentless work in the educational sector that the idea was gradually picked up (Allan 1996). Tyler popularized the use of learning outcomes, which he terms *educational objectives* and which he regularly shortens to *objectives* (Tyler 1988, 5). They should be stated in a format that puts an observable behavior into relation with a specific content (Tyler 1949, 46). If all objectives are written in this format, it is possible to arrange them in a two-dimensional chart or table (Tyler 1949, 46). The various forms of behavior are listed in one dimension, while in the other dimension the variety of the covered content is listed. The arrangement in a table is supposed to help disjoin as well as relate behavior to content at a glance (1949, 47). The disjointment may be particularly helpful to clearly and concisely identify all forms of desired behavior as well as all content that is covered by the objectives. At the same time, this would also reveal the relationship between the different items.

Tyler (1949, 48) does not provide a universal table with ideal objectives that may be used as a reference point. Instead, he discusses in detail an exemplary table for a high school course in biological science. For this, he presents the character of each of the seven identified behaviors and their relation with each other as well as the three divisions and corresponding sub-divisions of the content dimension, see Table 2. The reason for this extensive discussion is to exemplify the possible generation of one's own table. To this effect, Tyler gives some general advice that he derives from his own discussion.

Table 2
Exemplary Table by Tyler
(Tyler 1949, 50) [shortened by AB]

Illustration of the use of a two-dimensional chart in stating objectives for a high school course in biological science							
		Behavioral aspects of the objectives					
Content aspects [...	**Under-standing [...]**	**Famil-iarity [...]**	**Ability to interpret [...]**	**Ability to apply [...]**	**Ability to study [...]**	**Broad and mature interests**	**Social attitudes**
A. Functions of human organisms							
1. Nutrition							
2. Digestion							
3. Respi-ration							
4. Repro-duction							
B. Use of plant and animal resources							
1. Energy [...]							
2. Environ-mental [...]							
3. Heredity [...]							
4. Land [...]							
C. Evolution and development							

The description of the behavior aspect of objectives needs to balance specificity and generality (Tyler 1949, 56). Therefore, the described behavior should be clear enough to convey a common understanding and meaning, which usually would call for the description of concrete behaviors that should not be too specific but rather a general mode of reaction (Tyler 1949, 41). However, a large number of behavioral aspects would be hard to keep in mind, which would void their relevance as objectives for curriculum planning. Tyler (1949, 57) suggests that the number of behavioral aspects should be between seven and fifteen. In addition to the seven behavioral aspects of the biology course that he discusses in detail, he briefly mentions ten types of behaviors that he identified through his own research (Tyler 1949, 58; Tyler 1986): the acquisition of information, the development of work habits and study skills, the development of effective ways of thinking, the development of social attitudes, the development of interests, the development of appreciations, the development of sensitivities, the development of personal social adjustment, the maintenance of physical health and the development of a philosophy of life. He does not elaborate much further on these behaviors but clearly cautions to consider them as being ideal (Tyler 1949, 58). However, he suggests that they give an idea of what he would consider as balanced between specific and general (Tyler 1949, 58).

The description of the content aspect of objectives should similarly reflect the above suggestions concerning the specificity as well as the generality (Tyler 1949, 56). Given the importance of some topics in a concrete curriculum, Tyler (1949, 58) suggests to not only identify different divisions but to be more specific and to identify relevant sub-divisions. He suggests that between ten and thirty content objectives are a reasonable number for a course (1949, 58).

Overall, Tyler remains highly vague on the creation of a taxonomy. This also has to do with his role as a precursor of learning outcomes in general. Nevertheless, it is mostly in line with his general understanding of education for which he requires that everyone who is affected by it should have a say in it and to co-create it. This would need to include the description of educational objectives and the creation of one's own taxonomy (Tyler 1949, 49).

4.2.3 - Bloom et al. - Taxonomy of Educational Objectives. The Classification of Educational Goals. Handbook I: Cognitive Domain - 1956

The *Taxonomy of Educational Objectives: The Classification of Educational Goals.* is laid out as a framework that would cover the cognitive, the affective and the psychomotor domain (Bloom et al. 1956, 7). However, it is acknowledged that the differentiation between these three domains does not imply that educational objectives fall only in one of these domains. It is rather apparent that educational objectives might be easily sorted into one of the domains but they still usually comprise components of the other two domains (Krathwohl, Bloom and Masia 1964, 8, pp. 45).

This taxonomy became the most influential taxonomy in the educational sciences and is generally named after Benjamin Bloom, who was the driving member of an informal group of college examiners which was formed in 1948 (Shane 1981; Anderson and Sosniak 1994;, Krathwohl 1994; Kridel 2000). As the group's members were all college examiners, their initial intention was to create a framework which would facilitate the exchange of test material and practices of testing in higher education institutes (Bloom et al. 1956, 10).

The term *Bloom's Taxonomy* refers to the overall concept that was developed by this informal group for the remainder of this research project. They adopted the term *educational objective* which has been used earlier by Tyler (Tyler 1949) to whom the first handbook was dedicated and whose work it mostly builds upon (Tyler 1988, 4).

In fear of an atomization of the educational objectives, the group worked out a framework that stays on a general level. However, they encourage practitioners to specify the taxonomy according to their various needs and concrete requirements (Bloom et al. 1956, 6). With regard to concrete educational objectives, they rather see the danger of generalisation which would make a valid assessment unfeasible. Therefore, the number of 200 concrete educational objectives for the general education of American armed forces is not addressed as too little or too much (Bloom et al. 1956, 48).

Bloom et al. (Bloom et al. 1956, 17) deliberately chose a taxonomy over a classification, as they saw a need of creating a hierarchy by which they could sort the behavior of students. It was their viewpoint that behavior can be differentiated along an axis of simple to complex. They consider that the more complex behaviors are just a combination of more simple behaviors. Therefore, Bloom et al. (Bloom et al. 1956, 16) would argue that the mastery of the simple levels is necessary to achieve mastery of the higher, more complex levels of behavior (Krathwohl 2002).

Bloom's Taxonomy is based on educational objectives that state the intended student's behaviors as the result of an educational process (Bloom et al. 1956, 12). For this, it is assumed that despite the differences in content, the behavior of students is always comparable across all subjects and even across grade levels. In consequence, the framework is designed so that it may be used throughout the whole educational system. Furthermore, four aspects were heeded in the development of the framework as guiding principles (Bloom et al. 1956, 13). First, the framework should be designed in such a way that it stays compatible with the already existing educational concepts, programs and materials. Second, the framework should be grounded on an internal logic which also would lead to internal consistency of divisions and subdivisions. Third, the framework should be based on the understanding of psychological phenomena which would strengthen the ties of psychology and education. Forth, the framework should be applicable to all content and methods as well as with respect to every educational philosophy.

The first handbook describes a taxonomy for the cognitive domain (Bloom et al. 1956) and was developed in an iterative process where the members of this informal group regularly met up until 1957 (Krathwohl, Bloom and Masia 1964, 13). In between these meetings, they also consulted with colleagues in their respective institutions (Bloom et al. 1956, 5). The cognitive domain deals "with the recall or recognition of knowledge and the development of intellectual abilities and skills" (Bloom et al. 1956, 7). Bloom et al. (1956, 200) further state more precisely that knowledge is the possibility to recall specifics and universals which also includes the recall of methods and processes as well as the recall of patterns, structures, or settings. Abilities and skills are defined as the "organized modes of operation and generalized techniques for dealing with materials and problems" (Bloom et al. 1956, 204). Based on this differentiation Bloom et al. identify six divisions in the cognitive domain 1) knowledge, 2) comprehension, 3) application, 4) analysis, 5) synthesis and 6) evaluation. These six divisions are further specified through a number of subdivisions, see Table 3.

Table 3
Bloom's Taxonomy for the Cognitive Domain
(Bloom et al. 1967, 201)

1.00 Knowledge 1.10 - Knowledge of specifics 1.11 - Knowledge of terminology 1.12 - Knowledge of specific facts 1.20 - Knowledge of ways and means of dealing with specifics 1.21 - Knowledge of conventions 1.22 - Knowledge of trends and sequences 1.23 - Knowledge of classifications and categories 1.24 - Knowledge of criteria 1.25 - Knowledge of methodology 1.30 - Knowledge of the universals and abstractions in a field 1.31 - Knowledge of principles and generalizations 1.32 - Knowledge of theories and structures
2.00 - Comprehension 2.10 - Translation 2.20 - Interpretation 2.30 - Extrapolation
3.00 - Application
4.00 - Analysis 4.10 - Analysis of elements 4.20 - Analysis of relationships 4.30 - Analysis of organizational principles
5.00 - Synthesis 5.10 - Production of a unique communication 5.20 - Production of a plan, or proposed set of operations 5.30 - Derivation of a set of abstract relations
6.00 - Evaluation 6.10 - Judgements in terms of internal evidence 6.20 - Judgements in terms of external criteria

The second handbook addresses the affective domain and was not developed by the group as a whole, but only by Bloom, Krathwohl and Masia who still consulted the former members (Krathwohl, Bloom and Masia 1964). They (1964, 16) recognize that educational objectives in the affective domain have experienced an erosion in the curriculum as the cognitive educational objectives are easier assessable. However, they see it necessary to continue with their work as education is seen as more than the cognitive domain alone. This second hand book aims at describing "changes in interest, attitudes and values as well as the development of appreciations and adequate adjustment" through a learning process (1956, 7). The testing of educational objectives in this domain is deemed particularly difficult as the internal emotions and feelings are as significant as the displayed behaviors (1956, 7). Furthermore, any education in this field would address the relationship between the private and public sphere, which would render the teaching and testing of educational objectives of the affective domain susceptible to indoctrination (Krathwohl, Bloom and Masia 1964, 17). Despite these concerns, they developed a taxonomy for the affective domain with five major divisions: 1) receiving and attending, 2) responding, 3) valuing and committing, 4) conceptualizing and organizing, 5) generalizing and characterizing (Krathwohl, Bloom and Masia 1964, 95). As in the cognitive domain, they are further specified by subdivisions, see Table 4.

Table 4
Krathwohl's Taxonomy for the Affective Domain
(Krathwohl, Bloom and Masia 1964, 176)

1.0 - Receiving (Attending) 1.1 - Awareness 1.2 - Willingness to receive 1.3 - Controlled or selected attention
2.0 - Responding 2.1 - Acquiescence in responding 2.2 - Willingness to respond 2.3 - Satisfaction in response
3.0 - Valuing 3.1 - Acceptance of a value 3.2 - Preference of a value 3.3 - Commitment
4.0 - Organization 4.1 - Conceptualization of a value 4.2 - Organization of a value system
5.0 - Characterization by a value or value complex 5.1 - Generalized set 5.2 - Characterization

By setting up the framework the informal group recognized that there is observable behavior by students undergoing a learning process which could be summed up in a psychomotor domain. Educational objectives in this domain would "emphasize some muscular or motor skill, some manipulation of material and objects, or some act which requires a neuromuscular coordination" (Krathwohl, Bloom and Masia 1964, 7). Bloom et al. (1956, 7) recognize that there are some undertakings in describing educational objectives in the psychomotor domain, however, they remain in doubt whether it would be useful to create a taxonomy for it. Albeit the informal group has not published a taxonomy, based on their guiding principles, Simpson (1971) and Harrow (1972) have proposed a psychomotor domain taxonomy which adheres to the design principles of the cognitive domain and affective domain.

4.2.4 - Anderson and Krathwohl et al. - A Taxonomy for Learning, Teaching and Assessing: A revision of Bloom's Taxonomy of Educational Outcomes - 2001

A revision of *Bloom's Taxonomy* (Bloom et al. 1956; Krathwohl, Bloom and Masia 1964) was initiated by Anderson and Krathwohl in 1994 (2001, XXVIII). Similar to the original enterprise they initiated the revision of the taxonomy as a group process for which they invited cognitive psychologists, curriculum theorists and instructional researchers as well as testing and assessment specialists (Anderson et al. 2001, XXVIII). This newly formed group regularly met over the course of five years during which they continually revised their work internally. In 1998 they invited external reviewers to comment on their manuscript. In the subsequent revision, almost all references to the original taxonomy were dropped, so that readers new to the topic would not be obfuscated (Anderson et al. 2001, XXIV). To this effect, the title of the publication does not refer to the original taxonomy but only the subtitle: *A Taxonomy for Learning, Teaching and Assessing. A Revision of Bloom's Taxonomy of Educational Objectives* (Anderson et al. 2001). This revision of *Bloom's Taxonomy* is called *Anderson/Krathwohl Taxonomy Table* for the remainder of this research project.

The extensive chapters on assessment in the two handbooks of *Bloom's Taxonomy* underline that the framework initially was conceived mostly by college examiners. Albeit this initial focus on higher education, it was Bloom who suggested at the first meeting of the informal group that their work is of use for all levels of education (Anderson et al. 2001, 306). Anderson and Krathwohl et al. (Anderson et al. 2001, 305) heeded in the revision process a shift of focus from universities to primary and secondary schools, which is underlined by a very detailed discussion of eight cases (Anderson et al. 2001, 110). Along with this shift, they focused more on the planning of a curriculum and the actual instruction and less on the assessment. In contrast to *Bloom's Taxonomy* which uses the term *educational objectives*, they just use the term *objectives*, which they (2001, 16) further differentiate into *general objectives*, *educational objectives* and *instructional objectives* as described above.

The revision process solely aimed at the cognitive domain of *Bloom's Taxonomy* (Anderson et al. 2001, 301) and drew mostly from two readily available sources (Anderson 2005). First, Anderson and Krathwohl et al. (Anderson et al. 2001, 257) analyzed 19 newly published alternative taxonomies which mostly refined or restructured the original taxonomy. The most significant difference identified was that eight alternative frameworks make use of two or more dimensions where the original taxonomy is only unidimensional. Second, numerous states have created curriculum standards which are based on describing learning outcomes of a learning process (Anderson 2005). The analysis of the existing objectives showed that objectives almost always were formulated in the grammatical structure of subject - verb - object (Anderson 2005). The subject is the learner while the verb indicates what the learner does with the object that is with the content. Furthermore, it showed that knowledge was used in a dual function as a verb and as an object.

This combined analysis eventually led to the major change of the revised taxonomy in comparison to the *Bloom's Taxonomy*. The one-dimensional cumulative hierarchy was transformed into a two-dimensional matrix which consists of a knowledge dimension and a cognitive process dimension. The knowledge dimension mostly resembles the sub-categories of the original knowledge category, whereas the cognitive process dimension resembles the total of the six categories (Krathwohl 2002), see Table 5.

The knowledge dimension and the cognitive process dimension form a two-dimensional table which Anderson and Krathwohl termed *Taxonomy Table* (2001, 27). The intersections of the four forms of knowledge on the vertical axis with the six categories of the cognitive process dimension on the horizontal axis constitute 24 cells in total, see Table 5. Accordingly, objectives can then be located in these cells. This visual representation of the objectives in table format easily shows to which extent the different categories of the process dimensions are addressed as well as which forms of knowledge may be acquired in the respective learning process. Furthermore, Anderson and Krathwohl et al. praise the usefulness of their taxonomy table when aligning objectives, activities and assessments (Anderson et al. 2001, 10, pp. 102) which allows for a comprehensive curricular alignment (Anderson 2002).

Table 5
Anderson/Krathwohl Taxonomy Table
(Anderson et al. 2001, 28)

The Knowledge Dimension	**The Cognitive Process Dimension**					
	1. Rememberer	**2. Understand**	**3. Apply**	**4. Analyze**	**5. Evaluate**	**6. Create**
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-Cognitive Knowledge						

The knowledge dimension consists of four forms of knowledge where the first three are already included on the first level of *Bloom's Taxonomy*: factual, conceptual and procedural knowledge (Anderson et al. 2001, 38). These three major divisions of knowledge are further divided into several sub-divisions, see Table 6. Anderson and Krathwohl (2001, 55) introduce metacognitive knowledge as the fourth form of knowledge which bridges the gap between the cognitive and affective domains (2001, 301; Pintrich 2002). Metacognitive knowledge is defined as knowledge "about cognition in general as well as awareness of and knowledge about one's own cognition" (Anderson et al. 2001, 55). Metacognitive knowledge is further divided into strategic knowledge, contextual/conditional knowledge and self-knowledge (Flavell 1979).

Table 6
Anderson/Krathwohl Taxonomy Table: 4 Categories of the Knowledge Dimension
(Anderson et al. 2001, 29)

A. Factual Knowledge A.a - Knowledge of terminology A.b - Knowledge of specific details and elements
B. Conceptual Knowledge B.a - Knowledge of classifications and categories B.b - Knowledge of principles and generalizations B.c - Knowledge of theories, models and structures
C. Procedural Knowledge C.a - Knowledge of subject-specific skills and algorithms C.b - Knowledge of subject-specific techniques and methods C.c - Knowledge of criteria for determining when to use appropriate procedures
D. Metacognitive Knowledge D.a - Strategic knowledge D.b - Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge D.c - Self-knowledge

The verb components of the *Bloom's Taxonomy* are subsumed in the cognitive process dimension. The verb components are ordered along 'a scale of judged complexity' (Anderson et al. 2001, 309): 1) *to remember*, 2) *to understand*, 3) *to apply*, 4) *to analyze*, 5) *to evaluate* and 6) *to create*. These verb components are further specified, see Table 7. Backed by research conducted on the correlation of the six categories, it seems justified to Anderson and Krathwohl et al. (Anderson et al. 2001, 289) to place *to create* on the top level. In addition, it is pointed out that the categories may overlap in order to allow for a better teacher usage (Anderson et al. 2001, 309). The revised taxonomy no longer postulates a cumulative hierarchy of these categories as the empirical evidence is judged weak for such a claim (Anderson et al. 2001, 287, 293). Therefore, the whole framework should be considered as a categorization, but they probably kept the term taxonomy as it is well established.

Table 7
Anderson/Krathwohl Taxonomy Table: 6 Categories of the Cognitive Process Dimension
(Anderson et al. 2001, 31)

1. Remember 1.1 - Recognize 1.2 - Recalling
2. Understand 2.1 - Interpreting 2.2 - Exemplifying 2.3 - Classifying 2.4 - Summarizing 2.4 - Inferring 2.6 - Comparing 2.7 - Explaining
3. Apply 3.1 - Executing 3.2 - Implementing
4. Analyze 4.1 - Differentiating 4.2 - Organizing 4.3 - Attributing
5. Evaluate 5.1 - Checking 5.2 - Critiquing
6. Create 6.1 - Generating 6.2 - Planning 6.3 - Producing

4.2.5 - Schaper et al. - Umsetzungshilfen für kompetenzorientiertes Prüfen (Implementation Guide for Competence-Oriented Assessment) - 2013

Schaper et al. (2013) point out that higher education institutes are seen today as an environment where students shall acquire both knowledge in their specific academic discipline as well as general competences (Tuning Project 2008; Schaper et al. 2012; Schaper, Hilkenmeier and Bender 2013, 13). Therefore, a taxonomy to be used in the context of higher education should still include the cognitive aspects of competence previously discussed, but it also needs to integrate the non-cognitive aspects as they are becoming more and more relevant. The growing relevance of competences also led to the need for an adaptation and extension of assessment methods. This is the primary concern of Schaper et al. when developing their framework, as they clearly state in the title of their publication *Umsetzungshilfen für kompetenzorientiertes Prüfen* (Implementation Help And Manual for Competence-Oriented Assessment). As noted above, Schaper et al. use the term *Lernziel* (learning goal) which is commonly used in a German-speaking context and which generally addresses all aspects of the term learning outcomes as it is used in this research project.

Schaper et al. (2013, 54) primarily build upon the *Anderson/Krathwohl Taxonomy Table* (2001). The second source of inspiration is the TAMAS-Konzept (Hochschuldidaktik 2010) which builds upon the *Anderson/Krathwohl Taxonomy Table* as well. Schaper et al. (2013, 54) keep the distinction between a process dimension and a content dimension. In the process dimension, Schaper et al. (2013, 57) reduce the number of levels from six to four through a simple clustering. They argue (Schaper, Hilkenmeier and Bender 2013, 57), that this reduction might also help to better integrate with their proposed extension of the content dimension to three categories which are presented below in detail.

The combination of the three categories of the content dimension and the four levels of the process dimension lead to a two-dimensional taxonomy table proposed by Schaper et al. (2013, 54), which is referred to as *Schaper Taxonomy Table* for the remainder of this research project. It consists only of 12 cells which are extensively explained and described in their text with concrete learning outcomes, activities and assessments (Schaper, Hilkenmeier and Bender 2013, 64). This is done to assist lecturers unacquainted with taxonomies to use them more readily (Schaper, Hilkenmeier and Bender 2013, 62). Nonetheless, it is compatible with the *Anderson/Krathwohl Taxonomy Table* in case a higher degree of differentiation is needed (Schaper, Hilkenmeier and Bender 2013, 62), see Table 8.

Table 8
Schaper Taxonomy Table
(Schaper, Hilkenmeier and Bender 2000, 56)

Content Dimension		**Process dimension**			
		Remember and Understand Knowledge and Skills	**Apply Knowledge, Skills and Attitudes**	**Analyze and Evaluate of Knowledge, Skills and Attitudes**	**Create and Extend Knowledge, Skills and Attitudes**
		Remember and Understand	Apply	Analyze and Evaluate	Create
Factual Knowledge and Procedures	Factual Knowledge	A1	A2	A3	A4
	Conceptual Knowledge				
	Procedural Knowledge				
Values, Attitudes and Beliefs		B1	B2	B3	B4
Interdisciplinary Skill and Knowledge	Metacognitive Knowledge	C1	C2	C3	C4
	Social and Communicative Knowledge and Skills				

The first category in the content dimension is named *factual knowledge and procedures* (Schaper, Hilkenmeier and Bender 2013, 62). It merges factual, conceptual and procedural knowledge of the *Anderson/Krathwohl Taxonomy Table* into one category that is subsequently divided into three sub-categories:

1) Factual knowledge, which covers the specialized knowledge of a scientific discipline and which also covers its specific terminology;
2) Conceptual knowledge relates the different content of a scientific discipline with each other, which is necessary to categorize knowledge and to build scientific models;
3) Procedural knowledge refers to the processes and methods relevant in a scientific discipline and refers to how models are to be applied.

The newly created second category in the content dimension is named *values, attitudes and beliefs* (Schaper, Hilkenmeier and Bender 2013, 63) and covers the normative and the motivational aspects of competences. It comprises the knowledge and reflection of personal as well as professional and collective values, attitudes and beliefs. This knowledge includes the interrelation of these and possible justifications as well as the capacity to make ethical judgements. This category has no equivalent in the revised *Anderson/Krathwohl Taxonomy Table* but it loosely relates to the affective domain of *Bloom's Taxonomy* (Krathwohl, Bloom and Masia 1964).

The third category in the content dimension transcends the boundaries of specific knowledge of a scientific discipline by addressing *interdisciplinary skill and knowledge* (Schaper, Hilkenmeier and Bender 2013, 63). This category is further divided into two sub-categories. The first sub-category comprises metacognitive knowledge, which is knowledge of cognitive processes in general as well as the awareness of one's own cognition which includes the knowledge of action strategies and their suitability for a certain task. In addition, metacognitive knowledge relates to interdisciplinary knowledge, that is knowledge which transcends one specific discipline and is relevant to a number of disciplines or which is scientific knowledge in general. This sub-category is already included in the *Anderson/Krathwohl Taxonomy Table* (2001, 55). The second sub-category comprises social and communicative knowledge and skills, which are necessary to realize one's own goals with regard to the individual and social sphere.

There is not a hierarchical order of these three content categories, however, it is pointed out that they move from specificity to generality which is highest in the *interdisciplinary skill and knowledge* category, as it comprises competences that are relevant in most professional and personal settings (Schaper, Hilkenmeier and Bender 2013, 62). The category in the middle *values, attitudes and beliefs* is characterized by a high level of subjectivity which is counterbalanced by the normative aspects of social life and work life (Schaper, Hilkenmeier and Bender 2013, 62). The category *factual knowledge and procedures* is mostly limited to specific knowledge and procedures one's specific academic discipline as well as of neighbouring disciplines (Schaper, Hilkenmeier and Bender 2013, 62).

In contrast to the *Anderson/Krathwohl Taxonomy Table* (Anderson et al. 2001), Schaper et al. (2013, 58) use the term category only in the content dimension. For the process dimension, they make use of the term *level*. By doing so, they underline that they perceive the process dimension as a hierarchy, where a mastery of the lower levels is necessary to reach the higher levels. This perception is not explicitly stated for the *Anderson/Krathwohl Taxonomy Table*, instead, Anderson and Krathwohl et al. (2001, 293) conclude after a detailed discussion that there is only weak evidence for a cumulative hierarchy. This could explain, why they use the term "category" for the process dimension as well. However, the view of a cumulative hierarchy is in line with the original taxonomy (Bloom et al. 1956, 16).

The number of levels in the process dimension is reduced from six in the revised *Bloom's Taxonomy* to four in total as this helps to better reflect the non-cognitive aspects of competences (Schaper, Hilkenmeier and Bender 2013, 58). For this, Schaper et al. (2013, 59) merge *remember* and *understand* (Anderson et al. 2001, 66) into one category which they call *To Remember and to Understand Knowledge and Skills*. They point out that *remember* hardly is a learning goal on its own in an academic context. Nonetheless, they state that *To Remember and to Understand* is seen as necessary in order to successfully perform on the other levels of the process dimension (Schaper, Hilkenmeier and Bender 2013, 59).

The second level in the process dimension is termed *To Apply Knowledge, Skills and Attitudes* (Schaper, Hilkenmeier and Bender 2013, 59), which corresponds with the third category of the *Anderson/Krathwohl Taxonomy Table* (2001, 77). At this level, the newly learned (procedural) knowledge, attitudes or skills are applied to solve known problems. In addition, they may be transferred and used in yet unknown conditions where they might have to be adapted to be used in that context (Schaper, Hilkenmeier and Bender 2013, 59).

The categories 4) *to analyze* and 5) *to evaluate* of the *Anderson/Krathwohl Taxonomy Table* (2001, 79, pp. 83) are pragmatically combined as these operations usually should complement each other (Schaper, Hilkenmeier and Bender 2013, 60). Hence, the newly formed third level of the process dimensions is termed *To Analyze and To Evaluate Knowledge, Skills and Attitudes* (Schaper, Hilkenmeier and Bender 2013, 60). On this level the newly learned knowledge, attitudes and skills are readily used to analyze and evaluate problems and complex situations based on (scientific) criteria and concepts (Schaper, Hilkenmeier and Bender 2013, 60).

The fourth and last level *To Create and Extend Knowledge, Attitudes and Skills* (Schaper, Hilkenmeier and Bender 2013, 60) is identical with the sixth category of the *Anderson/Krathwohl Taxonomy Table* (Anderson et al. 2001, 84). At this level, problems are defined and redefined and new creative solutions are developed and implemented to solve them (Schaper, Hilkenmeier and Bender 2013, 60). This does not necessarily imply that something totally new is created or discovered, but it is sufficient if learners are able to show that they can create something that is new to them (Schaper, Hilkenmeier and Bender 2013, 80).

4.2.6 - Spady - Outcome-Based Education: Critical Issues and Answers - 1994

Spady popularized the term outcome-based education. He refers to learning outcomes simply as *outcomes*. According to Spady (1994b, 54), the intended outcome is reached if the learner at the end of a learning process is able to perform successfully "1) to have something to perform; 2) be willing to carry out a performance process; and 3) be willing, motivated and confident enough to carry out the performance under the conditions defined." In other words, the outcome is reached by the learner, if she_he knows something that she_he is able and willing to do in a confident way at least during an assessment at the end of a learning process. Therefore, outcomes are a mixture of competence, content and confidence (Spady 1994b, 61).

Spady primarily intends to create a comprehensive overview and to provide a sound basis for discussion of the intentions of an outcome-based education (Spady 1994b pp. iii). This clarification became necessary in the United States of America at the end of the 1980s and the beginning of the 1990s since a high number of political activists blindly labeled everything they opposed as outcome-based education. Spady gives two examples for this: the opposition to the introduction of computers and the discussion whether the educational system is questioning or even undermining patriotism (Spady 1994b, 141; Wilson 1994).

Spady (1994b, 51) differentiates outcomes and *outcomes of significance*. The former is the comprehensive term that would also include highly specific skills or overly concrete knowledge such as the competence to name particular rivers shown on a specific map (Spady 1994b, 53). Spady does not disdain these kinds of outcomes. However, he argues to use rather *outcomes of significance* in educational contexts as these have systematic relevance in the further education as well as in work and life of the learner in general. Consequently, Spady (1994b, 52) argues for learning outcomes that are as close as possible to real-life situations. This would also call for learning experiences that provide extensive practice of certain performances and an assessment that ideally takes place in a real-life situation.

Spady (1994b, 60) proposes one simple and one more complex framework to cluster learning outcomes. For the simple framework he identifies three domains of outcomes: 1) *Performance*; 2) *Content*; 3) *Literacy*. This is a cumulative framework which places literacy at the lowest level. This domain comprises literacy outcomes such as the competence to speak, read, write, calculate and other low-level competences. The second domain contains content outcomes which notably stress specific content over distinct processes which basically comes down to core knowledge. The two already described domains of outcomes are essential to show demonstrations of learning in the performance domain, which is the third domain. It constitutes of performance outcomes which refer to "clearly identified competencies and performance abilities" (Spady 1994b, 191). *Outcomes of significance* may only be described at this level.

The more complex framework which Spady has developed is called *The Demonstration Mountain* (1994a; 1994b, 61), see Figure 2. Strictly speaking, this represents a taxonomy, however, Spady uses the term framework for it. *The Demonstration Mountain* consists of six levels that form a strict hierarchy of possible demonstrations of learning, where the higher levels build upon the lower ones. This requires a sufficient mastery of the lower levels, otherwise, the learner is not able to perform successfully on one of the higher levels. As described earlier, Spady differentiates these outcomes according to the simplicity or complexity of the required skills. Outcomes that only require discrete skills or a limited number of skills rank lower than outcomes of significance that require more complex skills in order to successfully demonstrate challenging performances. Since outcomes are a mixture of competence, content and confidence, Spady (1994b, 61) explicitly points out that the higher outcomes also require a higher degree of self-direction and motivation.

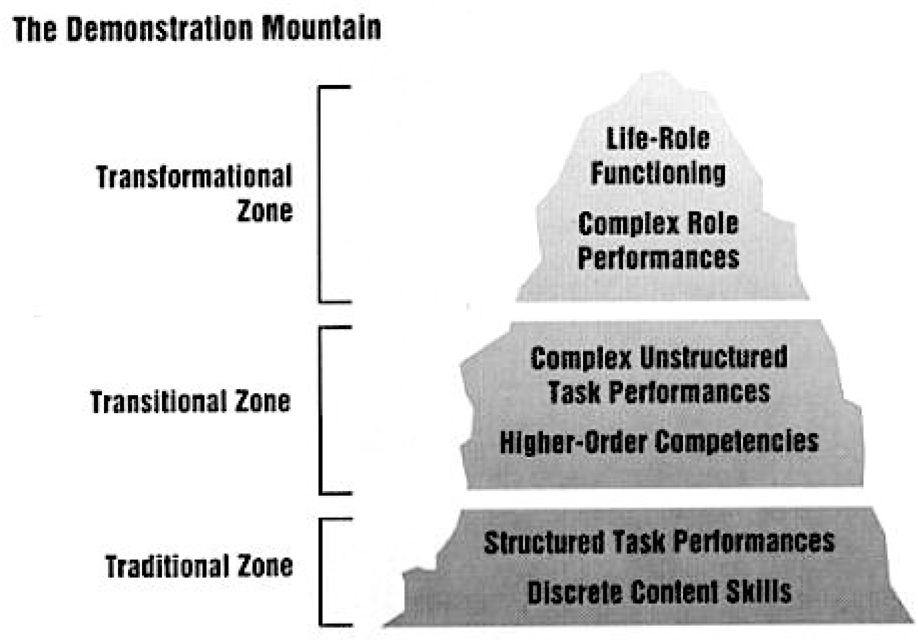

*Figure 2 - Demonstration Mountain clipped out from Spady (1994*a)

The six levels of *The Demonstration Mountain* can be further grouped into three zones where each zone comprises two levels which are subsequently explained (Spady 1994a; Spady 1994b). The highest zone is labeled *Transformational Zone* which contains the outcome level of *Life-Role Functioning* and *Complex Role Performances*. The *Transitional Zone* is in the middle and contains the outcomes that can be grouped into *Complex Unstructured Task Performances* and *Higher Order Competencies*. The *Traditional Zone* is the base of the mountain which is formed by *Structured Task Performances* and *Discrete Content Skills*.

At the bottom of *The Demonstration Mountain* lies the *Traditional Zone* which contains outcomes that are highly context and content dependent (Spady 1994a). The content in this zone is usually limited to the segregation into traditional subjects at school level or scientific disciplines at the level of higher education. The content is highly specific and is not generalizable which prevents a successful use in other subjects or disciplines (Spady 1994a). The context of the *Traditional Zone* is limited to the educational setting which makes the demonstrations of learning mostly irrelevant to a setting outside of school or university (Spady 1994a).

Discrete Content Skills is the first level of *The Demonstration Mountain*. As the name of it already suggests, the skills to be acquired are inseparably linked with the content (Spady 1994a). These are micro skills which require specific content out of a larger curriculum and learning process. The demonstrations of learning for these discrete content skills are highly dependent on a structured environment as it is provided by a school's classroom.

Structured Task Performances are located at the second level in the *Traditional Zone*. These performances require the successful completion of a series of rather simple tasks that are already given. These highly structured demonstrations of learning are widely used in educational settings, i.e. writing an essay on a given topic (Spady 1994a).

The *Transitional Zone* transcends subject or disciplinary borders (Spady and Marshall 1991; Spady 1994a). Performances in this zone depend on the successful combination and synthesis of various competences and a wide range of knowledge. It is in this zone that interdisciplinary approaches are performed by learners which makes these performances relevant for a variety of contexts and settings. The traditional educational setting, such as a lecture hall, are often left behind, in order to allow for performances that are closer to real-life situations.

The third level of *The Demonstration Mountain* is called *Higher Order Competencies* (Spady 1994a). Here, the learner faces multifaceted problems. In order to solve them and to come up with possible solutions, a thorough analysis is needed that might reveal the interdependencies of the various factors. Subsequently, a solution needs to be selected and communicated. Ideally, this whole demonstration involves the public to some degree.

At the fourth level, the learner demonstrates *Complex Unstructured Task Performances* (Spady 1994a). The major difference between the third and second level is that the performance is not structured beforehand, but requires that learners identify a sufficiently complex problem on their own and to create their independent research accordingly. In other words, at this level learners "are not simply carrying out tasks defined and assigned by others, but are taking the initiative and responsibility to design and to create new things" (Spady 1994b., 65). At the beginning of these tasks, neither the learner nor the teacher might foresee how they will end up.

The *Transformational Zone* is the highest zone located at the top of *The Description Mountain* (Spady 1994a). The performances in this zone imply that the learner responds to the complexity of real-life situations (Spady 1994a). In comparison with the ground zone of the mountain, where learning and the demonstration of it take place in a highly controlled educational setting, it is that at the highest two levels context becomes a dominating factor (Spady 1994a). Here, the learner integrates and synthesizes competences and content covering a wide range of subjects or disciplines in order to deal with concrete problems of social systems. In addition, they need to show the highest degrees of confidence and ownership in their performances as they will have to act according to their personal responsibilities in the learning process that is not situated in a classroom but in society itself. Overall, the learner is required to successfully show *Complex Role Performances* which is the fifth level.

The highest level *Life-Role Performances* calls for an education that requires performances of learners in real-life, where they continuously take up one of the ten life-roles identified by Spady (1994b, 69). By doing this, the learners engage in individual and team activities that aim at transforming society. Spady (1994a) acknowledges that this understanding of education is fundamentally different from how schools and universities organize learning today. However, to him, this kind of learning is the best preparation for real-life that learners may get.

4.3 - Competences

To distinguish between competences and learning outcomes it helps to consider two central roles within education: Teachers and students (Tuning Project 2008). Competences are what students acquire through the process of learning, whereas learning outcomes are statements what learners are "expected to know, understand and be able to do after successful completion of a process of learning" (European Communities 2009). Therefore, competences may be specified as learning outcomes, if that is what students are expected to acquire as part of a study program, module or lesson. The role of the teacher in an outcome-based education is then to create a learning environment where the students acquire the competences that are specified as learning outcomes.

The discussion of the historical development of the various concepts of an outcome-based education has already shown that there is a shift happening within education from knowledge and cognition towards performance and competence on the side of the students. The terms *performance* and *competence* have already been used in the previous section without properly defining them. For this research project a general differentiation may suffice: P*erformance* is what students actually do in a concrete situation whereas *competence* can be defined as what a person knows and would be able to do.

As with learning outcomes and their vast differing terminology, there is a similar large corpus of concepts that make use of the term *competence* or the closely related term *competency*. This varying terminology is clarified in the next section which eventually proposes a multidimensional and holistic definition of *competence* for the remainder of this thesis. Next, the concept of *key competences* and some variants of it are presented. This discussion shows that despite many differences between the concepts, there is a common understanding which key competences every individual should acquire in order to lead an autonomous life while also being capable of contributing to the prospering of society as a whole. For the context of this thesis, this implies that the concept of key competences is further specified with respect to competences that might foster a sustainable development. This discussion also shows the compatibility of the various concepts. Consequently, only the concept of *Gestaltungskompetenz* (Haan 2006) is presented and discussed in detail as this provides the most comprehensive and overarching framework for competences relevant for an education for sustainable development.

4.3.1 - The Concept of Competence

There is neither a common definition of *competence* crossing all sciences, where they are applied to specific contexts nor within one single scientific discipline, where the process of defining competences borders arbitrariness (Weinert 1999). Moreover, *competence* and *competency* are in some cases used as synonyms (Brown 1993; Brown 1994), whereas in the human resource management their differences are pointed out. Likewise, there is not yet a clear differentiation of these two terms. Le Deist and Winterton (2005) identify the definition of Woodruff (Woodruff 1991) as the "clearest statement, contrasting areas of competence, defined as aspects of the job which an individual can perform, with competency, referring to a person's behavior underpinning competent performance." Despite these controversies, this thesis uses the generic term *competence* referring to both terms (Mochizuki and Fadeeva 2010).

Le Deist and Winterton (2005) identify three theoretical strands that have developed independently of each other. They label these strands according to the geographic sphere where they have gained the most influence and radiated into other countries that follow these approaches (Winterton, Delamare-Le Deist and Stringfellow 2006). The first and historically the oldest strand has been developed in the United States of America and it has a distinct *behavioral approach towards competences* in the sense that personality and intelligence are regarded as learnable competences (Barrett and Depinet 1991). Therefore, successful persons are observed to identify their effective behavior that subsequently may be learned by persons to succeed in similar situations (McClelland 1998).

A *functional approach towards competences* has been developed in the United Kingdom that aimed at identifying occupational standards which are further divided into units and elements of competences (Mansfield 1993). Competences in this sense describe performance standards in a work context (Knasel and Meed 1994) which makes this functional approach relevant for a vocational training where it gained considerable influence. These two approaches advocate a one-dimensional understanding of competence arguing either for behavioral aspects or for functional aspects. Thereby, they neglect for one the other approach as well as other aspects of competences that have been identified such as personal competences, ethical competences and meta-competences.

These aspects of competence are incorporated in the *multidimensional and holistic approaches towards competences* that have recently been developed in continental Europe, especially in France and in Germany. In the latter one, vocational action competence (Handlungskompetenz) typically includes domain competence or subject competence (Fachkompetenz), personal competence (Personalkompetenz) and social competence (Sozialkompetenz) (Le Deist and Winterton 2005). The concept of competences generally applied in France differentiates between knowledge (savoir), experience *(*savoir faire*)* and a behavioral component (savoir être) (Le Deist and Winterton 2005).

There are also recent developments in the United States of America as well as in the United Kingdom that widen the concept of competence more and more (Hodkinson 1994; Cheetham and Chivers 1998; Collins, Lowe and Arnett 2000). Le Deist and Winterton (2005) conclude that one-dimensional concepts of competences are more and more replaced with multi-dimensional and holistic concepts which at least consider knowledge, skills, behavior and attitudes. They themselves (2005) argue for a concept of competences that units cognitive, functional, social and meta competences.

The *DeSeCo Project* (Definition and selection of competences: theoretical and conceptual foundations) builds upon these multidimensional and holistic concepts (2001). This project was initiated by the Organisation for Economic Co-operation and Development (*OECD*) which dominates the governance of education. Subsequently, this led to a considerable dominance in the educational sciences and in the educational sector in general. The definition of competence of the *DeSeCo Project* is based on Weinert's definition with its functional, demand-driven approach that argues for competences as a combination of cognitive, motivational, moral and social skills which are available or learnable by a person in order to potentially solve a broad range of problems as well as to successfully complete complex tasks (Weinert 2001). Thus, competences require more than surface knowledge or its application. Instead, it involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context (OECD 2005). Consequently, Rychen, one of the coordinators of the *DeSeCo Project* defines competences as follows:

> "A competence is defined as the ability to meet a complex demand. Each competence corresponds to a combination of interrelated cognitive and practical skills, knowledge and personal qualities such as motivation, values and ethics, attitudes and emotions. These components are mobilised together for effective action in a particular context." (2004)

The *European Qualifications Framework for Lifelong Learning* builds upon the *DeSeCo Project* (Voogt and Roblin 2012). It defines theoretical and factual knowledge as the "outcome of an assimilation of information" that is of "facts, principles, theories and practices" (European Commission 2008, 11). The ability to apply this knowledge in order to solve problems is called cognitive and practical skills (European Commission 2008, 11).

The *European Qualifications Framework for Lifelong Learning* defines, competences as

> "the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development" (European Commission 2008, 11).

People who acquire competences have the ability to act autonomously as well as responsibly (European Commission 2008, 11). For the remainder of this research project, this definition is used while bearing in mind the more complex definition of the *DeSeCo Project* upon which it builds up.

A rather general critique of the concept of competence is that it seems to provide precise definitions of concrete competences. However, upon close inspection, these seemingly accurate definitions only show simple and vague approximations which are bordering arbitrariness (Norris 1991). In addition, it must be noted that some authors reject the concept of competences in total as it remains inadequate from a capability perspective by limiting personal development (Elliot 2007). Others, wholly refuse the concept of competence due to its behaviorist underlying (Hyland 1993) or due to its central role in a neoliberal reform of the educational sector (Barnett 1994; ak religionslehrer_innen 2013).

4.3.2 - Key Competences

Generally speaking, key competences can be identified as being transversal, multidimensional competences which are necessary to handle complex often unpredictable problems (Voogt and Roblin 2012). This means that key competences are a combination of knowledge, skills and attitudes that may be applied not only in a limited context or specific subject but that they are relevant across many academic disciplines as well as in various situations outside educational settings (Westera 2001; OECD 2005; Gordon et al. 2009).

Apart from this general understanding, the concept of key competences remains highly disputed with respect to the exact nature of these competences and which competences can be considered to be key for mastering current, complex problems. Defining key competences is about defining the core of the curriculum and with it the end of education itself (Voogt and Roblin 2012; Dede 2010). Therefore, the amount and variety of lists of key competences as well as the number of actors involved in this process show that it is a highly contested field within education and society as a whole. This led to numerous, almost arbitrary lists of key competences (Weinert 2001). Even different names addressing the concept of key competences are used such as the term 21st century competences (Voogt and Roblin 2012), which mainly refers to a very similar concept. Consequently, all similar concepts are subsumed under the term key competences for the remainder of this research project.

Despite all differences between the various concepts of key competences, Voogt and Roblin (2012), show in an extensive review study that the eight major concepts in this educational debate are generally comparable (Voogt and Roblin 2012). Five out of eight analyzed frameworks have been developed in an international context (*ISTE* 2007; Griffin, McGaw and Care 2012) of which three frameworks have been developed by international organizations (OECD 2005; European Communities 2007; UNESCO 2008). Five frameworks have been developed in cooperation with private organizations, mostly multinational companies from the information and communication sector. Only two of the presented frameworks are linked with each other as the *European Qualifications Framework for Lifelong Learning* (European Communities 2007) directly builds upon the *DeSeCo Project* by the *OECD* (2005). The differences between these frameworks seemingly arise only because of different points of focus or emphasises on certain overarching competences (2012). Overall, all of the frameworks include collaboration, communication, literacy, especially the literary of information and communication technologies as well as social/cultural competences. Other key competences that are identified by most of the frameworks are creativity, critical thinking, productivity and problem-solving (Voogt and Roblin 2012).

Due to the role of the *OECD* in the field of education, it is again the *DeSeCo Project* that provides the internationally dominant framework for key competences (OECD 2005). Before addressing the key competences, the *DeSeCo Project* takes care to list three central differences between domain-specific competences and key competences. First, they "contribute to valued outcomes for societies and individuals" (OECD 2005), which leads to the question what might qualify as a valued outcome. Human rights, democratic values and sustainable development are taken as such a normative anchoring point for the valued outcomes (Rychen 2004). Second, key competences "'help individuals meet important demands in a wide variety of contexts" (OECD 2005). Therefore, key competences do not replace domain-specific competences (Weinert 2001) but act transversely to them which makes them necessary to be applicable across different domains and areas of life, such as private life and work life, health and politics (Rychen 2004). Thirdly and consequently, it is stated that key competences are "important not just for specialists but for all individuals" (OECD 2005).

This framework of the *DeSeCo Project* intends to equally address educators, researchers and policy-makers by providing a generic framework that covers a broad range of key competences. In order to reach this objective, the *DeSeCo Project* was organised as an international multi-stakeholder panel. It concluded that nine key competences are learnable by most people who may use them in a wide variety of contexts in order to lead a successful life within a well-functioning society. They can be subsumed into three main categories containing three key competences each (OECD 2005):

- *Tools*: Using tools interactively, or the set of competences to use tools, such as a) language, text, b) knowledge, information and c) technology as active mediators with one's surroundings.
- *Cooperation*: Interacting in heterogeneous groups, or the set of competences needed a) to relate well with others, b) cooperate within teams and to c) resolve conflicts.
- *Action*: Acting autonomously, or the set of competences which allows individuals a) to act within the big picture while also b) forming and conducting personal projects and c) asserting rights, interests, limits and needs.

A context-dependent combination of the key competences would give an individual the potential to solve society's complex problems (OECD 2005). Thus, she_he would be able to safeguard human rights, realize democratic procedures and implement sustainable development in a variety of contexts. However, the descriptions of the key competences remain highly abstract and somewhat vague which lessens their practicality and immediate use within educational settings (Weinert 2001). This lack is understandable with regard to the international multi-stakeholder process in which they were developed. Thus, they must be adapted to concrete settings, e.g. general education for sustainable development or engineering education for sustainable development, which comes along with the cost of losing intellectual brilliancy for the benefit of gaining practicality (Weinert 2001). Such a pragmatic adaptation is also necessary because key competences have to be acquired in domain-specific circumstances through situational learning as this guarantees the transferability to other situations and problems (Weinert 2001).

4.3.3 - Key Competences of an Education for Sustainable Development

The concept of sustainability is highly volatile and problem-driven. This affects the competences that are deemed necessary to ensure sustainable development involving complex societal problems. There are numerous collections of competences which are advocated as being essential for individuals to take part in a sustainable development on a societal level. A common ground of the various lists of key competences of an education for sustainable development is the idea that students acquire "the skills, competencies and knowledge to enact changes in economic, ecological and social behavior without such changes always being merely a reaction to pre-existing problems" (Haan 2006, 22).

Wiek et al. (2011) state that there is a lack of frameworks of sustainability competences. Instead, most of the lists of competences are nothing short of "laundry lists" (Wiek, Withycombe and Redman 2011), meaning that these collections are highly arbitrary and without any transparent selection. The few existing frameworks such as *Gestaltungskompetenz* (Haan 2006), *Heads, Hands and Heart* (Sipos, Battisti and Grimm 2008) and others (Steiner and Posch 2006; Sterling 1996; Segalàs et al. 2009) converge at a comprehensive problem-solving competence according to Wiek et al. (2011). They set out to clarify the growing jungle of competences necessary to ensure a sustainable development through an extensive literature review which they have subsequently clustered. For this, they identified in total 43 relevant documents of which 28 were journal articles or books and 15 are works in the category of grey literature, such as reports and websites. This set of literature was reviewed by identifying the relevant competences. The main selection criterion hereby was whether a competence was listed in more than one document as their paper intends to converge the existing debate on sustainability competences (Wiek, Withycombe and Redman 2011). Next, they synthesized them into categories. Overall, Wiek et al. derived five central competences that are listed in most of the documents: 1) systems-thinking competence, 2) anticipatory competence, 3) normative competence, 4) strategic competence and 5) interpersonal competence.

Another approach to compare lists of competences is done by Lambrechts et al. (2013). Based on Roorda, (Roorda 2010) they show that the concept of *Gestaltungskompetenz* (Haan 2006) and the Curriculum, Sustainable development, Competences, Teacher training (CSCT) project (2008) propose competences with similar characteristics: responsibility (values, ethics), emotional intelligence (transcultural understanding, empathy), system orientation (inter- and transdisciplinary), future orientation, personal involvement (self-motivation, motivating others) and the ability to take action (participatory skills).

Likewise, Svanström et al. (2008) have pointed out four core competences that are common among the various lists of competences: systemic or holistic thinking; integration of different perspectives; skills that are emphasised and the prominent role of attitudes and values in such an education. They argue for this convergence after comparing two international declarations: 1) the Tbilisi Declaration of UNESCO in 1977 (Svanström, Lozano-García and Rowe 2008) which is the front-runner of the UNESCO Decade of the Education for Sustainable Development 2005-2014 (Svanström, Lozano-García and Rowe 2008) and 2) the Barcelona Declaration which calls for an engineering education for sustainable development. These two declarations are then compared with the sustainability learning outcomes that are applied at all 33 campuses of the Instituto Tecnológico y de Estudios Superiores de Monterrey in Mexico as well as with the seven learning outcomes proposed by the sustainability task force group of the American College Personnel Association (ACPA) (2010). In addition, Svanström et al. (2008) draw upon a few other examples, to support their findings. Overall, they conclude that there are considerable commonalities of sustainability competences across countries and cultures.

Ségalas et al. (2009) have analyzed the competences for sustainable development listed in the description of engineering study programs from three universities in Europe. They conclude that the listed competences at *Chalmers University of Technology in Göteborg*, Sweden, *Delft University of Technology* in The Netherlands and *Technical University of Catalonia*, Spain, converge. The results of their study show that the competences can be classified by referring to *Bloom's Taxonomy* which shows that there are only minor divergences with respect to the competences and their implementation as learning outcomes among the three universities. Ségalas et al. (2009) don't wish for homogeneity but strongly call for more harmoniousness of the varying descriptions to ensure transparency, comparability and recognition in the European Higher Education Area.

in 2015 the General Assembly of the United Nations adopted 17 Sustainable Development Goals which are to be reached by 2030. In the corresponding educational program implemented by UNESCO, eight key competences (UNESCO 2017) are identified that "sustainability citizens" (Wals and Lenglet 2016) need to acquire in order to collaborate, speak up and act for positive change (UNESCO 2015) in face of society's and nature's complex problems. Albeit a reference to three German authors (Haan 2010) (Wiek, Withycombe and Redman 2011; Rieckmann 2012), it remains unclear how these eight "crucial" (UNESCO 2017) key competences for a global sustainable development have been identified: 1) systems thinking competency, 2) anticipatory competency, 3) normative competency, 4) strategic competency, 5) collaboration competency, 6) critical thinking competency, 7) self-awareness competency and 8) integrated problem-solving competency. However, this shows once more that a broad international convergence of sustainability competences seemingly takes place.

Consequently, the various lists of key competences of an education for sustainable development hardly show any fundamental differences and more so commonalities (Svanström, Lozano-García and Rowe 2008). It seems that the little differences that remain are preferences. Thus, the differences can be seen as an invitation to openly discuss the underlying concepts of sustainability as well as education and as an invitation to incorporate new aspects to one's own list of competences. Differing sets of competences may foster a continuing and vivid discussion of sustainability and how it can be implemented in society and education. Clustering existing competences, or lifting them to more abstract levels, does not help in this process. Therefore, there is no need for a standardized list of competences spanning all cultures and contexts. Instead, as it is impossible to capture all required competences (Mochizuki and Fadeeva 2010), the existing list should be adaptable to various contexts and be flexible for current and future developments. In this sense, the various concepts of key competences only address universal or global aspects which further need to be specified according to the context where and how these competences are acquired as well as for the purpose where and how these competences might be shown by individuals. In addition, lists of competences should be comparable. This requires a reference framework for competences that provides enough scientific abstractness as well as an openness to cultural differences and a tolerance of changes over time. It also should have a sound normative starting point to properly provide a framework for a competence-based education for sustainable development. Overall, it seems that only the *OECD* framework with its multinational stakeholder background fulfills these requirements, although a more obvious bias towards sustainable development is desirable.

In addition, it can be pointed out that Svanström et al. (2008) and Ségalas et al. (2009) have shown that engineering education takes an active part in the description of key competences for a sustainable development. However, as they are deemed key competences they are not engineering specific. Therefore, depending on their overall usage, a domain- or course-specific adaptation might be needed.

The usual critique of competences is also easily applicable to the key competences of an education for sustainable development. However, with respect to sustainability competence Wiek et al. (Wiek, Withycombe and Redman 2011) summarize the essential critique as follows: 1) there is insufficient empirical evidence in the literature that an education for sustainable development competences helps to solve real world problems; 2) the education for sustainable development key competences are not sufficiently operationalized as specific learning outcomes and appropriate evaluation formats, 3) there is a lack of “conceptually embedded sets of interlinked competencies” (Wiek, Withycombe and Redman 2011) and 4) Wiek et al. (2011) also stress the lack of a theoretical justification.

4.3.4 - The Concept of Gestaltungskompetenz and its 12 Sub-Competences

Due to the convergence of the competences deemed necessary in order to ensure a sustainable development, only one set of competences is presented in detail. It has been developed in Germany to be used in secondary school as part of the UNESCO Decade for Sustainable Development. Besides this initial use, it received national and international recognition from all educational sectors.

The concept of *Gestaltungskompetenz* was first described by de Haan and Harenberg (1999). It was picked up in the BLK ‘21’ Program (Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung [BLK]/State - Federal States Commission for Educational Planning and Research Promotion) and later ‘Transfer 21’ until 2006, which conveyed on a national level an education for sustainable development into German secondary schools from 1999 to 2004. The two programs were coordinated by de Haan, who initiated a multi-stakeholder process to execute the program that included scientific experts from various fields as well as administrative staff from various German ministries (Haan 2009). Three goals guided the development of the whole program: 1) To test interdisciplinary learning, as sustainability can no longer be expected to conform to one subject or be isolated in its own course; 2) to test new forms of participatory learning, as education must shift towards group work, collaboration skills and hands-on experience; 3) to develop and test innovative structures, e.g. allowing students to create their own projects and to collaborate with non-academic institutions (Haan 2006).

Gestaltungskompetenz describes the competence “to modify and shape the future of society and to guide its social, economic, technological and ecological changes along the lines of sustainable development” (Haan 2010). Thus, *Gestaltungskompetenz* is the competence as well as the opportunity to actively shape and co-create a future according to one’s values. At first, it comprised eight sub-competences (Haan 2006): 1) Competence in foresighted thinking; 2) Competence in interdisciplinary work; 3) Interdisciplinary learning; 4) Competence in cosmopolitan perception, transcultural understanding and cooperation; 5) Learning participatory skills; 6) Competence in planning and implementation skills; 7) The capacity for empathy, compassion and solidarity; 8) Competence in self-motivation and in motivating others. At this point, they are not yet matched with the *OECD* reference framework for key competences.

In the second revision (Transfer 21 - German 2007; Transfer 21 - English 2007), the two sub-competences on interdisciplinary learning and working were merged into one, whereas competence number 8 was split in two: motivating oneself and motivating others. Additionally, three more sub-competences were included to make a total of 11. The additional competences are 1) to gather knowledge with an openness to the world and integrating new perspectives; 2) to reflect upon one’s own principles and those of others and 3) to plan and act autonomously. This last competence repeats the exact wording of the *OECD* key competence action category, with the addition of planning. This is not surprising, as it’s only with this second revision, that the subcomponents of *Gestaltungskompetenz* are aligned with the reference framework of *OECD*.

Nonetheless, this matchmaking is not force-aligning sub-competences with key competences, but it's rather broadening the scope of the existing key competence.

Three more competences were added during the final revision of the sub-competences of *Gestaltungskompetenz* (Haan 2009; Haan 2010). The sub-competence to deal with incomplete and overly complex information was aligned with the *OECD tools* category. The *OECD cooperation* category was complemented with the competence to cope with individual dilemmatic situations of decision-making. The third added competence refers to the idea of equity in decision-making and planning actions. Through the merging of the two competences "to motivate oneself" and "the motivation of others", the final set of 12 sub-competences of *Gestaltungskompetenz* was created and four sub-competences are subsumed under each *OECD* category: *tools*, *cooperation* and *action*.

- T1 - Perspective-Taking - to gather knowledge in a spirit of openness to the world, integrating new perspectives
- T2 - Anticipating - to think and act in a forward-looking manner
- T3 - Gaining Interdisciplinary Knowledge - to acquire knowledge and to act in an interdisciplinary manner
- T4 - Dealing with Incomplete and Overly Complex Information - to deal with incomplete and overly complex information

- C1 - Cooperating - to co-operate in decision-making processes
- C2 - Coping with Dilemmas of Decision-Making - to cope with individual dilemmatic situation of decision-making
- C3 - Participating - to participate in collective decision-making processes
- C4 - Motivating - to motivate oneself as well as others to become active

- A1 - Reflecting Principles - to reflect upon one's own principles and those of others
- A2 - Acting Morally - to refer to the idea of equity in decision-making and planning actions
- A3 - Acting Independently - to plan and act autonomously
- A4 - Supporting Others - to show empathy for and solidarity with the disadvantaged

The number of revisions and the multi-stakeholder process of developing the concept of *Gestaltungskompetenz* shows that it is not a fixed framework. Instead, it is a living system that is open to change, which may be revised and be adapted to arising problems. Given the context and the process of its development, it is clear that the concept of *Gestaltungskompetenz* has no universal claim to it. It is expressly pointed out that it is a national implementation of the UNESCO Decade of Education for Sustainable Development (Transfer 21 - German 2007) to be used on the secondary school level.

The development of the concept was not a particularly democratic process as the number of stakeholders was fairly limited. Therefore, a further adaptation is needed for the future in order to better consider everyone who is affected by the implementation of *Gestaltungskompetenz*, be it in study programs (Dam-Mieras et al. 2008), modules (Wals 2010) or lessons. Therefore, a careful adaptation is needed to ensure a sustainable development with respect to cultural contexts. This includes an adaptation of the sub-competences as learning outcomes for specific universities, study programs, courses or modules since the goals for each of these levels may be as unique as the participants of a single lesson. Furthermore, the concept may also be adopted as a reference framework for research without further adaptation (Barth et al. 2007).

As pointed out in the preceding sub-chapter, the various concepts of key competences for an education for sustainable development gradually, but nevertheless continually, converge. The concept of *Gestaltungskompetenz* plays a central role in this process as it is widely adopted or is used as groundwork for one's own developments. For instance, this can be seen in die UNESCO Education for Sustainable Development Goals program (UNESCO 2017), where the concept of

Gestaltungskompetenz is named as one of three references, while the other two references (Wiek, Withycombe and Redman 2011; Rieckmann 2012) draw upon the concept of *Gestaltungskompetenz*. Overall, the eight “crucial” key competences (UNESCO 2017) identified by UNESCO do not significantly surpass the original 12 sub-competences of *Gestaltungskompetenz*. Wiek et al. (2011) point out that the eight sub-competences of *Gestaltungskompetenz* (Haan 2006) that they have taken into account for their literature review leave two competence clusters blank: systems thinking and normative competence. However, this criticism is outdated since the publishing of the final 12 sub-competences of *Gestaltungskompetenz* (Haan 2010).

5 - Designing the Learning Outcomes for the Blue Engineering Course

This research project is organised as an educational design research. Its primary objective is it to design and to evaluate learning outcomes for the *Blue Engineering Course* at *Technische Universität Berlin* which can be placed within the field of an engineering education for sustainable development. Following the general steps of the chosen research method, first the problem area was described, that is an extensive description of the design and setup of the *Blue Engineering Course*. Next, a preliminary research was undertaken as a literature review that analyzed the status quo of describing the concept of an outcome-based education as well as the concept of learning outcomes and identifying key competences within the field of an education for sustainable development.

Based on the description of the problem area as well as based on the literature review from the preceding two chapters, the following chapter describes the design down and description of the learning outcomes of the *Blue Engineering Course*. This is the fourth step of this educational design research. It starts off with 5.1) a brief introduction to the concept of designing down learning outcomes (Spady 1994a; 1994b), which is a systematic approach to design learning outcomes first on one of the higher educational levels, such as study programs, and then deriving from these the learning outcomes on the lower levels, such as for courses. For this design down process, first the general framework of the *Blue Engineering Course* is presented, that is the 5.3) relevant state law, 5.4) guidelines of the responsible accreditation agency as well as 5.5) regulations at *Technische Universität Berlin*. Next, 5.6) the characteristics of the course with regard to learning outcomes are highlighted. The design down process starts with the description of 5.3) two general learning outcomes of the course. These are then further designed down to describe the respective learning outcomes on 5.8) module level, 5.9) block level as well as 5.10) activity level.

The learning outcomes on module level are used to describe the entire course, while the learning outcomes on block level are used to describe a set of activities. The learning outcomes on block level thus describe the sum of activities included in an individual building block, but also the activities necessary for the complex assessments of the course, such as the keeping of a learning journal or through the conduction and documentation of a semester project. The concrete activities within a block are then described through the learning outcomes on activity level.

Each step is a precisioning of the learning outcomes so that they become not only more and more course-specific but also describe more and more domain-specific competences which contrast the broad and abstract key competences of an education for sustainable development described in the preceding chapter.

5.1 - Organization of the Design Down Process for the Learning Outcomes of the Blue Engineering Course

In the preceding chapter, it was stated that the description of learning outcomes and the implementation of such an education is not limited to a specific educational level, topic or sector. Tyler (1949, 128) who is the most eminent proponent of an outcome-based education, argues for the description of learning outcomes on any level ranging from a whole school district all the way down to a concrete course including its lessons. However, when describing the learning outcomes one must ensure a coherent educational experience (Tyler 1949, 41), therefore learning outcomes need to be designed down from the global level to exercise level (Spady 1994b, 18; Glatthorn 1993; Harden 1999). In this design down process, all the specific factors for a course need to be considered which calls for a wide consultation and if possible a multi-stakeholder process to ensure a broad agreement on the learning outcomes by everyone who is affected by their contents (Spady 1994, 3; Willis and Kissane 1997, 6; Rees 2004). Harden (1999) provides a case study for such a design down process within the field of medical education.

The learning outcomes of the *Blue Engineering Course* have been developed in a participatory process over the course of two years starting in spring 2013 and finishing in spring 2015. The core team charged with the design and the subsequent design down of the learning outcomes consisted of the two lecturers of the course. One of them is the author of this research project, who took the lead for the whole process. They were responsible for the design of the first draft as well as the continued revisioning of the learning outcomes on all levels. This process was continuously supervised by the responsible professor of the course.

To guarantee a continuous formative assessment of the learning outcomes, the two lecturers regularly organised expert reviews either in small group sessions or through one-on-one discussions. The experts regularly involved are, in total over the whole period, eight student tutors, students who were involved in the *Blue Engineering* student group at the respective points in time as well as students and alumni of the *Blue Engineering Course*. Additionally, one senior expert and one junior expert from the strategic controlling department of *Technische Universität Berlin* were regularly involved in this revisioning process. The expertise of the latter two lies in the area of quality management at a higher education institute, including the description of learning outcomes and measurement of competences at study program level. Apart from these regularly consulted experts, the description of the learning outcomes was also provided with feedback from participants of the *Blue Engineering Course*. Furthermore, individual discussions took place with a total of five experts, that is one retired engineer, one labour union official, one PhD-Student and two professors from universities outside of Germany. Lastly, the design down process as well as the description of learning outcomes was presented and discussed at three international conferences (Baier and Meyer 2015; Baier 2015; Baier 2017a). Overall this led to a multidisciplinary revisioning process, due to the background of the people involved in engineering, social sciences, political sciences, philosophy and history of technology of the people involved.

5.2 - Overview of the Steps of the Design Down Process for the Learning Outcomes of the Blue Engineering Course

The description of the learning outcomes for the *Blue Engineering Course* follows a design down process, which means that the learning outcomes on the higher educational levels function as guidance to derive the learning outcomes on the lower levels. State law, guidelines of accreditation agencies as well as various regulations at *Technische Universität Berlin* constitute a general framework. A brief description of this general framework, in which the *Blue Engineering Course* is located in, shows that students are required to learn aspects of responsibility as well as aspects of sustainability through the various study programs within the field of engineering education. Therefore, this general framework helps to describe learning outcomes on the lower levels as it sets a favorable environment to implement such learning outcomes.

For the *Blue Engineering Course* itself, the iterative participatory design process described above, first let to the development of two general learning outcomes that describe what the participants may have learnt at the end of the course. One general learning outcome addresses the individual engineer while the other general learning outcome addresses engineers as a collective, see chapter 5.7. In both cases, the participants learn how to analyze and evaluate the reciprocal relations of technology, nature, individuals, society and democracy (*TINS-D Constellation*) as well as to reflect upon their values and to act accordingly.

These two general learning outcomes of the course form the basis for the further design down process which adapts the 12 sub-competences of *Gestaltungskompetenz* as learning outcomes. The concept of *Gestaltungskompetenz* (Haan 2009; Haan 2010) provides a sufficiently robust framework for this as the 12 sub-competences of *Gestaltungskompetenz* are already centered on a specific verb and briefly highlight the content, subject matter as well as a context for the noun part of the competences. Designing down the 12 sub-competences in conjunction with the two general learning outcome leads to a set of 12 learning outcomes on module level that adequately consider the particularities of a concrete course as well as the overall discussion which competences need to be acquired through an education for sustainable development.

In two more steps, these 12 learning outcomes on module level are further designed down in order to make them applicable on block level as well as on activity level. The first step is achieved through merging the 12 learning outcomes on module level with the framework of learning outcomes described by Schaper et al. (2013). These learning outcomes on block level are in a second step used to describe concrete activities and assessments on activity level.

5.3 - State Law that Affects the Description of Learning Outcomes

The single federal states in Germany are primarily responsible for legislation on universities and higher education. Berlin is a city state within the Federal Republic of Germany, therefore its parliament has the right to issue a *Gesetz über die Hochschulen im Land Berlin (Berliner Hochschulgesetz - BerlHG)* [Law on Higher Education Institutions in the State of Berlin Berlin Higher Education Law - BerlHG] (2011). This is the central law that regulates the public and private higher education institutes in Berlin. It is regularly revised in order to implement new developments. In addition, the Senate of Berlin, which is the executive body of the federal state of Berlin, signs a contract with each public university every four years (Land Berlin 2006; Land Berlin 2010; Land Berlin 2014). The primary objective of these contracts is to clarify the financial commitment of the federal state of Berlin as well as objectives to be reached by the respective university, such as the number of students that enroll for a first time into a university or gender mainstreaming.

The *Berliner Hochschulgesetz* as well as the university contracts address the Bologna Process. The creation of a common framework and common tools within the European Higher Education Area was first implemented into the university contract of 2006 (Land Berlin 2006) and it is implemented into the current version of the *Berliner Hochschulgesetz* of June 26, 2011 (2011). This includes the European Credit Transfer System (ECTS) (Land Berlin 2011, sec. 22a) as well as the organization of higher education as a system of three educational cycles, that is Bachelor, Master and Doctorate (Land Berlin 2011, sec. 23).

In contrast to the Bologna Process, the *Berliner Hochschulgesetz* also clearly defines the overall purpose of higher education crossing all academic disciplines. The first task of higher education institutes named in the law is to uphold democratic and social principles (Land Berlin 2011, § 4, 1). The second task of higher education institutes is to improve the environmental and general living conditions (Land Berlin 2011, § 4, 2). Consequently, all study programs offered in the federal state of Berlin need to provide opportunities where students acquire the competence to think critically as well as the competences associated with responsible, democratic and social actions (Land Berlin 2011, sec. 21). The university contracts typically do not address such issues, however, they are concerned with topics that are at least related such as the access to universities, internationalization and gender (Land Berlin 2006; Land Berlin 2010; Land Berlin 2014).

5.4 - Guidelines of the Responsible Accreditation Agencies that Affect the Description of Learning Outcomes

In Germany, a wide variety of accreditation agencies offer their services to public and private universities. They divide their field of activity mostly along the lines of the scientific disciplines. As *Technische Universität Berlin* focuses mostly on study programs centered around mathematics, information technology and engineering most of the study programs are accredited by *ASIIN e.V.* (*Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e. V.* [Accreditation Agency for Engineering, Information Technology, Natural Sciences and Mathematics]). *ASIIN e.V.* is part of *ENAEE* (*European Network for Engineering Accreditation*) which was formed as a result of a networking process that began in 2000 with the foundation of *ESOEPE*, that is the *European Standing Observatory for the Engineering Profession and Education*. The next step was the development of the *EUR-ACE® Label* (*EURopean-ACcredited Engineer*) which was supported by the *EU Socrates and Tempus Programmes* as well as by 14 European associations concerned with engineering education.

The *EUR-ACE® Label* describes standards and guidelines for accreditation of engineering programs which were first published in 2006 and which have been published in a revised version in 2015 (ENAEE 2015). It is claimed that the standards incorporate views and perspectives of the main stakeholders, such as students and employers (ENAEE 2015, 2). The *EUR-ACE*® Framework Standards and Guidelines list already precise learning outcomes of study programs. The framework identified eight clusters which are 1) *Knowledge and understanding*; 2) *Engineering Analysis*; 3) *Engineering Design*; 4) *Investigations*; 5) *Engineering Practice*; 6) *Making Judgements*; 7) *Communication and Team-working*; and 8) *Lifelong Learning*. Reflecting the two lower cycles of higher education established through the Bologna Process, the *EUR-ACE® Label* lists separate learning outcomes for bachelor and master level. The learning outcomes in all of the eight clusters describe engineering as a complex action that needs to incorporate vast knowledge and competences that lie outside of the core engineering practice, such as reflecting on social and ethical responsibilities or the communication with non-specialist audiences in national and international contexts (ENAEE 2015, 8). This eventually underlines an engineering practice and design that heeds technical and non-technical knowledge and competences which are necessary in order to study and work in a complex as well as multidisciplinary environment (ENAEE 2015, 5). Although the *EUR-ACE® Label* criteria do not draw an explicit link between the described learning outcomes and a sustainable development, it can be concluded that they at least reflect "societal, health and safety, environmental, economic and industrial" aspects in engineering analysis, design and practice (ENAEE 2015, 5). In addition, the criteria address the competence to make judgements as well as to take responsibility in a complex environment and to eventually communicate them to others. Overall, these are competences that can easily be linked to ensure a sustainable development.

Since *ASIIN e.V.* is part of *ENAEE* which published the *EUR-ACE*® Framework Standards and Guidelines (ENAEE 2015) it adopted the learning outcomes on study program level almost to the full extent (ASIIN e. V. 2011). It is only due to the differentiation between research-oriented universities and universities of applied science that *ASIIN e.V.* did an almost negligible adaptation of the learning outcomes to be applied in research-based and application-oriented study programs on bachelor as well as on master level (ASIIN e. V. 2011).

5.5 - Regulations at Technische Universität Berlin that Affect the Description of Learning Outcomes

As a public university, *Technische Universität Berlin* is bound by the *Berliner Hochschulgesetz* and its normative setting with regard to the tasks of a university and the aims of study programs. As described above, this includes the adoption of the Bologna Process as well as upholding democratic principles in research and education with the general objective of improving the environment and living conditions of everyone. In addition, *Technische Universität Berlin* needs to adhere to the guideline of the responsible accreditation agency, that is *ASIIN e.V.*. The guideline does not state sustainability as part of the learning outcomes, however, they list competences generally linked to a sustainable development, see chapter 5.4, so that it is up to the universities to explicitly choose to adopt more specific competences within their study programs.

Apart from this general framework in which *Technische Universität Berlin* has to operate, it is granted much autonomy with respect to the governance as an institution as well as with respect to research as well as education. As upholding democratic principles is one of the objectives of universities set by the *Berliner Hochschulgesetz* it also lays out the democratic decision-making within the universities. Therefore, *Technische Universität Berlin* is governed by democratic procedures that allow students, research and teaching assistants, technical and office staff as well as professors a comprehensive participation in its legislative as well as executive bodies (Technische Universität Berlin 2006). Therefore, all of the subsequently described particularities of *Technische Universität Berlin* have gone through an intensive deliberation process that involved elected representatives of all internal stakeholders.

As an institution, *Technische Universität Berlin* does not have an integrated implementation of sustainability and responsibility yet. However, the existing commitments and initiatives clearly show that *Technische Universität Berlin* is engaged in providing a favorable environment for future endeavors in this direction. *Technische Universität Berlin* as an institution pledges to address societal challenges within education and research, which includes an orientation towards the principles of sustainable development. In 1993, *Technische Universität Berlin* signed the *Copernicus Charter* (1993) along with 319 other universities. This charter became the most influential document that describes universities as a central actor in ensuring a sustainable development. Based on the *Copernicus Charter* (1993), *Technische Universität Berlin* establishes *Umweltleitlinien* [environmental guidelines] in 1997, which state that ensuring a sustainable development is the university’s foremost goal in education, research and operations (Technische Universität Berlin 1997). In 2011, *Technische Universität Berlin* adopts a mission statement that likewise focuses on sustainability along with a specific responsibility as a university (Technische Universität Berlin 2011). This is further specified in the future concept of *Technische Universität Berlin* which places solutions to societal challenges in the center of all the university’s activities (Technische Universität Berlin 2013b). Apart from a broad understanding of social and ecological responsibility, *Technische Universität Berlin* actively upholds a specific responsibility that arises from the role of its predecessor *Technische Hochschule Charlottenburg* [Technical High School Charlottenburg] during fascist Germany. For instance, this leads to the adoption of a civil clause by the Academic Senate which basically states that the university does not partake in military research (Technische Universität Berlin 1991).

Sustainability and responsibility are also upheld through the general study and examination regulations which state in one learning outcome among others that all study programs at *Technische Universität Berlin* foster the ability to think and act strategically with regard to societal responsibility and sustainable development (Technische Universität Berlin 2013a). This learning outcome on the top level of the university is further developed in the learning outcomes of specific study programs where the *Blue Engineering Course* is included as a compulsory elective course. For instance, the specific study and examination regulations for *Mechanical Engineering* and *Transport Systems Engineering* state learning outcomes that address the competence to analyze and evaluate the relation between technology and environment that surpass an engineering-centric view in favor to societal and economic factors (Technische Universität Berlin 2009a; Technische Universität Berlin 2009b). While the regulations of *Industrial Engineering* state learning outcomes that stress the need of combining transdisciplinary theory and practice along with the societal, economic and technical questions that arise from it as well as the responsibility of the individual within its society (Technische Universität Berlin 2017).

5.6 - The Design of the Blue Engineering Course as it Affects the Description of its Learning Outcomes

The *Blue Engineering Course* was developed in adherence with the general framework for higher education such as the state law, the accreditation criteria and the regulations at *Technische Universität Berlin*. As described above, there is an emphasis on sustainability-related issues at all of these levels and a call to implement them as learning outcomes. However, around 2010 there were only a few courses on this topic at *Technische Universität Berlin* and they were more often lectures than interactive discussions with peers as well as co-working environments. Therefore, the student group drew inspiration from the need for a course on the social and ecological responsibility of engineering which breaks with traditional forms of teaching such as a teacher-centered approach and instead calls for a co-creation by lecturers, tutors and students alike. In short, because of the lack of proper alternatives, the students wanted to create a course design at their own university that they would like to attend because of its didactical design as well as its content.

One of the main principles of the course design is to take the shift from teaching to learning (Barr and Tagg 1995) seriously. In the implementation of the course, this goes even one step further by not only creating a student-centered teaching and learning environment but by creating a course design that is actually student-driven (Baier 2013). In that sense, the course design is a valuable contribution to an outcome-based education as it is advocated by Spady where students take responsibility for their course and the outcomes that they create (Spady 1994b). With respect to the topics of the course, the student group did not explicitly state that sustainability or sustainable development must lie at the core of the course in order to broaden the scope of the course as well as to pin down a more overarching social-ecological responsibility of engineers and engineering. This applies similarly to the emphasis on the reciprocal relations of technology, individuals, nature, society and democracy which in itself describes overly complex relations. Applying a notion of sustainability to these reciprocal relations would unnecessarily reduce their inherent complexity.

Overall, the *Blue Engineering Course* was designed and implemented in a highly agile process where the need and the want to change were equal driving forces. The guiding principles hereby were

- to foster discussion about social and ecological responsibility of engineering which is to be seen differently on the individual level and on the societal level;
- to understand and analyze the reciprocal relations of technology, individuals, nature, society and democracy;
- to handover the responsibility to the students by letting them co-conduct and co-create the course.

It is only since winter semester 2015/2016 that capacities within the *Blue Engineering* team became available to develop the theoretical background of the course. Therefore, the description of the learning outcomes is done after fundamental decisions regarding the course design have been made. Overall, the description of learning outcomes has been an iterative process that led to a continuous precisioning of learning outcomes, activities and assessment in order to align them properly.

5.7 - Two Learning Outcomes on General Level

Since the design of the course was a highly agile process, this also affected the description of the general learning outcomes. Overall, the description has been an iterative process which has resulted in many versions of general learning outcomes. For instance, one former version was based on the differentiation of micro- and macro-ethics as well as the subjective and objective dimension of ethics (Conlon 2010) or another was referring to the VDI Guideline on Technology Assessment (2000). However, none of the former versions neither proved to be applicable within interactive teaching sessions nor to be particularly useful for engineers to better grasp their ecological and social surroundings and especially their responsibility.

Through the refining and further development of the course it became more and more clear that the best solution would be to stick closer to the aforementioned guiding principles, see sub chapter 3.1, that is 1) individual and collective responsibility of engineers, 2) the reciprocal relations of technology, individuals, nature, society and democracy (*TINS-D*) and 3) letting students co-conduct and co-create the course.

Eventually, this led to a description of two general learning outcomes based on the *TINS-D Constellation*, see Figure 1, which describes the individual and collective responsibility of engineers as the competence to analyze and evaluate the *TINS-D Constellation* and to state personal and societal values as well as to act according to these values. Therefore, the following two general learning outcomes reflect the three principles that guided the development of the *Blue Engineering Course*.

The two general learning outcomes are as follows:

- The prospective engineers analyze and evaluate the present reciprocal relations of technology, individuals, nature, society and democracy by taking different perspectives. Based on this analysis and evaluation, they are able to state their personal perspective and values of the reciprocal relations and act accordingly.
- The prospective engineers cooperate with others to analyze and evaluate in a democratic process the present reciprocal relations of technology, individuals, nature, society and democracy. Based on their analysis and evaluation, they are able to work out a collective understanding with regard to their collective values and to democratise the reciprocal relations.

The first learning outcome picks up the individual scope of action which is framed by a thorough analysis of the surroundings with respect to one's own values. The second learning outcome builds upon the first learning outcome, as it calls individual prospective engineers to cooperate with others in order to democratise the reciprocal relations. Therefore, prospective engineers are not only addressed as individuals who have an influence on engineering design and the respective decisions, but they are also addressed on a collective level where engineering decisions usually take place. This two-fold approach is additionally necessary in a growingly complex world where engineering and technology plays a central role and which can only be addressed by combining individual and collective action.

These two learning outcomes are only useful on the general level of the *Blue Engineering Course*. They adequately provide an overall setting of what is to be achieved by the students participating in this course. However, they remain vague with respect to what is actually happening in the course. This leaves a high degree of autonomy to create corresponding activities and assessments. However, the two learning outcomes do not provide a concrete enough setting to actively develop a constructively aligned course design. Instead, the two learning outcomes on general level may only function as points of reference to describe more precise learning outcomes on the lower levels, such as the module level and block level as well as activity level. As such, the two general learning outcomes function as points of reference in the further design down of the learning outcomes.

5.8 - 12 Specific Learning Outcomes for Module Level

The two learning outcomes on general level are the first part to create learning outcomes on module level. The two general learning outcomes provide an orientation of what students may be able after completion of the course. However, they remain vague with respect to the concrete competences that students acquire. The second part of the learning outcomes on module level is the concept of *Gestaltungskompetenz* (Haan 2009; Haan 2010). However, the 12 sub-competences of *Gestaltungskompetenz* are too abstract as well to be used in a concrete course. This calls for a careful design down process which transforms the 12 sub-competences into learning outcomes and subsequently merges them with the two general learning outcomes. Overall, this results in a set of 12 concrete learning outcomes that are specific for one course but which still are linked back to a greater framework. This process is described in detail for the remainder of this subchapter along with a detailed description of each of the 12 learning outcomes on module level.

The two learning outcomes on general level are the first part of this design down process. They consist of the following key aspects which need to be integrated in the learning outcomes on the lower levels:

- to analyse and to evaluate the reciprocal relations between technology, individuals, nature, society and democracy (*TINS-D*);
- to be able to identify their values on an individual level as well as group level;
- to act according to their values;
- to democratise group-processes as a consequence.

There is no need to implement each key aspect in every single learning outcome on module level, as it is sufficient enough if the combination of all learning outcomes on module level covers the key aspects in their totality.

The second part of the design down process for the learning outcomes on module level consists of the 12 sub-competences of *Gestaltungskompetenz* (Haan 2009; Haan 2010). This concept provides a sufficiently robust framework in order to adapt the sub-competences as learning outcomes. As shown above, learning outcomes are typically described through a verb part and depending on their usage also a specific description of their content or context. The 12 sub-competences already fulfill these basic requirements, so that the 12 sub-competences of *Gestaltungskompetenz* can easily be used as learning outcomes. In addition, the concept of *Gestaltungskompetenz* is in widespread use in Germany and therefore creates the possibility for collaboration with other players inside and outside the higher education sector. Furthermore, *Gestaltungskompetenz* is broadly recognized on the international level which ensures a further comparability. However, the set of 12 sub-competences of *Gestaltungskompetenz* only serves as a general description of key competences, as it remains vague how these generic key competences are applicable in a domain-specific context of teaching/learning (Weinert 2001). Therefore, it suggested itself to use the concept of *Gestaltungskompetenz* in order to describe the learning outcomes on module level.

Overall, the two general learning outcomes provide a course-specific context and highlight in a general manner what the students may learn through the course, it is only the 12 sub-competences that describe actual competences. However, the sub-competences as such only refer to generic key competences which call for a domain-specific adaptation. The two general learning outcomes provide this context in which the course takes place and they may act as reference points on how to specify the 12 sub-competences. Therefore, a careful merging of the two general learning outcomes and the 12 sub-competences render course-specific learning outcomes that are clear with respect to the competences that are to be achieved, see Table 9.

Table 9
12 Learning Outcomes of the Blue Engineering Course on Module Level

Sub-Competences of *Gestaltungskompetenz* (de Haan 2010)	**Learning Outcomes of the Blue Engineering Course on Module Level**
OECD Category Tools	
T1 - Perspective-Taking - to gather knowledge in a spirit of openness to the world, integrating new perspectives	T1-BE - Students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, society and nature.
T2 - Anticipating - to think and act in a forward-looking manner	T2-BE - Students anticipate spatial and temporal effects of technology on individuals, society and nature.
T3 - Gaining Interdisciplinary Knowledge - to acquire knowledge and to act in an interdisciplinary manner	T3-BE - Students gain knowledge of the reciprocal relations between technology, individuals, nature and society through inter- and transdisciplinary approaches.
T4 - Dealing with Incomplete and Overly Complex Information - to deal with incomplete and overly complex information	T4-BE - Students deal with incomplete and overly complex information on the reciprocal relations between technology, individuals, nature and society and the risks, dangers and uncertainties which arise from them.
OECD Category Cooperation	
C1 - Cooperating - to co-operate in decision-making processes	C1-BE - Students cooperate for a democratic decision-making with regard to process, result and implementation.
C2 - Coping with Dilemmas of Decision-Making - to cope with individual dilemmatic situation of decision-making	C2-BE - Students cope with dilemmas of decision-making when values and aims are conflicting.
C3 - Participating - to participate in collective decision-making processes	C3-BE - Students participate at collective decision-making processes.

C4 - Motivating - to motivate oneself as well as others to become active	C4-BE - Students motivate oneself and others to democratize the reciprocal relations between technology, individuals, nature and society.
OECD Category Action	
A1 - Reflecting Principles - to reflect upon one’s own principles and those of others	A1-BE - Students reflect principles which control the reciprocal relations of technology, individuals, nature and society.
A2 - Acting Morally - to refer to the idea of equity in decision-making and planning actions	A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.
A3 - Acting Independently - to plan and act autonomously	A3-BE - Students plan independently and act autonomously according to one's own values.
A4 - Supporting Others - to show empathy for and solidarity with the disadvantaged	A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.

This adaption to a specific course is backed by de Haan (2007), who has argued that there is not a universal set of competences for a sustainable development, but that the competences always have to be described with respect to the country or culture where they are acquired and applied. As the 12 sub-competences have been developed to be used in secondary schools in Germany, this might also imply an adaptation to the higher education context in which the *Blue Engineering Course* takes place. In addition, this would also go along with a domain-specific adaptation of the competences.

The first four sub-competences of *Gestaltungskompetenz* are subsumed under the *OECD* category *tools*. This adaptation of *T1 - Perspective-Taking*; *T2 - Anticipation*, *T3 - Gaining Interdisciplinary Knowledge* and *T4 - Dealing with Incomplete and Overly Complex Information* as learning outcomes of the *Blue Engineering Course* is most apparent through the incorporation of the *TINS-D Constellation*. For instance, sub-competence *T3 - Gaining Interdisciplinary Knowledge* describes that students are able *to acquire knowledge and to act in an interdisciplinary manner* (Haan 2010). The core of this sub-competence is interdisciplinarity, therefore the students need to acquire competence in interdisciplinary approaches which are necessary to gain a more wholesome understanding of the *TINS-D Constellation*. Hence, the learning outcome *T3-BE* on module level was phrased as *Students gain knowledge of the reciprocal relations between technology, individuals, nature, society and democracy through inter- and transdisciplinary approaches.*

The second *OECD* category *cooperation* contains the sub-competences *C1 - Cooperation*, *C2 - Coping with Dilemmas of Decision-Making, C3 - Participation* and *C4 - Motivation*. Their adaptation mainly focuses on implementing aspects of democracy and democratic decision-making into the 12 sub-competences. However, the aspect of values as well as individual and collective action is also incorporated into sub-competence C2 and C3 respectively. The sub-competence *C4 - Motivation* describes the competence *to motivate oneself as well as others to become active* (Haan 2010). As this is deemed a central competence to be acquired in the course, it reflects three of four aspects of the two general learning outcomes. The learning outcome on module level is described as follows: *C4-BE - Students motivate oneself and others to democratise the reciprocal relations between technology, individuals, nature and society.* Hence, the description of this learning outcome on module level clearly states the *TINS-D Constellation*, the capacity to take action on an individual and collective level as well as the competence to democratise one's surroundings.

The implementation of the last four sub-competences *A1 - Reflecting Principles*, *A2 - Acting Morally*, *A3 - Acting Independently* and *A4 Supporting Others* focuses again on the incorporation of the *TINS-D Constellation*. This time it is not with respect to the competence of expanding one's knowledge, but rather with respect to one's own values and to shared group values that can be linked to the *TINS-D Constellation*. This is seen as a starting point for individual and collective action. Although it is not mentioned explicitly, the aspect of democratization is picked up in sub-competence *A4 Support Others* which is the competence *to show empathy for and solidarity with the disadvantaged* (Haan 2010) as this a central aspect of a democracy, that is the equal and free participation in decision-making processes of everyone. The aspect of democracy is further stressed in the adaptation of this sub-competence as the learning outcome for the *Blue Engineering Course* on module level states: *A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.*

Overall, adapting the 12 *Gestaltungskompetenzen* as learning outcomes for the *Blue Engineering Course* leads to a set of 12 learning outcomes on module level. It is expected that the students of this course acquire these competences through its successful completion. Since these competences are linked to an education for sustainable development, this makes the participants of the course competent to contribute to a sustainable development. Moreover, it is even expected that they are not only able to show these competences in settings outside of a controlled classroom but more so that they actively involve in a sustainable development in their private and work life.

In the following paragraphs, each learning outcome on module level is described in detail. This description does not focus on the actual course activities or assessments as this not part of the learning outcomes on module level. Instead, actual activities and assessments are discussed along with proper learning outcomes on block level and activity level later on in this chapter. Here, a rather general description of the respective learning outcomes on module level is given as well as their relations to the overall design of the course. In addition, this description also shows how the learning outcomes on module level relate to each other. The following description partially refers to the description of the 12 *Gestaltungskompetenzen* (Haan 2006; Haan 2010).

T1-BE - Students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, nature, society and democracy.

This learning outcome implies that students are able to successfully research and name approaches and concepts on a broad range of topics. By doing this, they consider varying forms of knowledge and sources which makes it necessary to evaluate the biases of each source, evaluate cultural and ecological diversity and synthesize these variances into a well-informed perspective of their own. This implies with regard to the *Blue Engineering Course* that the students are especially able to grasp the complexity that is linked to technology and its effects on the other parts of the *TINS-D Constellation*. In that respect, it is additionally challenging to consider the varying perspectives that are not yet present in the discussion for various reasons. However, they must be considered as technology has far-reaching effects on the future and to faraway places, cultures and traditions that students are not yet acquainted with.

T2-BE - Students anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.

With this competence set as a learning outcome on module level, students are able to research and analyze problems of non-sustainable developments as well as to anticipate the effects of transitioning into more sustainable developments. They are able to use these findings to assess and apply them within the *TINS-D Constellation* as well as specifically with respect to ecological systems, social justice, economic developments and political action. The starting point for this is their current life as students and their future working life as engineers. This means, that they are able to identify their current mode of living and its spatial and temporal effects. In addition, they are also able to shift from their individual perspective to a societal, yet global, perspective in order to adequately consider the overall effects of the current mode of living. Next, they are able to identify their needs in conjunction with societal needs and how to achieve them as well as to anticipate their possible future effects. Therefore, this competence is not limited to the ecological effects of technology on to individuals, society and nature but it also includes considering the educational system as well as the current and future work of engineers as these two are linked with each other and have an effect on the overall mode of living.

T3-BE - Students gain knowledge of the reciprocal relations between technology, individuals, nature, society and democracy through inter- and transdisciplinary approaches.

De Haan differs between two types of interdisciplinarity, that is first a subject-related interdisciplinarity and second, a problem-oriented interdisciplinarity (Haan 2006). The first approach takes place when a specialist from one scientific field implements methods, approaches or tools from closely related but yet different academic fields. The second approach is more linked to an education for sustainable development as specialists from different academic fields cooperate in order to deal with complex problems that cannot be addressed by one scientific discipline alone. This is already addressed through the setup of the *Blue Engineering Course* as it is not limited to one study program alone, but students from various study programs participate in the course. In addition, their academic background is not limited to engineering alone, but regularly students from the humanities and social sciences participate in the course. Therefore, the structure of the course itself allows for interdisciplinary approaches and in addition, the different topics as well as the group assignments make it necessary that students from different fields cooperate. Transdisciplinarity only plays a minor role in the course, but students are encouraged to incorporate partners from the outside in their assignment and in addition, experts from outside of academia are regularly invited to give a presentation.

T4-BE - Students deal with incomplete and overly complex information on the reciprocal relations between technology, individuals, nature, society and democracy as well as the risks, dangers and uncertainties which arise from them.

Sustainable development addresses complex problems that require action from individuals as well as groups despite having only incomplete information regarding the problems as well as of the possible effects of their own actions. This is a dilemma situation where conflicting values, beliefs and perspectives are involved and which cannot be resolved to the full extent. These situations already occur in the life of students as well as in their private life. More so, they face this situation once they will start working as engineers where the division of labour not only involves the direct working colleagues but where the overall problem is defined by many factors that lie outside of the reach of engineers. Even the competences listed above, that is perspective-taking, anticipating and gaining inter-/transdisciplinary knowledge de not address all open questions. Therefore, the students need to acquire the competence to deal with incomplete information and uncertainty regarding the effects their own actions. This is addressed in the *Blue Engineering Course* through the concept of building blocks that expose the participants already to a teaching/learning setting that typically addresses complex topics. In addition, in the group assessments, they are even more exposed to directly taking action when facing complex problems with a high degree of uncertainty.

C1-BE - Students cooperate in a democratic decision-making and regard process, result and implementation of it.

Sustainable development is a complex task that calls individuals as well as groups and societies to take action. As such, cooperation among individuals is necessary at all stages. Within the *Blue Engineering Course* it is advocated that decisions must be taken through democratic processes that equally consider the results and their implementation. Therefore, the participants regularly analyze their group interactions within the course with regard to process, result and implementation. Moreover, they also analyze decision-making on the societal level. One of the key factors here is the question whether all individuals that are affected by the decision have the proper chance to take part in the decision-making process. In addition, the participants get to know a broad range of methods to create decision-making processes which involve everyone present. First and foremost, this is achieved by facilitating group discussions that aim at involving all the participants while also handing over the responsibility for these discussions onto the participants. Next, they learn to value the different perspectives and the differences among students in order to adequately incorporate them in the decision-making process. This also requires that the students learn to recognize prejudices as well as discrimination in order to address them and to resolve them.

C2-BE - Students cope with dilemmas of decision-making when values and aims are conflicting.

Reflection on sustainable development and the appropriate actions take place before a broad background of preferences, values, beliefs and aims of the people involved in this process. This is not restricted to global problems alone, but dilemma situations also affect the decision-making in the private life of the students as well as in the future work life as engineers. Eventually, there are many situations where two values or aims are conflicting that are deemed equally important. This dilemma situation first has to be recognized and acknowledged as such. Through the *Blue Engineering Course* students regularly unveil these dilemmas even in situations where at first they are not expecting any dilemma at first. In addition, exposing them in group processes helps also to unveil dilemmas that people individually face within themselves. Recognizing a dilemma of values or aims might help to further clarify the whole situation and to realize an understanding of the different positions involved. Individuals might realize that in this particular situation they prefer a certain value over another and in another situation, it is the other way around.

C3-BE - Students participate in collective decision-making processes.

On the one hand, it is necessary to consider and to incorporate others in decision-making, on the other hand, it is equally important to engage oneself with one's own values and aims in the decision-making process. The first aspect is picked up in the learning outcome *C1-BE Cooperating* that addresses the competence to cooperate with others as well as to integrate others in a decision-making process. The second aspect is picked up in learning outcome *C3-BE Participating* which focuses on the acting individual. Democratic decision-making is therefore not only about recognizing the others in this process, but also about the necessity to take care of oneself and to actively engage in the process. This might entail that an individual engages in a process even if others do not show the competence *C1-BE Cooperating* by incorporating the individual. The competence to participate is actively acquired in several situations in the *Blue Engineering Course* when individuals need to take action in order to start group processes as well as when certain methods require that individuals actively participate in group processes. Through keeping a learning journal over the course of one whole semester, the students are further encouraged to reflect upon their role in decision-making processes when working within their student group or when interacting with others in the lessons.

C4-BE - Students motivate themselves and others to democratize the reciprocal relations between technology, individuals, nature and society.

Taking the hurdle from gathering and assessing knowledge towards acting is a competence in its own right. This implies that students are able to motivate themselves and others to act upon the knowledge that they have gathered and assessed. In combination with the previous three learning outcomes, this results in motivating oneself and others to democratize the reciprocal relations between technology, individuals, nature and society. As the *Blue Engineering Course* is designed in such a way that the students co-conduct and co-develop the whole course, they constantly need to motivate themselves in order to participate properly in the course. In addition, they have the chance to commit themselves over the course of the semester to various little challenges to take proper action in their private live, e.g. living without plastic for a week. By conducting an existing building block as well as by creating a new building block, the participants also actively motivate others to take action. This prepares them for their later work life, as it is here that individuals need to motivate oneself and others to partake in a sustainable development through their work.

A1-BE - Students reflect principles which influence the reciprocal relations of technology, individuals, nature, society and democracy.

This learning outcome basically states the competence to reflect one's own mode of living as well as the overall societal modes of living. This means that students are able to identify power relations of their own society. In that sense, reflection is not about identifying the concrete effects of certain actions or anticipating these effects or the various perspectives on these actions alone, but it is also about identifying the deeper rooted structural conditions which favor certain actions over others. The competence of reflection also helps to address the phenomenon of cognitive dissonance, that is not taking action although the knowledge and insight of taking a specific action are there. Among others, reflection in that sense is relying on previously described learning outcomes and competences such as *T1-BE Perspective-taking* and *C2-BE Coping with Dilemmas*. In the context of the *Blue Engineering Course* this learning outcome is addressed constantly over the course of the whole semester and especially when the connections and similarities between the different lessons are addressed. The students hereby continually learn to identify major principles that are affecting the reciprocal relations of technology, individuals, nature, society and democracy.

A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.

This learning outcome is directly linked to the previous learning outcome *A1-BE Reflecting Principles*. The difference between the two learning outcomes is that one is reflecting upon the principles while the other is identifying the values that help to justify the principles and the actions that follow from these principles. Here it becomes necessary also to identify the relations between the different dominant values that not only shape the overall reciprocal relations but more so each of the single aspects of the *TINS-D Constellation*. In a next step, students learn to identify how society resolves the arising conflicts between these values. In addition to identifying the dominant values, the participants of the *Blue Engineering Course* identify their personal values as individuals and also in a collective process in small student groups. These values are then contrasted with the dominant values. Next, they learn to refer to their own values to identify appropriate actions and to justify them by referring to their values. For this, the participants especially have to recur to competence *C2-BE Coping with Dilemmas*.

A3-BE - Students plan independently and act autonomously according to one's own as well as collective values.

This learning outcome builds upon all previously described learning outcomes as it describes the competence of the participants to plan and act according to one's own values. This competence overcomes the previously described cognitive dissonance, so that the participants are not only aware of the effects of specific unsustainable development but that they are able to take concrete action which might lead to a more sustainable development. For this, they have identified the underlying societal principles that favor unsustainable developments and are able to contrast their personal values with the dominant values that help to justify the underlying societal principles. During the *Blue Engineering Course*, the participants regularly have to plan and to act after properly identifying their own values. This regular practice during the course might affect also the actions that take place outside of the classroom and hopefully once the students start working as engineers. This is further enforced as the students regularly work together in various small groups where they are facing differing values within the group, which must not hinder them at jointly working out a plan and to act together according to their values. In addition, this resembles settings from work life where people stand to have a higher chance to implement their project if they plan and act together in teams.

A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.

Sustainable development has a strong impetus in the direction of social justice within one's own generation as well as with regard to future generations. However, the previous learning outcome *A3-BE* addresses only the competence to plan and to act individually or in a small group. The learning outcome *A4-BE* broadens this horizon by describing the competence to not only act in one's own interest but also to support others who are disadvantaged. This competence builds upon all of the previous learning outcomes as they provide the necessary information as well as the competence to reflect upon principles and values which form the common basis to cooperate with others and to initiate action. This learning outcome is regularly addressed in the *Blue Engineering Course* as the position of underrepresented, disadvantaged and underprivileged people is considered and analyzed in various building blocks. Especially the building block on *Gender, Diversity and Technology* raises awareness in that direction as it addresses overall societal discrimination while linking it back to personal experiences of the participants. In addition, the discussions in the course are structured in such a way as to incorporate everyone present. However, due to the course design and its setting within one university, acquiring this competence is mostly restricted to properly identifying others who need support, without providing adequate opportunity to actually show that support.

5.9 - Learning Outcomes on Block Level

The two learning outcomes on general level provide a course-specific context that helps the students to grasp what the whole *Blue Engineering Course* is about. As there are only two general learning outcomes, this is not sufficient enough to reflect a complex course design as well as the competences that are achievable through attending the course. Therefore, learning outcomes on module level are created by merging the two general learning outcomes with the 12 sub-competences of *Gestaltungskompetenz*, which in itself would be too abstract and not course-specific enough. The result of this design down process is a set of 12 learning outcomes on module level that are adequately reflecting the context of the *Blue Engineering Course* while also describing concrete competences that may be acquired through the course.

The learning outcomes on module level, however, are still more or less abstract and describe rather complex competences. They are functioning properly only on module level as this level aggregates the various activities and assessments that take place in the single block as well as exercises. Therefore, specific learning outcomes for the block level as well as the activity level are needed. They could be described independently of the learning outcomes on the higher levels, however, this is not advisable. Instead, the design down process is taken to its end, when the learning outcomes on module level function as a reference point to describe the learning outcomes on block level. The description of learning outcomes on activity level is covered in the following sub-chapter.

So far, this design down process made only use of the concept of learning outcomes and the concept of competences that were introduced above. It is now that the various frameworks of learning outcomes can be of help in this design process as they usually provide a subject-independent method to group as well as to expand existing learning outcomes. Therefore, a framework of learning outcomes may help to specify already existing broad learning outcomes in a coherent way.

The two-dimensional framework by Schaper et al. (2013) was chosen over the other presented frameworks as this is a comprehensive framework that covers both the cognitive and the affective domains and also addresses the metacognitive domain along with social and communicative skills. Covering these three domains is an obvious advantage of the *Schaper Taxonomy Table* over the widespread frameworks by Bloom et al. (1956) and Anderson et al. (2001). These two frameworks are limited to the cognitive dimension alone, which is overall a major limitation as higher education should not be limited to the cognitive dimension alone as Bloom et al. (1956) and Anderson et al. (2001) would agree with. As shown above, Schaper et al. (2013) also address the affective dimension to a certain extent as it was developed by Krathwohl et al. (1964). Instead of providing a guide to design down learning outcomes for a specific course which is needed to describe coherent learning outcomes on lesson level, the primary objective of the framework developed by Spady (1994b) is to group and rank existing learning outcomes according to their real-life-relatedness. However, as the learning outcomes are building upon complexe competences they can be considered as *competences of significance* that can be placed either in the transitional zone or the transformational zone of the demonstration (Spady 1994b). And lastly, Tyler (1949) has not developed an actual functioning framework but rather calls for the joint creation of frameworks of learning outcomes by everyone involved in the educational system to meet their proper needs in their respective context (Tyler 1949, 49).

This call by Tyler is answered in the following paragraphs, where the previously described 12 learning outcomes on module level are merged with the framework by Schaper et al. (2013) in order to design down to the learning outcomes on block level. As described above, this *Schaper Taxonomy Table* consists of two dimensions, that is a content dimension with three categories and a process dimension with four levels. In total, they form a 3 by 4 matrix. The content dimension is vertically aligned and consists of the three categories: 1) *factual knowledge and procedures*; 2) *values, attitudes and beliefs*; and 3) *interdisciplinary skill and knowledge*. This three categories can be loosely linked to the three *OECD* categories that are used to group the set of key competences (OECD 2005), that is: 1) *to gain knowledge (tools), 2) learn how to cooperate (cooperation)* and 3) *to take action (action)*. The link between the three categories of Schaper et. al. (2013) and *OECD* categories becomes more apparent when the 12 sub-competences of *Gestaltungskompetenz* are taken into consideration, see Table 10.

Table 10
48 Learning Outcomes of the Blue Engineering Course on Block Level

		Process dimension			
Content dimension		Remember and understand knowledge and skills	Apply knowledge, skills and attitudes	Analyze and evaluate of knowledge, skills and attitudes	Create and extend knowledge, skills and attitudes
Factual knowledge and procedures	**T1-BE - Perspective Taking**	T1-BE-1	T1-BE-2	T1-BE-3	T1-BE-4
	T2-BE - Anticipating	T2-BE-1	T2-BE-2	T2-BE-3	T2-BE-4
	T3-BE - Interdisciplinarity	T3-BE-1	T3-BE-2	T3-BE-3	T3-BE-4
	T4-BE - Complexity	T4-BE-1	T4-BE-2	T4-BE-3	T4-BE-4
Values, attitudes and beliefs	**A1-BE - Reflecting**	A1-BE-1	A1-BE-2	A1-BE-3	A1-BE-4
	A2-BE - Acting Morally	A2-BE-1	A2-BE-2	A2-BE-3	A2-BE-4
	A3-BE - Acting Independently	A3-BE-1	A3-BE-2	A3-BE-3	A3-BE-4
	A4-BE - Supporting Others	A4-BE-1	A4-BE-2	A4-BE-3	A4-BE-4
Interdisciplinary skill and knowledge	**C1-BE - Cooperating**	C1-BE-1	C1-BE-2	C1-BE-3	C1-BE-4
	C2-BE - Dilemmas	C2-BE-1	C2-BE-2	C2-BE-3	C3-BE-4
	C3-BE - Participating	C3-BE-1	C3-BE-2	C3-BE-3	C3-BE-4
	C4-BE - Motivating	C4-BE-1	C4-BE-2	C4-BE-3	C4-BE-4

The first category *factual knowledge and procedures* of Schaper et al. (2013) comprises the following four sub-competences of *Gestaltungskompetenz* grouped in the *OECD tools* category: *T1 - Perspective-Taking*; *T2 - Anticipation*; *T3 - Gaining Interdisciplinary Knowledge*; and *T4 - Dealing with Incomplete and Overly Complex Information*. These competences clearly address various forms of knowledge and the procedures necessary to obtain new knowledge. Especially, sub-competence

T4 - Dealing with Incomplete and Overcomplex Information shows on the one hand, that it is rightfully placed in this category, while on the other hand, it surpasses the initial intention of Schaper et. al. by explicitly addressing overcomplex and incomplete forms of knowledge as well as non-knowledge.

The second category *values, attitudes and beliefs* of Schaper et al. (2013) covers the set of sub-competences of *Gestaltungskompetenz* grouped in the *OECD action* category. This grouping can be done since the four sub-competences not only focus on action, but rather on a form of reflective action, that actively takes individual, collective and societal *values, attitudes and beliefs* into consideration. Therefore, the following four competences can be grouped in the second category of the *Schaper Taxonomy Table*: *A1 - Reflecting Principles*; *A2 - Acting Morally*; *A3 - Acting Independently*; and *A4 Supporting Others*.

The third category *interdisciplinary skill and knowledge* of Schaper et. al. holds the remaining four sub-competences of *Gestaltungskompetenz* that are grouped in the *OECD cooperation* category. The four sub-competences are the following: *C1 - Cooperation*; *C2 - Coping with Dilemmas of Decision-Making*; *C3 - Participation*: and *C4 - Motivation*. A grouping of these sub-competences into the category *interdisciplinary skill and knowledge* seems feasible as this category transcends the limitations of discipline-specific knowledge and skills. In addition, Schaper et al. created two sub-categories that cover metacognitive knowledge as well as social and communication knowledge and skills. These two sub-categories are clearly addressed by the four sub-competences grouped in the *OECD cooperation* category.

Since the learning outcomes on module level are designed down through merging the learning outcomes on general level with the 12 sub-competences of *Gestaltungskompetenz*, they can be placed in the same three categories of the content dimension as the 12 sub-competences were just placed.

The process dimension of the *Schaper Taxonomy Table* consists of the following four levels: 1) *To Remember and to Understand Knowledge and Skills*; 2) *To Apply Knowledge, Skills and Attitudes*; 3) *To Analyze and To Evaluate Knowledge, Skills and Attitudes*; and 4) *To Create and Extend Knowledge, Attitudes and Skills*. These four levels are placed on the horizontal axis. Consequently, each of the three categories from the content dimension are addressed by the process dimension. This helps in designing down the learning outcomes to block level as the 12 learning outcomes on module level can be addressed in each of the four levels of the process dimension.

This adaptation is a very systematic process since the learning outcomes on module level are already clearly stated and consist of a verb part as well as a noun part, that covers content and context. The four process levels also consist of clearly stated verbs: 1) to remember and *understand*; 2) to *apply*; 3) to *analyze and to evaluate* and 4) *to create*. These four verbs are now merged with the learning outcomes on module level in order to describe a new set of learning outcomes to be used on block level. The problem that arises through this merging is that now there are two verb parts. Nonetheless, the two can be merged in a consistent manner, if the verb of the process dimension always becomes the verb in the newly created learning outcome. In return, the verb part of the learning outcome on module level is put into the object part of the new learning outcome. This systematic design down of the learning outcomes from module level to block level helps to describe 48 new learning outcomes, that are more precise and specifically state what the students may or may not acquire as competence in a single block or lesson.

For example, the learning outcome *T2-BE* on module level describes that *students anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.* The verb part here is *to anticipate* which becomes the object part of the learning outcome so that it can be merged with the four verbs of the process dimension, which become the verb part of the newly designed learning outcomes. This merging leads to the following more concrete learning outcomes that can be used on block level:

- T2 - Anticipation - to think and act in a forward-looking manner

- T2-BE - Students anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.

- T2-BE-1 - Students *understand* methods to anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.
- T2-BE-2 - Students *apply* methods to anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.
- T2-BE-3 - Students *analyze and evaluate* methods to anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.
- T2-BE-4 - Students *create* methods to anticipate spatial and temporal effects of technology on individuals, nature, society and democracy.

The second example is taken from the *OECD cooperation* category. Here, the learning outcome *C3-BE* states that *students participate in collective decision-making processes*. The verb part here is *to participat*e which becomes part of the object, while the verbs of the process dimension become the verb parts of the learning outcomes on the block level:

- C3 - Participation - to participate in collective decision-making processes

- C3-BE - Students participate in collective decision-making processes.

- C3-BE-1 - Students *understand* methods to participate in collective decision-making processes.
- C3-BE-2 - Students *apply methods* to participate in collective decision-making processes.
- C3-BE-3 - Students *analyze and evaluate* methods to participate in collective decision-making processes.
- C3-BE-4 - Students *create* new methods to participate in collective decision-making processes.

The third example for this designing down of learning outcomes from module level to block level is from the *OECD action* category. Here the learning outcome *A2-BE* states that *students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally*. The verb part here is *to act morally* of the learning outcome on module level, which becomes the object part of the newly described learning outcome on block level, while the verbs of the process dimension of the *Schaper Taxonomy Table* become the verb part:

- A2 - Act Morally - to refer to the idea of equity in decision-making and planning actions

- A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.

- A2-BE-1 - Students *know* methods to identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.
- A2-BE-2 - Students *apply* methods to identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.

- A2-BE-3 - Students *analyze and evaluate* methods to identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.
- A2-BE-4 - Students *create* methods to identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.

These three examples have shown that the merging of learning outcomes on module level with the four verbs of the process dimension can be easily implemented. The benefit of this seemingly simple adaptation is a consistent as well as a coherent set of learning outcomes on block level. However, this set of 48 learning outcomes on block level is not limited to be used in building blocks alone. They may easily be used also to grasp complex activities and assessments that take place in a course, such as developing and testing a building block or keeping a learning journal. Both activities and assessments are part of the *Blue Engineering Course* and span over one whole semester as is shown in the chapter on the course design.

5.10 - Learning Outcomes on Activity Level

With each step of the design down process from general level to module level to block level, the learning outcomes are getting more and more concrete. However, they still remain abstract on block level to the extent that it is not clear what concrete competences the students actually acquire. For example, learning outcome *T1-BE* states that *students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, nature, society and democracy.* This leaves room for interpretation even if the learning outcome on module level is designed down to block level. It remains unclear what exact competences the students acquire and with respect to which scientific domain as well as with respect to the exact content, topic and context the students acquire said competences.

Therefore, a further design down to the activity level is needed. As it was described above, one of the common objectives of a framework for learning outcomes is not only the grouping of existing learning outcomes but moreover the expansion and precisioning of learning outcomes. The newly created matrix of learning outcomes on block level helps to create meaningful learning outcomes for concrete activities and assessments. In addition, this matrix helps to avoid free floating learning outcomes as it helps to link them back to a greater framework of learning outcomes and competences, that is the concept of *Gestaltungskompetenz* as well as the *OECD* key competences. The use of the *Schaper Taxonomy Table* also helps to make the learning outcomes comparable to other sets of learning outcomes that make use of this taxonomy table.

It now becomes apparent, that this design down process of learning outcomes for the *Blue Engineering Course* is structured in such a way, that concrete topics and methods are addressed only at the activity level. Here, it is the obligation of the people who design and offer a whole lesson to describe the learning outcomes in a meaningful way as well as to align them properly. This would count also for the description of the learning outcomes of short activities or assessments that take place within one lesson. As the description of learning outcomes should be an open process, the people in charge should take care to include various stakeholders, such as students and working engineers. In addition, the people that describe these learning outcomes need to place them within the matrix of the learning outcomes for the block level to ensure comparability within the course.

Three examples now illustrate how learning outcomes on the activity level can be described and linked back to the matrix of learning outcomes on module level as well as block level. The first example addresses how open discussions take place in the *Blue Engineering Course*. During the second lesson, a method is introduced that is kept for the whole semester: People who want to contribute to the open discussion raise their hand. The person who last spoke chooses the person who will speak next. This method has the advantage of engaging everyone in the moderation of the discussion, while also more students seem to engage in the discussion. Therefore, the students know a method to facilitate an open discussion that is less hierarchical than others and are able to apply it. Therefore, this learning outcome can be placed at the process levels 1) *to understand* and 2) *to apply* of the process dimension. With respect to the 12 sub-competences, the students acquire the competences *C1-BE Cooperating* in democratic decision-making. Therefore, the two concrete learning outcomes on activity level for this method would be:

- C1-BE-1: Students *know* one method to structure an open discussion less hierarchical, e.g. by letting the last person who spoke decide who will speak next.
- C1-BE-2: Students *apply* one method to structure an open discussion less hierarchical, e.g. by letting the last person who spoke decide who will speak next.

The second example addresses level 3) *to analyze and to evaluate* of the process dimension. The example stems from one of the core building blocks that is conducted in the first weeks of every *Blue Engineering Course*. In the building block *Technology as Problem-Solver!?* the participants are divided into groups and each group is placed in a different age of humanity, e.g. Stone Age, Middle Ages, Present and Future. The problem that each group faces is the same for all the groups, that is to cope with a sudden and still unknown pollution of the drinking water supply. The way in which they cope with this problem is to be presented in a short skit. In this building block, the students acquire various competences, but here especially the competence *T1-BE Perspective-Taking* as well as *A1-BE Reflecting Principles* are to be pointed out. Students clearly analyze and evaluate the implications of the same problem in different ages of humanity and learn how to transfer this knowledge into other situations. Two concrete learning outcomes on activity level for this building block are, therefore:

- T1-BE - Students gather differing perspectives, points of view and diverse forms of knowledge from various actors in order to *analyze and to evaluate* the spatial and temporal effects of a sudden water pollution with respect to technology, individuals, nature, society and democracy.
- A1-BE - Students *analyze and evaluate* the principles that have an effect on the drinking water supply in different ages of humanity and how these principles affect the reciprocal relations of technology, individuals, nature, society and democracy.

The third and last example on how to describe learning outcomes on activity level address the semester projects which forms a central part of the student activities as well as of the assessment of the students. This example addresses especially the process level 4) *to create* as the students design, test and document a whole new building block. The competences that the students acquire here are numerous as it is a complex task to successfully create a demanding teaching unit of about 60 minutes length. The topic can be chosen freely by the group of about three to six students, however, it should have an apparent connection to the social and ecological responsibility of engineers. So depending on the exact topic and the chosen methods, the students create something totally new in a number of learning outcomes on module level. However, the competence *C4-BE Motivation* is a common competence that everyone acquires who creates a new building block along with his fellow participants. The learning outcome on activity level is, therefore, the following:

- C4-BE-4 - Students *create* a teaching unit/building block in order to motivate oneself and others to democratize the reciprocal relations between technology, individuals, nature and society.

6 - Evaluation of the Blue Engineering Course

This research project is based on two research questions. The first research question aims at describing a set of learning outcomes for the existing *Blue Engineering Course*. The result of the first research question provides the basis for the second research question, that aims at evaluating the course on module level according to the previously described learning outcomes.

So far, the *Blue Engineering Course* has been described as the problem area of this educational design research project. This was followed by an analysis of the current state of knowledge on what to consider when setting off to describe learning outcomes within the field of an engineering education for sustainable development. In the preceding chapter, this analysis was used to design down the learning outcomes from general level to activity level. The learning outcomes are becoming more and more concrete with each step of the design down process. By starting off with highly abstract learning outcomes on a general level as well as abstract key competences of an education for sustainable development, the design down process resulted in domain-specific and course-specific learning outcomes.

In this chapter on evaluation the two research questions of this research project are now jointly addressed leading to a twofold evaluation. With regard to the first research question, it is evaluated if the learning outcomes are practical and effective. According to the previously described criteria of quality research, this means that the learning outcomes are evaluated on whether they are expected to be actually usable and used. This is achieved through making the learning outcomes the basis of the evaluation of this course. Therefore, the usability and usefulness of the learning outcomes on module level are only indirectly demonstrated by making them the central criteria to evaluate the *Blue Engineering Course* on module level.

The primary focus of this evaluation chapter lies in the evaluation of the *Blue Engineering Course* according to its learning outcomes, which addresses the second research question. Therefore, in this sub-chapter, the design of the evaluation of the *Blue Engineering Course* will be presented and conducted accordingly. This overall evaluation of the course eventually is the basis used to devise the local instructional theories as well as the design principles in the concluding and last chapter of this research project.

The evaluation of the *Blue Engineering Course* consists of the following parts:

- A quantitative analysis shows who participated in the course.
- A qualitative evaluation gives an overview which learning activities and learning assessments contribute to reaching the 12 learning outcomes on module level.
- A triangulation of data shows how and to what degree three selected core building blocks contribute to the 12 learning outcomes on module level. This triangulation consists of a qualitative analysis of the documentation of the three building blocks. These findings are backed by a perception-based test where the students, the responsible tutors and an external observer will record in a quantitative test if they have perceived during class the use of the 12 sub-competences of Gestaltungskompetenz.
- A comparative self-assessment of the students provides an additional quantitative evaluation. For this, the learning outcomes on module level are adapted as items of a questionnaire through which the students self-assess their personal competence with regard to the 12 sub-competences of *Gestaltungskompetenz*.

6.1 - Design of the Evaluation of the Blue Engineering Course

Throughout the past centuries, evaluation has seen many different forms and its basic concept is not limited to the educational or political sector. Madaus and Kellaghan (2000) identify 20 different definitions of evaluation in total, such as objective/goals-based evaluations or decision-oriented evaluations. Each definition emphasizes different aspects of evaluation so that some definitions might be merged to form a more comprehensive understanding of evaluation while other definitions are mutually exclusive, where either of the options needs to be chosen. In addition, Madaus and Kellaghan (2000) identify 12 different theoretical perspectives with regard to the evaluation of education, such as modernity/post-modernity and rationalistic/naturalistic perspectives which need to be considered when designing the evaluation of an educational project.

With regard to education, it can be pointed out that the underlying model of education also shapes the congruent model of evaluation. Madaus and Kellaghan basically differ between a factory model as one possible metaphor for education or "schooling as travel" as yet another metaphor (Madaus and Kellaghan 2000, 23). In addition, the "ways of knowing", that is the underlying epistemology of an evaluation, needs to be carefully considered (Madaus and Kellaghan 2000, 24). Furthermore, the overall purpose and context of the evaluation need to be considered as well as whether the evaluation adheres to scientific principles and to what degree it is dedicated to political decision-making or mere opinion polling (Stockmann and Meyer 2014, 74). While Madaus and Kellaghan describe rather general characteristics of various definitions of evaluation, Stufflebeam (2000) identifies 22 different approaches of program evaluation, which he clusters into four categories, that is 1) pseudoevaluations; 2) questions/methods-oriented evaluation approaches (quasi-evaluations), 3) improvement/accountability-oriented evaluation approaches and 4) social agenda-directed/advocacy approaches.

Apart from these basic variances of evaluation, evaluation can generally be defined as an instrument to generate empirical knowledge which will be linked with an assessment according to a set of criteria and which will guide purposeful decision-making (Stockmann and Meyer 2014, 72). Therefore, three key aspects of evaluation can be identified as: 1) the generation of knowledge, 2) that serves as the basis for an assessment based on criteria and 3) which will prepare and ground a decision-making. This general definition is in line with definitions that have received broad recognition, such as "Evaluation is the systematic investigation of the merit or worth of an object (program) for the purpose of reducing uncertainty in decision making" by Donna Mertens (1998, 219). In contrast, Lee J. Cronbach simply defines evaluation "as the collection and use of information to make decisions about an educational program" (2000).

Building upon this rather general definition of evaluation, Stockmann and Meyer (2014, 74) list six quality criteria in order to conduct a scientifically grounded evaluation:

- the clear definition of an object of research, such as an intervention, process, project, program or policy;
- an empirically grounded generation of objective data;
- the assessment based on explicit and transparent criteria that are adequate for the object of research;
- the assessment needs to make systematic use of comparative methods;
- the evaluation is undertaken by qualified persons and
- a decision-making based on the findings of the evaluation.

The fulfilment of these quality criteria allows for a scientific grounding of an evaluation which is in contrast to mere measurements of efficiency, target-performance comparisons or the analysis of the operational capability of an organization. Stockmann and Meyer (2014, 75) sum up these criteria through a series of five questions:

- *What or which object is evaluated*
- for *which purpose*
- based on *which criteria*
- by *whom*
- through the use of *which methods*?

These questions will be discussed in the following paragraphs with regard to their general nature as well as with regard to the evaluation of the *Blue Engineering Course*.

6.1.1 - What or which object is evaluated?

Stockmann and Meyer (2014, 75) state that there are almost no limits to *what can become the object of an evaluation*. In general, they differentiate between four levels: policy level, program level, project level and intervention level. The highest level is the policy level which constitutes of one or more programs that are implemented in order to realize a policy. The program level is the level that is most often specifically evaluated as programs are comprised of instrumental as well as organizational aspects. With regard to instrumental aspects, programs can be characterized through their set of projects and interventions which realize explicit innovations within social systems. With regard to organizational aspects, programs are integrated into a bigger structure or organization but are equipped with their own proper financial and personal resources which grants a certain autonomy. This helps to implement projects and to realize concrete interventions according to the program objectives. Programs might be aimed at internal as well as external target groups.

Accordingly, the *Blue Engineering Course* can be identified as a program within *Technische Universität Berlin*. The course itself will be the object of this evaluation and the scope is further narrowed down to an evaluation of the course on module level. This level of evaluation is chosen over other levels as this is the first level where the two learning outcomes on general level are merged with the 12 sub-competences of *Gestaltungskompetenz*. This results in a set of 12 learning outcomes on module level which are already course-specific but remain abstract enough to represent only an adaptation of the 12 sub-competences of *Gestaltungskompetenz*. This aspect is also reflected in the design of the two quantitative evaluations as it is seen important that the participants of the course are competent to participate in an overall sustainable development instead of a highly domain-specific sustainable development.

6.1.2 - What is the purpose of the evaluation?

The second sub-question asks *what purpose* an evaluation might serve and which goals might be associated with it. Stockmann and Meyer (2014, 77) differentiate between two types of evaluation, the first being a *goal-oriented evaluation* based on a comprehensive target-performance comparison. This type of evaluation will basically help to check whether a program has reached its objectives. The danger of this type of evaluation is that it might reduce evaluation to a simple approval of the object as it is. Therefore, further improvement or development of the object might be neglected. In addition, this general setup of an evaluation will necessarily neglect any unintended effects, which can be addressed through an *effect-oriented* or *impact-oriented evaluation*. This second type of evaluation will lead to a statement of the cross-outcome of the object of evaluation, which will consist of a description of the net effects as well as extraneous factors and additional design effects.

Apart from this basic differentiation of purpose, Stockmann and Meyer (2014, 81) identify three purposes of an evaluation, that is 1) realizing societal enlightenment, 2) securing legitimacy of a democratic regime and 3) optimising program control. Stockmann and Meyer place this last purpose in the centre of attention. They identify four functions of an evaluation that may be analytically separated but which remain highly interrelated, that is 1) generating knowledge, 2) exercising control, 3) triggering development processes and learning processes and 4) legitimising interventions, projects and programs. Typically, an evaluation will focus on one function, while the other three functions take up a supportive and complementary role in the evaluation.

In addition to the functions of an evaluation, Stockmann and Meyer (2014, 83) identify three possible analytical perspectives of an evaluation. Evaluations can either be conducted as an ex-ante evaluation, an accompanying evaluation or an ex-post evaluation. This also affects whether the evaluation has an overall formative or summative character, that is to actively intervene in the object of the evaluation or to only analyze the outcomes and effects of the object.

With regard to this research project, the evaluation of the *Blue Engineering Course* is conducted as a goal or objective oriented evaluation. The primary function of this evaluation is to generate knowledge about the *Blue Engineering Course* which might serve to legitimise the course in the long run. Overall, this evaluation is designed as a summative evaluation that is done ex-post. However, if appropriate as part of this evaluation, little implications of design change are given in some sub-chapters.

6.1.3 - What are the criteria for the evaluation?

The third sub-question addresses the *criteria which will be used to evaluate* the object of evaluation (Stockmann and Meyer 2014, 85). The criteria for an evaluation are usually designed specifically for the object of evaluation, its context and the general purpose of the evaluation. The individual set of criteria for an evaluation is a major difference to a series of standards or process descriptions issued; for example, by organizations of standardisation or by quality management organizations. With reference to Dror (1983) and Vedung (2000), Stockmann and Meyer (2014, 86) list ten perspectives that may affect the characteristics of the criteria and the overall purpose of the evaluation, such as historical comparison, international comparison, goals of the object of evaluation, expectations of the addressees or professional standards. Stockmann and Meyer (Stockmann and Meyer 2014, 87) point out that within some fields of evaluation, broadly recognized criteria have been established. As an example, they provide the criteria of the *Development Assistance Committee* (*DAC*) of the *OECD* which are generally used to evaluate programs within the field of development cooperation. The five widely applied criteria for this field are 1) relevance, 2) effectiveness, 3) efficiency, 4) impact and 5) sustainability.

The two research questions of this research project already prompt the criteria which are to be used: the previously designed learning outcomes on module level of the *Blue Engineering Course*. Therefore, the learning outcomes on module level as well as the underlying domain-specific adaptation of the 12 sub-competences of *Gestaltungskompetenz* are used to analyze the overall course which might indicate the effectiveness of the course design.

6.1.4 - Who is conducting the evaluation?

Stockmann and Meyer (2014, 88) distinguish between internal and external evaluations, which provides an answer to sub-question four, that is *who is evaluating*. An internal evaluation can further be split into a self-evaluation and an in-house-evaluation. The overall advantages of internal evaluations are their rapid deployment in combination with a high expertise in the field as well as their low demand for resources. A possible low level of competence, missing independence and distance as well as "organizational blindness" can be identified as the general disadvantages of an internal evaluation. These disadvantages can be turned into the advantages of an external evaluation, that is independence and competence of conducting evaluations. This might lead to a higher degree of trustworthiness and reliability as well as the capacity to advocate change more freely. In return, the disadvantages are a lack of expertise, defence reactions by the persons affected and general problems of organising change. However, the internal and external approach might be combined for a more comprehensive evaluation.

The evaluation of this research project will be undertaken as an internal evaluation with partial assistance from external experts and evaluators. The organization of the evaluation and its conduction is undertaken by the responsible lecturer for the *Blue Engineering Course* who is also the author of this research project, which makes it a self-evaluation. However, as described in sub-chapter 5.2), among others, two experts of study program evaluation at *Technische Universität Berlin* continually advised the description of the learning outcomes of the course. These two also were regularly consulted in the design of the evaluation of the course on module level. In addition, the evaluation concept was presented at three conferences during its development phase and initial implementation phase (Baier and Meyer 2015; Baier 2015; Baier 2017a). The professional scrutiny by these experts led to a continual adaptation of the evaluation concept and thus it is not a mere internal evaluation. Furthermore, the triangulation of three selected core building blocks is done in cooperation with a former participant of the course. Therefore, she works as an external observer who previously participated in the course which gives her a particular insight into the workings of the course. Her role will be described in detail in the corresponding sub-chapter.

6.1.5 - How is the evaluation carried out and which methods are used?

The last and fifth subquestion aims at clarifying *how the evaluation is carried out and which methods are used*. Stockmann and Meyer (2014, 92) address this question from an epistemological point of view, when they first differentiate between an empirical approach to evaluation in contrast to social-constructivist approaches to evaluation. They conclude that the “cold war of paradigms” has not ceased, however, in the last years the commonalities of these two paradigms are more and more underlined. This led to an overall understanding of evaluation that makes use of methods which guarantee a certain objectivity. By doing this, the generation of an intersubjective understanding is fostered, since the methods as well as the results can be retraced and reproduced by others. This intersubjectivity as well as the scientific reliability of an evaluation is further ensured by separating descriptive statements from normative statements. Therefore, the only values and norms that are deemed crucial for an evaluation are the imminent values of a scientific approach. All other values are removed from the evaluation itself and are located within the context of the object of evaluation. The evaluation of this research design project will be undertaken within this scientific paradigm as the previous paragraphs on the purpose and the criteria of an evaluation have already hinted.

Stockmann and Meyer (2014, 96) contrast the above described general approaches of an evaluation with an action research evaluation approach, where the evaluators take up the role not as researchers but rather as facilitators. In this evaluation approach, the evaluators will structure and guide an evaluation process in close cooperation with the people involved and affected by the object of evaluation. This diminishes the previously described distance between evaluator, the object of evaluation and the group affected by the object of evaluation. This action research approach to evaluation results in the integration of values into the research process itself. This integration is intended as the primary objective of the evaluation as this kind of evaluation aims at emancipating and empowering the stakeholders of the object of evaluation. Thus, this type of evaluation focuses on the continued improvement of the object of evaluation by incorporating the persons affected in the evaluation process. For this, the action evaluation approach combines scientific methods and scientific research with change management, negotiation and group therapy (Stockmann and Meyer 2014, 98).

6.1.6 - Components of the Evaluation of this Educational Design Research Project

Overall, the evaluation phase of this educational design research project is a summative ex-post evaluation that uses the learning outcomes on module level as the primary set of criteria. Accordingly, the *Blue Engineering Course* as a whole module will be the object of evaluation which is undertaken as an internal evaluation feedbacked through external experts. This overall evaluation is undertaken through a mixed media research approach (Stufflebeam 2000), that includes qualitative and quantitative evaluations. In total, this evaluation consists of four components. Each component of this evaluation follows a basic scientific approach by first clarifying the research question as well as the research design, which is followed by a brief description of the problem area and its analysis, a description of the data collection, an analysis of the gained data and a concluding discussion. The four components of this evaluation will be presented in the following four sub-chapters.

First, the number of participants and their respective study programs are analyzed through descriptive statistics.

Second, the evaluation based on the learning outcomes on module level starts with a qualitative description of the corresponding learning activities and an assessment of the entire *Blue Engineering Course.*

Third, a triangulation of three selected core building blocks is undertaken. For this, the learning outcomes on module level are adapted as items of a quantitative questionnaire. The design of this questionnaire is based on the research concept of *EMU - Evidenzbasierte Methoden der Unterrichtsdiagnostik und -entwicklung* (Evidence-based Methods of Teaching Diagnostics) (Helmke et al. 2018) which provides a survey tool that makes use of the evidence-based educational research by John Hattie (2008; 2012).

Lastly, the learning outcomes on module level will be adapted as items of a comparative competence self-assessment of the students. This analysis is undertaken as a pre-post-assessment for three semesters followed by a then-post-assessment for three semesters. This research approach is inspired by the work on comparative self-assessment gains developed within the field of medical education research (Raupach et al. 2011; Raupach et al. 2012; Schiekirka et al. 2013; Schiekirka et al. 2014).

6.2 - Participants of the Blue Engineering Course

This sub-chapter does not contribute to the evaluation of the course based on the learning outcomes on module level. Instead, it provides a general overview of who participated in the *Blue Engineering Course*. The examination records of the courses from winter semester 2011/2012 to winter semester 2017/2018 show the number of students who registered for an examination, their respective study programs as well as their enrollment on bachelor or master level.

6.2.1 - Research Question and Research Design

The general aim of this sub-chapter is to clarify who participated in the *Blue Engineering Course*. As this is too broad to function as a question, the following two questions are to be addressed in this sub-chapter:

- How many students participated in the *Blue Engineering Course*? How many participated in total as well as in the different semesters?
- In which study programs, that is discipline as well as bachelor-/master-level, are the participants of the *Blue Engineering Course* enrolled in?

The two questions will be answered through a descriptive statistical analysis of the course's participants. The most reliable data source for this analysis is the examination records of the *Blue Engineering Course*. The scope of this research are the 13 semesters from winter semester 2011/2012 until winter semester 2017/2018.

6.2.2 - Problem Area

The *Blue Engineering Course* at *Technische Universität Berlin* started in winter semester 2011/2012 and since then it has been offered every semester. For the first 12 semesters, the course has been a compulsory elective in the master study programs of *Mechanical Engineering*, *Industrial Engineering* and *Computational Engineering Sciences*. Since its thirteenth semester, that is winter semester 2017/2018, the course is also a compulsory elective in the bachelor study programs of *Mechanical Engineering*, *Industrial Engineering*, *Transport Systems Engineering* and *Sustainable Management*. The students are not obliged to take the *Blue Engineering Course*, as there is a broad range of compulsory electives in the bachelor study programs as well as in the master study programs. In addition, students from other bachelor and master study programs may participate in the *Blue Engineering Course* within their electives for which they may typically choose any course offered at a university. For further background information on the design of the *Blue Engineering Course*, see chapter 3 which describes the problem area of this whole research project.

6.2.2 - Data Collection

There are two data sources that can be used to conduct a descriptive statistical analysis of the participants of the *Blue Engineering Course*. The first data source is based on a list that the participants have to fill out during the third lesson of the course. Here, they need to record their name, study program and faculty. This list is issued by the faculty which offers the *Blue Engineering Course*. Every course offered by this faculty needs to keep this list of participants with the purpose of identifying how many students participate in the courses along with their faculty of origin. This list may be used as a reliable data source. However, this list is issued before the participants have to register for an examination within in the course. Therefore, a few more students would be considered participating in course, while they actually have dropped out over the semester.

The second possible data source is the examination records. Students are required to register for an examination within the first six weeks of a semester. After registration, they are obliged to fully participate for the whole semester and to hand in all of the four assessments in order to receive credit. Otherwise, the course will be marked as "failed" in their examination report and they have to retake the course the following semester. Therefore, only students who are willing to participate regularly will sign up for the examination. The registration forms include the study program with regard to discipline as well as bachelor-level and master-level. The rest of the collected data is not relevant for the two questions in this sub-chapter as they are covering only personal information of the participants, such as their name and address.

The examination records are chosen as the data source instead of the faculty lists as they are more representative of who continually participated in the course. The examination records cannot be disclosed as such, since they contain sensitive personal data. The author of this research project was also the responsible lecturer of the *Blue Engineering Course*, so that he had direct access to the examination data. The aggregation of the relevant data described above was organized by him at the end of every examination period in a separate spreadsheet. Thus, no personal data was recorded as part of this research project.

The relevant data of the examination records are compiled into one spreadsheet containing the semester, the study program as well as the bachelor-level or master-level of every participant. Since study programs are offered by faculties, the faculty primarily responsible for the respective study programs is also given. The following naming convention is used to identify the thirteen semesters: The suffix *_1* stands for the summer semester, while the suffix *_2* stands for winter semester, e.g. *2014_2* is the winter semester of 2014/2015 and *2015_1* is the following summer semester of 2015, see Appendix - Participants.

6.2.3 - Data Analysis

6.2.3.1 - Number of Participants

As described in the previous two paragraphs, it is not possible to determine the exact number of participants of the *Blue Engineering Course*. Instead, the number of examinations will be presented. This is a valid approach since each examination corresponds to one unique student as students are only allowed to take one examination for each course. This may also rule out that students have participated in the course in their bachelor study program as well as in their master program. However, as hinted above, this approach does not account for all of the participants as they may have dropped out earlier or may not have registered for examination. In general, it is estimated that only about 80 % of the participants who show up in the first lesson continue with the course.

So far, the total number of examinations taken within the *Blue Engineering Course* amounts to 758. The following figure shows the number of examinations for each of the thirteen semesters that are within the scope of this research project, see Figure 3. In addition, this figure shows a red line indicating the moving average of the number of participants who have participated up until the respective semester. This line is used only to highlight a general trend as the moving average comprises only a concrete value for each semester. This figure clearly shows that the number of course participants gradually rose over time. This steady increase was intended as this would allow for a continuous adaptation to the growing number of participants.

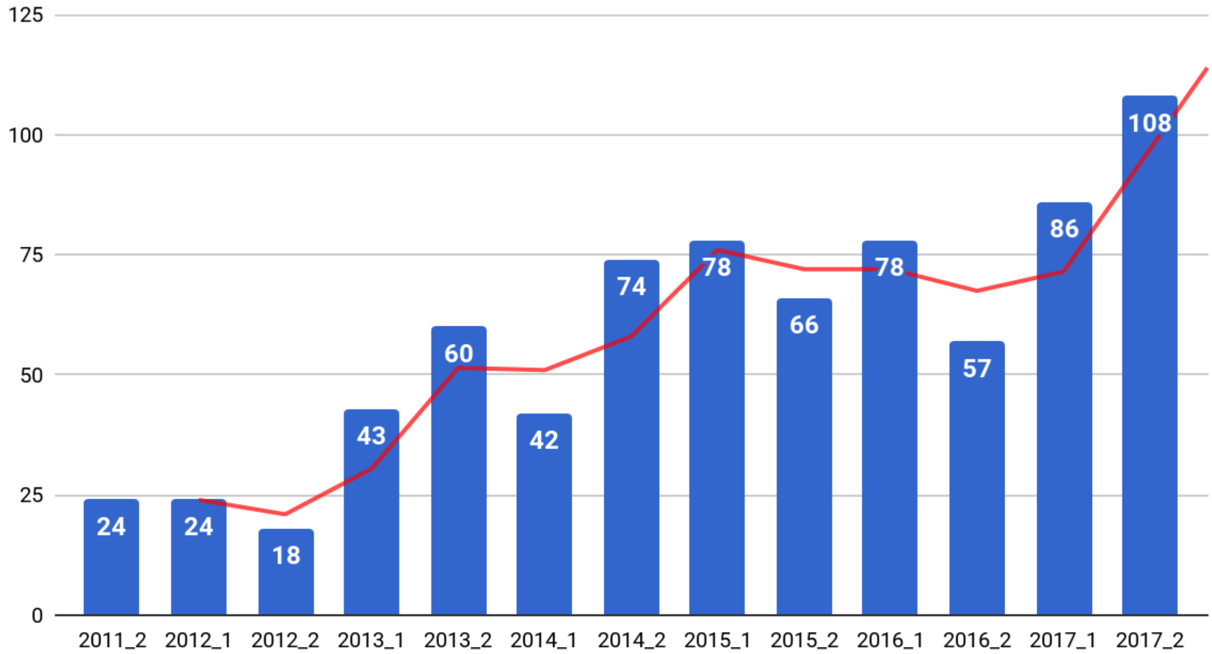

Figure 3 - Number of Examinations for Each Semester and Moving Average

Across the 13 semesters, a mean of around 58 students per semester took their exam. The course design has been stable since the winter semester 2015/2016. The average number of exams since then amounts to around 78. This roughly represents the intended capacity of the course. The jump to 108 exams in winter semester 2017/2018 is due to the acceptance of the course as a compulsory elective in a number of bachelor study programs starting in that semester.

6.2.3.2 - Bachelor-Level/Master-Level of Participants

Students of bachelor programs and master programs may participate in the *Blue Engineering Course*. In the first twelve semesters of the course, only students of several master degree programs could choose this course as a compulsory elective. The rest of the participants, including all students of bachelor degree programs, chose this course as an elective of their studies. In total, 56,7 % or 430 of the students were enrolled in a master degree program, while 41,7 % or 316 students were enrolled in a bachelor study program. The remaining 1,6 %, or 12 students, were enrolled in one of the discontinued diploma degree programs, see Figure 4.

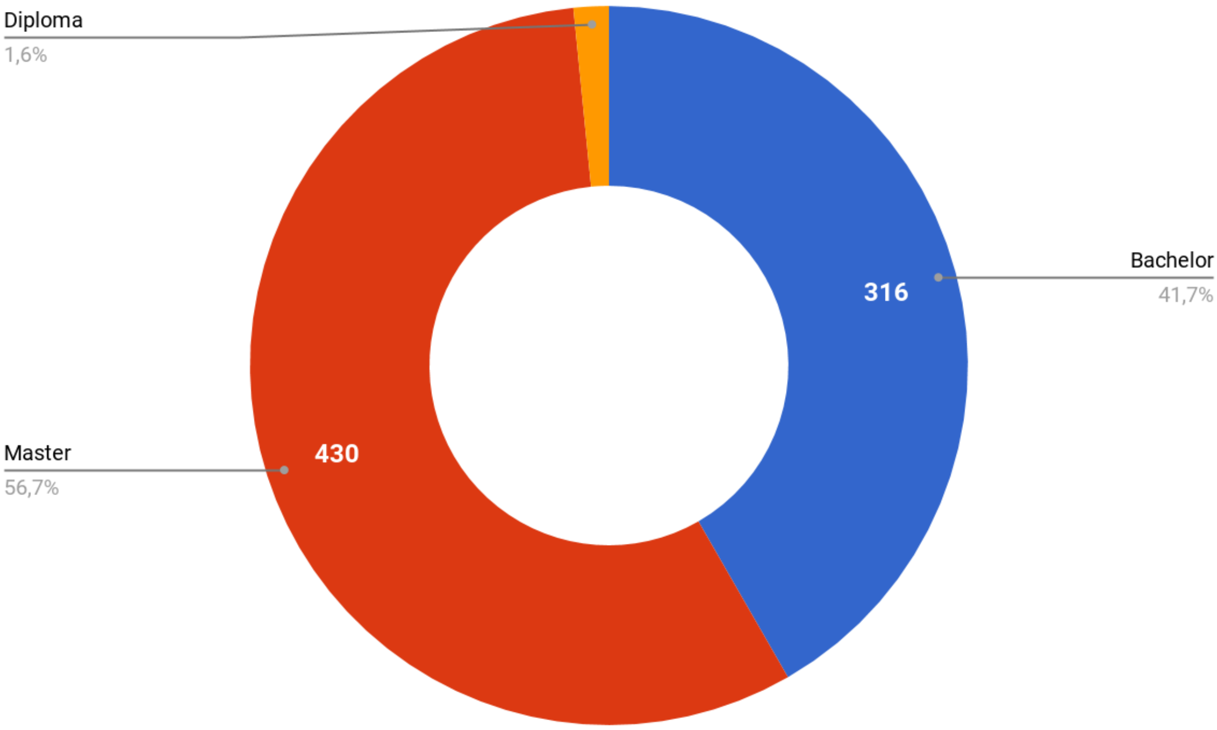

Figure 4 - Study Degree programs - Bachelor/Master/Diploma

During the first four semesters of the course, slightly more bachelor students participated in the course. Thereafter, more master students participated in the course. In the first twelve semesters, a mean of around 21 bachelor students participated with very little variance across the semesters. In contrast, a mean of around 32 master students participated in the first twelve semesters. Therefore, on average more master students than bachelor students have participated in this phase of the course, see Figure 5. The two lines connecting the concrete values for each semester are used only to highlight a general trend.

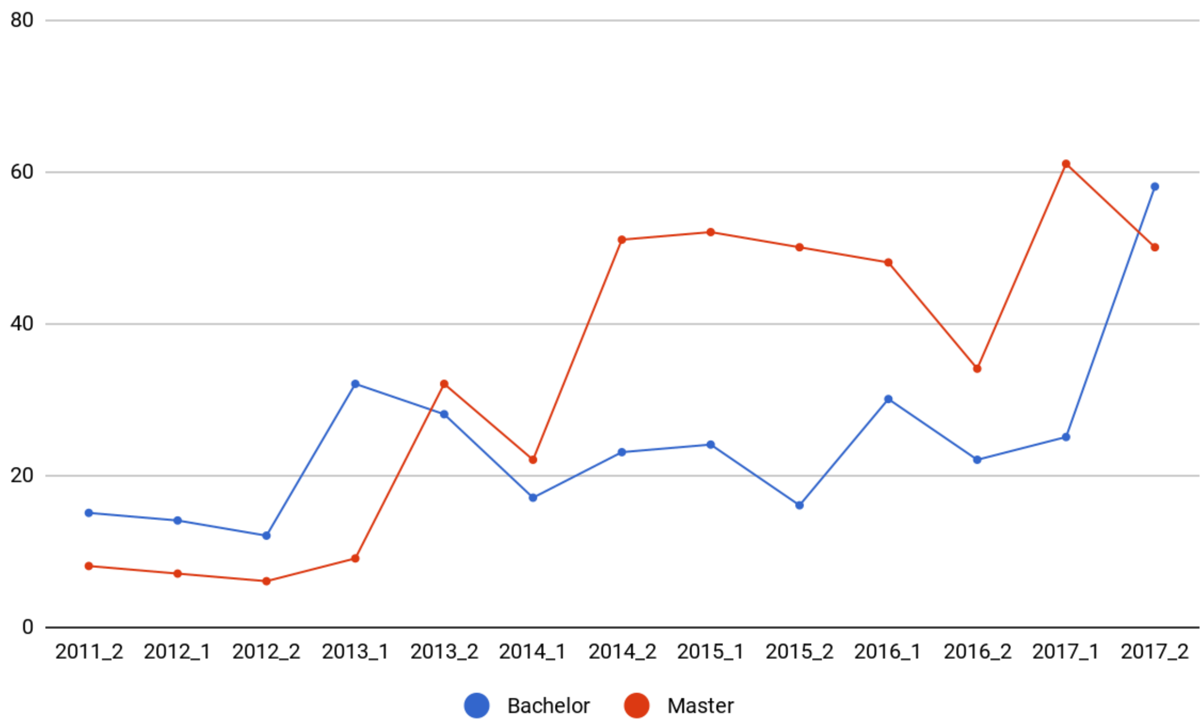

Figure 5 - Study Degree programs - Bachelor-/Master-Students per Semester

With the addition of the course as a compulsory elective to several bachelor study programs, the number of bachelor students increased and surpassed the number of master students in the thirteenth semester, which is the last semester in the scope of this research project. For the future of the course, it is expected that the number of bachelor students will continue to increase as the course will be firmly established within the aforementioned bachelor study programs.

6.2.3.4 - Academic Disciplines of Participants

The students of the *Blue Engineering Course* have been enrolled in 46 different academic disciplines. This high number clearly shows that the course attracts many students from a broad range of disciplines and study programs where the course may only be credited as an elective, see Figure 6. This figure shows only the ten study programs with the most participants, all other study programs are summed up as other study programs. This is congruent with the high number of students enrolled in bachelor programs which are shown in the previous sub-chapter.

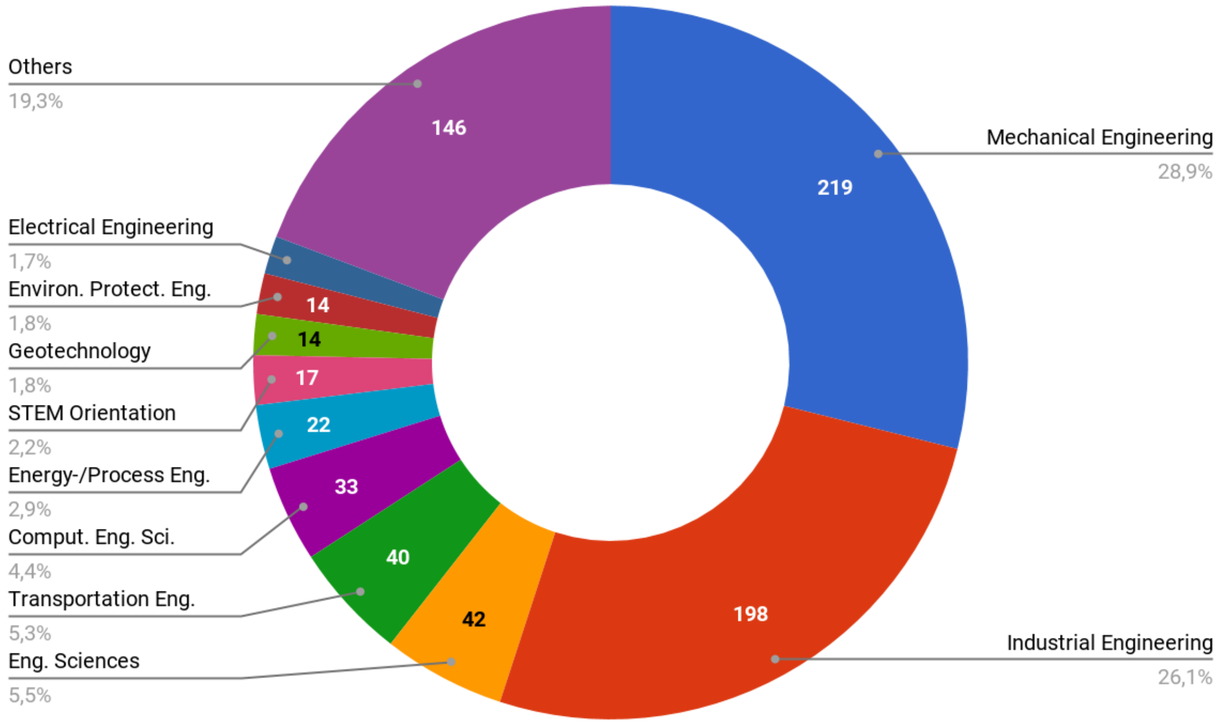

Figure 6 - Study programs of the Participants

Originally, the *Blue Engineering Course* has been a compulsory elective only in the study programs of *Mechanical Engineering*, *Industrial Engineering* and *Computational Engineering Sciences*. This clearly shows in the number of students with either of these backgrounds, which totals to 219 students of *Mechanical Engineering*, or 28,9 %, and 198 students of *Industrial Engineering* which amounts to 26,1 % of all students. In sum, 417 students of 758 students, or 55 %, took this course coming either from *Mechanical Engineering* or *Industrial Engineering*. The other half of students bring in a broad range of different technology-oriented disciplines.

The third and fourth ranking study programs with regard to the number of students in the *Blue Engineering Course* are *Engineering Sciences* with 42 students and *Transport Systems Engineering* with 40 students. Students of *Computational Engineering Sciences* only rank fifth with 33 students, or 4,3%, which is due to the smaller number of students enrolled in this discipline as well as a slightly different setup of the compulsory electives. These three disciplines as well as *Mechanical Engineering* are offered by faculty V *Mechanical Engineering and Transport Systems*. Therefore, the number of students in a study program offered by faculty V amounts to 373 students, or 49,2 %, see Figure 7. The number of students enrolled in a study program offered by faculty VII *Economics and Management* amounts to 211 or 27,8 %. The number of students enrolled in one of the remaining four faculties of *Technische Universität Berlin* amounts to 175 or 23,0 %.

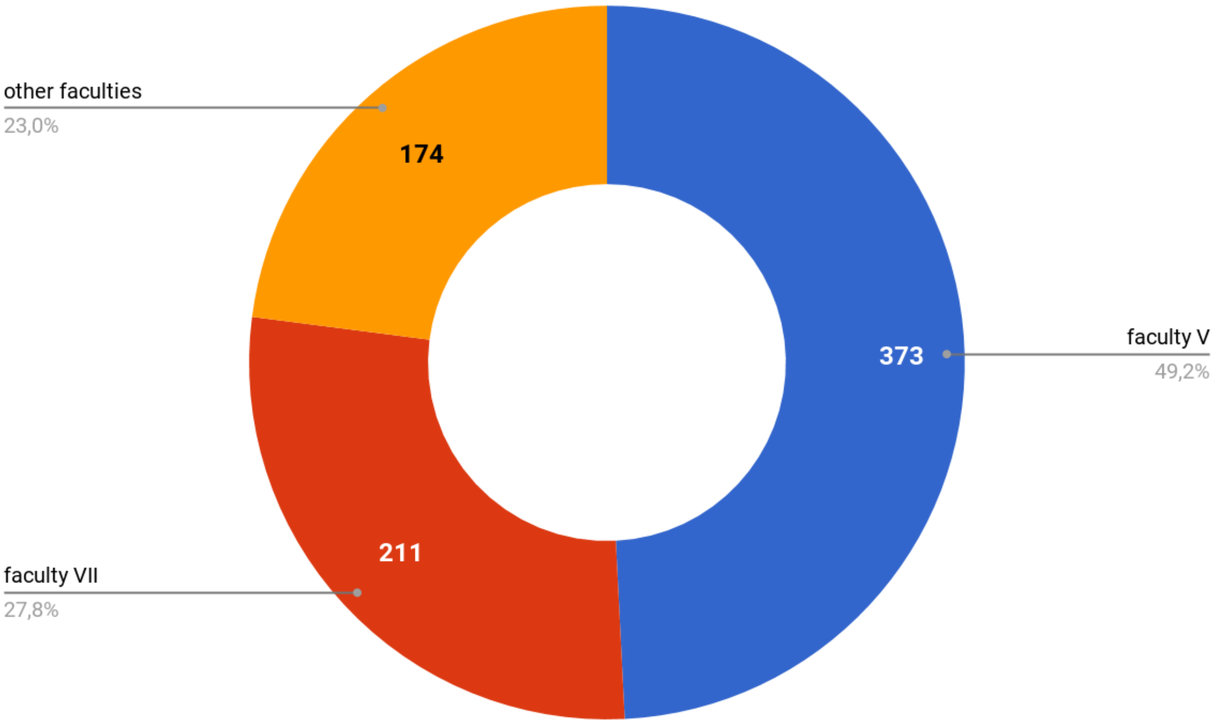

Figure 7 - Faculties of the Participants

6.2.4 - Conclusion

The two questions of this sub-chapter aimed at identifying the number of participants as well as their study backgrounds. This sub-chapter has shown, that the *Blue Engineering Course* attracts a high number of students which continuously grew from the start of the course in winter semester 2011/2012. The participants bring in a broad range of disciplines. In addition, roughly half of the students are enrolled in a bachelor program while the other half is enrolled in a master program. Therefore, the participants have the chance to work with students who have a different background than themselves. This is further enforced through the course design which requires a continuous interaction between the students. Overall, this leads to an interdisciplinary working atmosphere, which roughly corresponds to learning outcome *T3 - Gaining Interdisciplinary Knowledge*. Furthermore, the diverse background of students also helps to reach learning outcomes *T1 - Perspective Taking* as well as *A3 - Supporting Others.*

6.3 - Qualitative Evaluation of the Blue Engineering Course based on its Learning Outcomes on Module Level

This sub-chapter describes a qualitative evaluation of the *Blue Engineering Course*. The evaluation criteria for this are the learning outcomes on module level. If applicable, corresponding learning activities and learning assessments are identified for each of the learning outcomes. This evaluation shows that there is a broad range of activities and assessments for each of the 12 learning outcomes on module level. Therefore, the students do not need to acquire the corresponding sub-competences of *Gestaltungskompetenz* in one single lesson or even through one sole activity. Instead, the students actively need to show and practice the use of these competences throughout the course in various settings. This continuous acquisition of the respective sub-competences is seen as an asset of the course.

6.3.1 - Research Question and Research Design

The research question for this qualitative evaluation is the following:

- What are the learning activities and learning assessments of the *Blue Engineering Course* that correspond to the 12 learning outcomes on module level?

The author of this research project undertakes this qualitative evaluation. Therefore, this is an internal evaluation. To enhance the reliability of this evaluation, the findings are discussed with selected people who were directly involved in the conduction of the course. The course material as well as the course design are the object of the evaluation. Both are publicly available on the website of the project (Blue Engineering 2018), which allows for professional scrutiny. The scope of this qualitative evaluation is the stable course design as it has been conducted since winter semester 2015/2016. As described above in chapter 3, the core elements of the course have remained similar over the whole development phase of the *Blue Engineering Course* so that this evaluation may also apply, in general, for earlier semesters.

As described in detail in chapter 5, the learning outcomes on module level are too abstract to be used directly with the learning activities and learning assessments. Therefore, the learning outcomes on module level need to be refined through learning outcomes on both block and activity levels, respectively. However, such a comprehensive qualitative evaluation lies outside of the scope of this research project as well as outside of the two research questions. Thus, the following sections only provide a summarizing overview of selected learning activities and learning assessments which are linked to the 12 learning outcomes on module level.

6.3.2 - Problem Area

The research question of this section addresses the design of the entire *Blue Engineering Course*. The design with regard to content and methods is described in detail in chapter 3 of this research project. The course design is complex with regard to the learning outcomes in a twofold way. First, the learning activities and learning assessments hardly address one specific learning outcome on module level alone but are rather designed to address several learning outcomes on module level at once. Second, the various learning activities and learning assessments are highly interdependent and thus require the use of various competences at the same time as well as a continuously growing competence-level. Both factors are favorable assets of the learning environment as the students will have several opportunities to show the corresponding competences and to acquire them continuously throughout the entire course.

6.3.3 - Data Collection

All data used for this qualitative evaluation is publicly available on the website of the *Blue Engineering Course* (2018). This includes the overall course design used in the past semesters as well as a comprehensive documentation of each building block. In addition, the course design has been described in detail in chapter 3 of this research project. The focus of this evaluation lies in the core building blocks and the learning assessments of the course. Each element has been analyzed with regard to the degree it contributes to the students reaching the learning outcomes on a module level. To ensure validity, this analysis has been discussed with three persons who are part of the extended core team introduced in sub-chapter 5.1. Adjustments have been done accordingly.

6.3.4 - Data Analysis

In the following sections, the learning activities and learning assessments that mostly contribute to each learning outcome on module level are briefly presented. In addition, the context as well as a brief discussion of these activities and assessments are given in order to provide a better understanding of how they contribute to the learning outcomes.

T1-BE - Students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, society and nature.

This learning outcome is addressed across the whole curriculum and design of the *Blue Engineering Course*. This starts already in the very first lesson where the participants first identify and reflect on their personal understanding of responsibility which they will then discuss in small groups with their fellow students. Overall, the course is highly encouraging discussion among students so that they will get in contact with a plurality of standpoints and views on all topics addressed during the course.

This learning outcome is specifically addressed in the second lesson which is based on the topic of plastics. The underlying core building block *Plastics* is designed as a combination of building block, knowledge chest (Baier and Pongratz 2013) and e-learning. First, the students perform a 30 minute long e-learning exercise at home. Online, the students gain knowledge on various issues linked to plastics, i.e. economic strength of the plastics industry in Europe, plastic waste in the oceans, and particularities of the German bottle deposit system. Second, at the beginning of the class, they have time to explore the knowledge chest. This is an exhibition of over 30 posters, video files, audio files and over 30 artifacts which showcase different facets of plastics from varying perspectives. Lastly, the students participate in a building block that consists of comprehensive role play of 90 minutes length for four subgroups on the topic of Bisphenol A. Here, they take the roles of concerned citizens, 'neutral' scientists, representatives of the plastics industry and of an advisory committee that has to work out a final statement. Through this building block they get to know possible benefits, concerns and dangers of Bisphenol A. The general outcome of this is the actual or wished-for neutrality of the sciences as well as the relation of science and politics. At the end of the building block, the whole topic and process are transposed onto other technologies and the political controversies that arise from it, i.e. Glyphosate or nuclear power. In addition, this learning outcome is also especially addressed in the core building block on the *TINS-D Constellation* and the core building block on *Gender, Diversity and Technology*.

T2-BE - Students anticipate spatial and temporal effects of technology on individuals, society and nature.

There are two building blocks that emphasise the competence to anticipate spatial and temporal effects of *TINS*. In the core building block *Technology as Problem-Solver!?,* the students are divided into six groups and each group must solve the same problem of a sudden drinking water contamination but in another human age, i.e. Stone Age, Roman Empire, Middle Ages, Industrialization, Present and Future. The groups must then depict their solutions through small skits. Through this building block, they realize that technology increasingly becomes a cause for possible contaminations of water and nature while creating congruent solutions. Thus, the participants realize how society is shaping technology and how technology is shaped by society in return. This includes notably the spatial and temporal effects of technology. Secondly, the core building block on *The Productivistic Worldview* gives a historical overview of the development of technology and western society since the early days of industrialization up until the present which includes a distinct outlook on possible future developments.

T3-BE - Students gain knowledge of the reciprocal relations between technology, individuals, nature and society through inter- and transdisciplinary approaches.

Students acquire this competence throughout the whole course. As it is a compulsory elective in many study programs, the students already bring different disciplinary backgrounds to the course and to the learning activities through which they cooperate with each other. Furthermore, the broad range of content and methods requires students to use interdisciplinary as well as transdisciplinary approaches to perform the activities and assignments. Transdisciplinary approaches are presented through the incorporation of experts from society, e.g. representatives of a labour union. Furthermore, the core building block on *The Productivistic Worldview* directly confronts the students with the methodological approaches of philosophy and sociology with regard to the *TINS-D Constellation*. In addition, this learning outcome is further addressed through the semester project where small groups of students have to create, conduct and document a new building block. Here, a high degree of cooperation is needed, which typically includes inter- and transdisciplinary approaches.

T4-BE - Students deal with incomplete and overly complex information on the reciprocal relations between technology, individuals, nature and society and the risks, dangers and uncertainties which arise from them.

The acquisition of the competence to deal with incomplete and overly complex information requires that students first grasp the complexity of technology through unveiling its prerequisites. The first lesson starts with an activity where the students are required to list 100 material and social prerequisites to watch a video on the internet. They present social preconditions such as a reference from a friend, adequate free time, literacy, computer skills. On the material side, the participants list having access to a computer, production facilities for keyboards, ships and trucks that transport keyboards around the globe.

Other building blocks transcend the complexity of technology and address strategies for coping with missing or incomplete information including the aforementioned building blocks on *Plastics* and *Technology as Problem-Solver!?*.

In addition, this learning outcome is further addressed through the semester project of the students in which they typically start from scratch. Here, the students first have to acquire an overview so that they can select specific issues of a complex topic.

C1-BE - Students cooperate for a democratic decision-making with regard to process, result and implementation.

Since the whole concept of *Blue Engineering* is heavily influenced by the *Betzavta* pedagogy of democracy (Maroshek-Klarman and Raber 2015), this competence is a consistent theme in the course. This includes ways to address the present power relations within a course as well as the competence to organise group-processes and discussions which focus on the inclusion of as many participants as possible. In several building blocks, there is an integral part of time reserved for the reflection of group processes.

More specifically, the core building blocks, *Technology as Problem-Solver!?* and *Responsibility and Ethical Codes* contribute to democratic decision-making. In the latter, the participants discuss various case studies where engineers have encountered ethical dilemmas at their workplace. The case studies are then contrasted by a discussion of ethical codes for engineers with regard to their helpfulness, applicability and completeness.

In addition, the participants need to cooperate actively with their group member in order to conduct an existing building block as well as to create and to document a new building block.

C2-BE - Students cope with dilemmas of decision-making when values and aims are conflicting.

This competence is addressed specifically through the *Betzavta* pedagogy of democracy (Maroshek-Klarmann and Raber 2015). This pedagogy has been developed in Israel since the 1980's and provides a set of over 100 exercises which help to discover personal dilemmas of conflicting values and conflicts of aims that arise from them. The main difference between this pedagogy of democracy and other pedagogies of democracy is that the participants do not act as if they would have these dilemmas. Instead, the exercises allow the students to act according to their own understanding and will. In a facilitated phase of reflection after the exercises, the participants discover these dilemmas within themselves and may be more aware of them in other everyday situations. The general idea of *Betzavta* is heavily integrated into the overall *Blue Engineering Design* as well as into various building blocks, i.e. *Responsibility and Ethical Codes* and *Technology as Problem-Solver!?*. In addition, decision-making is also specifically addressed in the core building blocks on *Plastics* and *Work, Society and Labour Unions*.

C3-BE - Students participate in collective decision-making processes.

The competence to participate in collective decision-making processes is integrated at almost all stages of the *Blue Engineering Course*. The participants are constantly involved in various group and decision-making processes as the building blocks are all highly interactive and require final decisions. The participants also have to work together in groups of three to five participants to conduct an existing building block as well as to create their own building block and document it. Students are supported in their project with methods to organise their group processes as well as to improve the decision-making within their group. Thus, they acquire this competence through by constant practice throughout the course.

C4-BE - Students motivate themselves and others to democratise the reciprocal relations between technology, individuals, nature and society.

There are two central assessments which address this learning outcome. First, they have to conduct an already existing building block on their own in a group of students. For this, they can choose from a selection of 150 building blocks which they will use to create an interactive 60-minute building block on a specific topic. Secondly, by requiring the participants to create a new building block on their own as their semester project, they motivate themselves to pursue their passions. When conducting this newly created building block, they also motivate others to consider what they have just learned and to act accordingly. At the end of the semester, they document their newly created building block for further use which aims at motivating others to conduct this new building block on their own. Through these two assessments, they create both valuable teaching and learning experiences for themselves and others. This considers internal and external motivation as well as a democratic decision-making within their student group.

A1-BE - Students reflect principles which control the reciprocal relations of technology, individuals, nature and society.

This learning outcome is especially addressed through the core building block that introduces the *TINS-D Constellation* to the participants. This core building block includes the course's one and only ex-cathedra lecture of 25 minutes length where the *TINS-D Constellation* is introduced. This goes along with a clarification of each notion as well as their reciprocal relations. After this introduction, the participants engage in a constellation activity where they choose a position at one of the five coordinates based on their personal liking at that moment in time. They continue with a series of activities such as joining up with all five poles in a group in which they analyze the reciprocal relations and apply the constellation on a concrete topic of their choosing. In addition, the *TINS-D Constellation* is woven throughout the entire course and is used at the end of every lesson in order to connect the topics over the whole semester and to unveil underlying principles that are present in different topics.

A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.

Besides the recurrent *TINS-D Constellation* and the general setup of the course, it is mainly the building block on *The Productivistic Worldview* which helps to identify the underlying values that shape the current reciprocal relations of *TINS-D*. As this building block is based on a blended learning concept, the participants read an essay of the same title ahead of the activity in class (Ullrich n.d.). The text has a distinct techno- and socio-critical theoretical approach, which is based heavily on the works of the early Frankfurt School. Despite its short length, it gives a thorough historical overview of the role and development of technology with respect to individuals, nature, society and democracy. The activity in class is to reconstruct, analyze and critique this essay in small groups whose members continually change according to a predefined pattern. In the end, there is a general discussion on the main theses of the essay. Overall, the students are required to apply the main findings of this essay as well as the *TINS-D Constellation* throughout the entire course as they analyze the different topics that are addressed accordingly.

A3-BE - Students plan independently and act autonomously according to one's own values.

This competence is acquired through a number of activities within class, i.e. through certain elements of the *Betzavta* pedagogy of democracy or through the development of new building blocks according to one's own values, concerns and understandings. In addition, it is addressed in the core building block on *Responsibility and Ethical Codes* where the participants identify their personal values and apply them to various case studies that are based on the professional life of engineers. Furthermore, this learning outcome is reached through several activities that are linked with the *TINS-D Constellation* through which the students analyze and evaluate the scope of their individual actions. Lastly, the participants need to reflect in a learning journal how each lesson affected them later on during the week. Here, for instance, many students write after participating in the core building block on *Plastics* that they decided to reduce their use of plastic bags or how they made a wager with their flatmates that the first person who buys plastic bottles has to cook an organic dinner for everyone.

A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.

There are numerous elective building blocks which cover topics such as South-North-relations, development cooperation, technology transfer, international mining, exploitation and social justice. These are frequently chosen by groups for their semester projects. There are also two core building blocks where the participants gain an understanding of oppression and discrimination in their own country and how to tackle related issues. The first building block *Work, Society and Labour Unions* is a series of short presentations and short movies, followed each by a discussion with a labour union representative. In the second building block, *Gender, Diversity and Technology*, the participants engage in a spatial spectrum game which unveils the discrimination and oppression of minorities in the design of technology and within German society as a whole. This includes but is not limited to women, trans-persons, second or third generation migrants, refugees, disabled persons, elderly, non-heterosexuals, people living on social welfare and school dropouts.

6.3.5 - Conclusion

The research question for this sub-chapter is aimed at clarifying the links between the learning activities/learning assessments of the *Blue Engineering Course* and the 12 learning outcomes on module level. The qualitative evaluation has shown that every learning outcome on a module level is addressed by various activities and assessments. In addition, several learning outcomes are regularly addressed throughout the entire course. Overall, the design of the *Blue Engineering Course* requires a continuous use of the 12 sub-competences of *Gestaltungskompetenz* across all lessons and during the group assessments which are mostly prepared outside of class. Therefore, the participants do not need to acquire these sub-competences by a single use but they may reach a higher competence level by continuity and the necessity to show these competences in varying circumstances.

6.4 - Triangulation of Qualitative Data and Quantitative Data of Three Core Building Blocks

Building upon the qualitative evaluation of the previous sub-chapter, this sub-chapter will provide an evaluation that triangulates qualitative data and quantitative data from various sources. This triangulation will show that the 12 learning outcomes on module level are addressed through a series of learning activities within three selected core building blocks. For this, the corresponding activities will be presented and a quantitative survey will show that the students perceive themselves as using the underlying sub-competences of *Gestaltungskompetenz*. This finding is further supported by a similar quantitative survey among the tutors of the course as well as an external observer.

6.4.1 - Research Question and Research Design

The overarching research question for this sub-chapter is the following:

- Do the students of the *Blue Engineering Course* use the 12 sub-competences of *Gestaltungskompetenz* which form the corresponding 12 learning outcomes on module level?

This overarching research question is broken down into the following research questions:

- What are the learning activities of three selected core building blocks with regard to the 12 learning outcomes on module level?
- What is a quantitative test design that measures the perception of the use of the 12 sub-competences of *Gestaltungskompetenz* at the end of a lesson or at the end of a course?
- To what degree do the participants of a core building block perceive themselves using the 12 sub-competences of *Gestaltungskompetenz*? To what degree do tutors and an external observer perceive that the students of a core building block use the 12 sub-competences of *Gestaltungskompetenz*?

These research questions will be addressed through an inter-coordinated qualitative and quantitative evaluation. This leads to a triangulation of data where the reliability of the overall evaluation is increased if the findings mutually support each other.

The following three core building blocks will be the object of this evaluation: *Responsibility and Ethical Codes, Technology as Problem Solver!?* and *The Productivistic Worldview*. These three core building blocks are chosen over other building blocks as they are part of the three rotating core building blocks. Therefore, they were conducted a minimum of three times each semester. This will allow for a comparison within each semester as well as for a profound comparison across selected semesters. The overall evaluation will be coordinated by the author of this research project which makes it an internal evaluation. However, there is an external evaluator involved in this evaluation. She is a former participant of the *Blue Engineering Course* and worked closely with the author in designing this evaluation. This includes the qualitative evaluation of the three core building blocks as well as designing and conducting the quantitative evaluation.

The documentation of the three selected core building blocks will be used for the qualitative evaluation. The documented activities, content and methods will be analyzed with regard to the 12 learning outcomes on module level. A first classification was undertaken by the author of this research project which was then revised by the external evaluator.

The quantitative evaluation is inspired by the concept of evidence-based methods of diagnosis of classroom instruction (Helmke and Helmke 2017). The design of this diagnostic test is based on the work of John Hattie, especially on his seminal work *Visible learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement* (2008). Here, John Hattie identified a series of factors and analyzed them whether they support students in learning or hinder them respectively. This also includes the question, if students perceive themselves, doing what is intended by the learning activities and learning assessments. In addition, this diagnostic test is designed as a triangulation of what the students perceive in class as well as what the conductor of a building block is perceiving in class. Ideally, these two perspectives are complemented by an external observer.

The basis for this evaluation is a quantitative test that contains the same items written from the viewpoint of the three involved parties, that is students, conductor of a building block and observers. Each item is to be rated on a 4-point Likert-scale at the end of a lesson. The intent of this type of evaluation is to give a concrete feedback to what degree the perceptions of the students, the conductor and the observer are aligned. Solely comparing the values or doing statistical tests are not suggested to interpret the data, but it is rather recommended to individually interpret the data for oneself or through a collegial coaching (Helmke et al. 2018). The items for this quantitative evaluation will be partially based on the existing items of the evidence-based diagnosis of classroom instruction. However, new items will also be designed based on the 12 learning outcomes on module level which will be described in one of the following sections.

6.4.2 - Problem Area

The role of the core building blocks in the design of the entire *Blue Engineering Course* is sufficiently described in chapter 3. This description also includes the design of the three selected core building blocks for the research documented in this sub-chapter: *Responsibility and Ethical Codes, Technology as Problem Solver!?* and *The Productivistic Worldview*. As described above, each of the three tutors specializes in one of the three core building blocks so that they gain a certain competence and professionalisation in conducting the respective core building block. However, the general idea of building blocks still remains that they are documented so well that almost anybody may easily prepare them. Therefore, the building blocks, including the more demanding core building blocks, are not so complex that a specialist is needed to conduct them properly. This is also reflected on the student side as in general they may come to class unprepared since no special preparation is needed to actively attend and participate in the building block. An external observer may perceive the use of various competences during each of the three core building blocks as they comprise various activities that are carried individually by the students, in small groups as well as with the whole group.

6.4.3 - Design of the Perception-Based Test

The general aim of the perception-based test is to identify whether the students perceive themselves using the 12 sub-competence of *Gestaltungskompetenz* as well as to check if the tutors and an external observer perceive that the students are using these sub-competences. As described in chapter 5, the sub-competences form the basis of the 12 learning outcomes on module level. Hence, these learning outcomes are adapted as items for the questionnaire of the perception-based test. Accordingly, a minimum of 12 test items are required in order to test all of the facets of *Gestaltungskompetenz*.

The design of the items for the perception-based test was started after the design of the 12 learning outcomes on module level was completed. Apart from the persons in charge of the course, only the observer and former student was involved in this design process. The premises for the process was to design at least one test item linked to each of the 12 learning outcomes on module level. For this, the rather complex learning outcomes on module level were freely associated by the team with concrete activities of the core building blocks. This collection was then analyzed and clustered. Next, suitable test items were generated and internally tested. The creation of the test items also comprised two pre-tests with the student tutors of the course.

Overall, the learning outcomes on module level are now all linked with at least one item of the perception-based test, see Table 11. The learning outcomes *T1-BE, C1-BE, C3-BE, C4-BE, A1-BE, A2-BE* and *A4-BE* are linked with two or three test items as they are more complex learning outcomes or have been judged more essential for the *Blue Engineering Course*. The items have been designed in German and the perception-based test was also issued in German. It is only for the documentation of this research project that the items have been translated into English by the author.

Table 11
Items of the Perception-Based Test
Comparison of Sub-Competences of *Gestaltungskompetenz*, Learning Outcomes of the *Blue Engineering Course* on Module Level and Items of the Perception-Based Test.

Sub-Competences of *Gestaltungskompetenz* (de Haan 2010)	**Learning Outcomes of the Blue Engineering Course on Module Level**	**Items of the Perception-Based Test**
T1 - Perspective-Taking - to gather knowledge in a spirit of openness to the world, integrating new perspectives	T1-BE - Students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, society and nature.	T1.1 - During the lesson I got to know different perspectives/standpoints and I appreciate that. T1.2 - I perceive other opinions than mine as a personal enrichment.
T2 - Anticipating - to think and act in a forward-looking manner	T2-BE - Students anticipate spatial and temporal effects of technology on individuals, society and nature.	T2.1 - During the lesson I dealt with the temporal and spatial effects of technology.
T3 - Gaining Interdisciplinary Knowledge - to acquire knowledge and to act in an interdisciplinary manner	T3-BE - Students gain knowledge of the reciprocal relations between technology, individuals, nature and society through inter- and transdisciplinary approaches.	T3.1 - I acquired knowledge outside of the scope of my proper discipline during the lesson.

T4 - Dealing with Incomplete and Overly Complex Information - to deal with incomplete and overly complex information	T4-BE - Students deal with incomplete and overly complex information on the reciprocal relations between technology, individuals, nature and society and the risks, dangers and uncertainties which arise from them.	T4.1 - I dealt with incomplete and overly complex information during the lesson.
C1 - Cooperating - to co-operate in decision-making processes	C1-BE - Students cooperate for a democratic decision-making with regard to process, result and implementation.	C1.1 - I cooperated with others in a decision-making process and implemented the decision.
C2 - Coping with Dilemmas of Decision-Making - to cope with individual dilemmatic situation of decision-making	C2-BE - Students cope with dilemmas of decision-making when values and aims are conflicting.	C2.1 - I dealt with conflicting values and aims during the lesson.
C3 - Participating - to participate in collective decision-making processes	C3-BE - Students participate at collective decision-making processes.	C3.1 - I felt encouraged to participate in the discussions. C3.2 - The contributions of others were appreciated during class. C3.2 - If I wanted to, I could participate in the discussions.
C4 - Motivating - to motivate oneself as well as others to become active	C4-BE - Students motivate oneself and others to democratize the reciprocal relations between technology, individuals, nature and society.	C4.1 - The lesson motivated me to become active outside of the course. C4.2 - I motivated others to become active because of the course.
A1 - Reflecting Principles - to reflect upon one's own principles and those of others	A1-BE - Students reflect principles which control the reciprocal relations of technology, individuals, nature and society.	A1.1 - During the lesson I dealt with principles other than my own principles. A1.2 - I reflected the principles and attitudes of others during the lesson.
A2 - Acting Morally - to refer to the idea of equity in decision-making and planning actions	A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.	A2.1 - During the lesson I dealt with my personal responsibility. A2.2 - Along with others, I dealt with our joint responsibility.
A3 - Acting Independently - to plan and act autonomously	A3-BE - Students plan independently and act autonomously according to one's own values.	A3.1 - During the group works, I could work indepently of the tutor.

A4 - Supporting Others - to show empathy for and solidarity with the disadvantaged	A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.	A4.1 - During the lesson I dealt with the situation of people who are currently disadvantaged. A4.2 - If someone wanted to, that person could join the discussion.

The items remained unchanged over the whole testing period. Every item was to be assessed on a 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*. The test items were adapted with regard to the person expected to fill out the test, that is students, tutors and external observer.

Furthermore, these items have been adapted for an additional test to not only reflect a single lesson but to reflect the entire course, which is to be given out at the end of a semester. In addition to these test items, the test contained several more items which are not relevant for this evaluation since they do not correspond to one of the 12 learning outcomes on module level. Instead, these additional test items reflect other aspects of the original evidence-based test as well as items reflecting other elements of the course, such as the keeping of the learning journal or the *TINS-D Constellation*.

The perception-based test was designed using EvaSys, Version 7.1, which is the evaluation software provided by the Strategic Controlling Working Group of *Technische Universität Berlin*, see Appendix - Perception-Based Test - Questionnaires.

6.4.4 - Data Collection

The time frame for this comprehensive evaluation is the summer semester 2017 and the consecutive winter semester 2017/2018. In summer semester 2017, the course was conducted as outlined by the exemplary lesson plan, see Table 1. In winter semester 2017/2018 there was an unexpected increase of participants from normally 75 to 120, so that spontaneously a fourth parallel running session was implemented. This included also a new fourth core building block. Thus, with regard to the data collection each core building block is conducted seven times, that is three times in the summer semester and four times in the winter semester.

The data collection for the qualitative evaluation follows the method described in the previous sub-chapter for the qualitative evaluation of the whole *Blue Engineering Course*. The qualitative evaluation is based on the analysis of the documentation of the three selected core building blocks. The design, the content and the methods of each core building block are clustered with regard to the 12 learning outcomes on module level. Careful attention is given to the previously described complex characteristics of the learning activities as they may address several learning outcomes at once.

The data collection for the quantitative evaluation is based entirely on the perception-based test. The test was given out on paper by the tutors to the students at the end of each lesson. The participants were asked to fill out the test as it is part of the official evaluation of the test. The students were expressly assured, that the test is anonymous and the results are only used for the evaluation and not in any part of their assessment. The participation was voluntary, yet the students participated readily as enough time was given during the lesson to fill out the test. The tutors filled out their test at the same time. During the summer semester 2017, the external observer was present while three different core building blocks were conducted. During the winter semester 2017/2018, she was present as the building block on *Technology as a*

Problem-Solver!? was conducted to the four different groups. She filled out the test at the same time as well. The filled out tests were scanned using EvaSys, Version 7.1, and combined in one table, see Appendix - Perception-Based Test - Data Collection.

The following table shows the number of returned tests for each core building block and each semester, see Table 12. The following naming convention is used to identify the two semesters: The suffix *_1* stands for the summer semester, while the suffix *_2* stands for winter semester, e.g. *2017_1* is the summer semester of 2017 and *2017_2* is the following winter semester of 2017/2018. In addition, a second suffix *-1, -2, -3 or -4* is added as identifier for the date of data collection.

Table 12
Returned Questionnaires of the Perception-Based Test

	Semester	**Responsibility and Ethical Codes**	**Technology as Problem-Solver!?**	**The Productivistic Worldview**
Participants	2017_1-1	14	16	19
	2017_1-2	25	23	22
	2017_1-3	19	22	20
	2017_2-1	3	22	22
	2017_2-2	12	22	19
	2017_2-3	11	23	24
	2017_2-4	20	17	19
Tutors	2017_1-1	1	1	1
	2017_1-2	1	1	1
	2017_1-3	1	1	1
	2017_2-1	1	1	1
	2017_2-2	1	1	1
	2017_2-3	1	1	1
	2017_2-4	1	1	1
Observer	2017_1-1	0	0	1
	2017_1-2	1	0	0
	2017_1-3	0	1	0
	2017_2-1	0	1	0
	2017_2-2	0	1	0
	2017_2-3	0	1	0
	2017_2-4	0	1	0

The three responsible tutors stated that they had the impression that almost everyone participating in the respective building blocks has filled out the test. The number of returned tests filled out by students for the core building block *Responsibility and Ethical Codes* in winter semester 2017/2018 (2017_2) is roughly only half of the returned tests of the other two core building blocks in that semester. It is unknown why this number is so low in comparison, especially because the tests were filled out at each of the four dates. As mentioned above, the tutor stated that almost everyone had filled them out in each lesson and that she has probably misplaced a stack of filled out forms somehow.

There are several tests which have been filled out by students and which have been excluded from the data analysis as students did not mark in which core building block they had participated, for the summer semester 2017 that is 17 tests and for the winter semester 2017/2018 that is 8 tests.

The return rate is given in relation to the number of participants who registered for examination and the number of returned tests. Overall, the return rate of tests filled out by the students is satisfying for both semesters. The return rate for the summer semester 2017 is around 70 % and around 77 % for the following winter semester, if the filled out tests would not have been lost, that is 86 students in summer semester 2017 and 108 students in winter semester 2017/2018. The return rate of the tutors as well as of the observer is 100 % for each building block and each semester.

In addition to the testing of the three core building blocks, an adapted version of the test was also given out during the last lesson of the winter semester 2017/2018. The objective of this additional test Here again, the participation was anonymous and voluntary and the participants had enough time to fill out the test during the lesson. It was the impression of the tutors that most of the participants filled out the test. In total, 78 filled out tests were received which is a return rate of around 72 % of the 108 students who registered for examination. This adapted version was not issued at the end of the preceding summer semester 2017 as this semester was still part of the comparative self-assessment of competences which will be presented in the following sub-chapter.

6.4.5 - Data Analysis

In the following sections, each of the three selected core building blocks will be evaluated. Each section starts with the qualitative evaluation of the documentation which will analyze how the learning activities contribute to the learning outcomes on module level. Next, the data of the perception-based test will be analyzed. This sub-chapter on data analysis will conclude with an analysis which compares the aggregated perceptions of the students of the three selected core building blocks with the perceptions at the end of the winter semester 2017/2018. The formulas and results of the data analysis are included in Appendix - Perception-Based Test - Data Analysis.

6.4.5.1 - Evaluation of the Core Building Block *Responsibility and Ethical Codes*

The core building block *Responsibility and Ethical Codes* is described in detail in chapter 3. In brief, the participants identify and reflect their own personal values and discuss them with each other mostly in small groups. This is done through the use of a set of case studies which are contrasted with ethical codes for engineers. The following table identifies the learning activities of the core building block that correspond to the 12 learning outcomes on module level, see Table 13.

Table 13
Responsibility and Ethical Codes - Learning Activities Corresponding to the Learning Outcomes on Module Level

Learning Outcomes on Module Level	**Learning Activities of the Building Block *Responsibility and Ethical Codes***
T1 - Perspective-Taking	The participants analyze case studies which describe different aspects of the professional work life of engineers. They analyze these case studies based on existing ethical codes.
T2 - Anticipating	Based upon their individual and collective values, the participants design their own ethical codes through which they deal with aspects of their future professional work life. This includes anticipating the future development of work, e.g. digitalization.
T3 - Gaining Interdisciplinary Knowledge	The participants already bring different academic backgrounds to the lesson so that the lessons itself becomes an interdisciplinary activity. In addition, the participants get to know a specific pedagogy of democracy as well as a value theory.
T4 - Dealing with Incomplete and Overly complex Informations	The case studies present complex cases and there so no general guideline on how to deal with these. In addition, the cases are contrasted with ethical codes which identify values that are worth upholding despite changing environments - yet often neglected.
C1 - Cooperating	Apart from the identification of individual values, all of the activities are group activities, e.g. the working on the case studies and contrasting them with an analysis of existing codes.
C2 - Coping with Dilemmas of Decision-Making	The case studies call for an explicit decision-making although dilemmas are known. The *Betzavta* pedagogy is introduced in this building block and the general awareness for dilemmas is strengthened as this may help to cope with dilemmas.
C3 - Participating	The discussions and group works of the entire *Blue Engineering Course* are facilitated in such a way as to encourage and integrate every participant. This includes reflections of the ongoing processes as well as special techniques to facilitate discussions.
C4 - Motivating	Dealing with the case studies intends to motivate the participants to unveil their individual values and to do so in their future work life as engineers. This includes encouraging others to identify their values and to jointly reflect them in a work context.
A1 - Reflecting Principles	By working on the case studies and ethical codes, the participants identify and reflect their personal values and principles. This is done in order to start a joint reflection in small groups on individual and collective values as well as principles.
A2 - Acting Morally	Although the participants are not in the position to act morally in a concrete working situation, they are facing similar dilemmas and complexities through the case studies. In addition, based on ethical codes they analyze these case studies and identify actions.
A3 - Acting Independently	Through working on the case studies and the ethical codes, the participants identify their own values as well as collective values.

	This is an emancipating act in itself and helps to act independently within with one's own environment.
A4 - Supporting Others	The analysis of the case studies and ethical codes shows that they are often considering the role of less privileged persons and intend to support their cause. This may help the students to realize there are people in their environment that need their support.

The qualitative evaluation has shown that each learning outcome on module level is addressed through the learning activities of the core building block *Responsibility and Ethical Codes*. It remains the question if the participants of this building block perceive themselves as actively using the underlying sub-competences of *Gestaltungskompetenz*. The means of the students for the perception-based test show similar results for each item of the test and for each time the building block is conducted, see Figure 8. It is only the third conduction of the winter semester 2017/2018 which visibly sticks out from the others. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

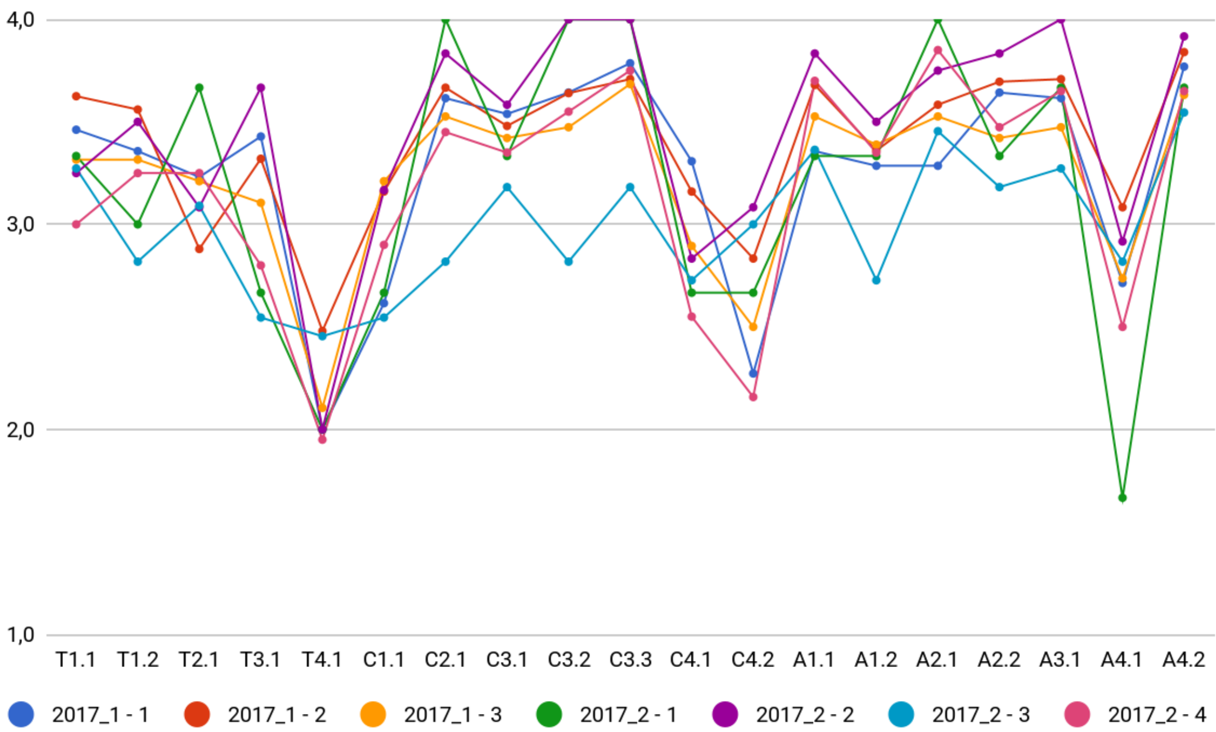

Figure 8 - Responsibility and Ethical Codes - Students' Means for Each Conduction of the Building Block in different sub-groups per semester

With regard to the items, there are four items that visibly stick out with a comparably low mean. Item *T4.1* asks if the students dealt with incomplete and overly complex information. Supposedly, the students applied this item on the complexity of the actual activities within the lesson, in contrast to the characteristics of the actual case studies and ethical codes. Items *C4.1* and *C4.2* address the self-motivation and the motivation of others to become active. This is an issue that can be addressed better in the future by incorporating possible concrete actions that the students can do themselves once they leave class. Item *A4.1* addresses the situation of disadvantaged and non-privileged people.

Overall, the participants clearly responded that they are using the 12 sub-competences. This is further underlined as the mean is 3,3 on a 4-point Likert-scale across all items and across all conductions.

A comparison of these results with the means of the tutor and the one-time observation of the external observer is in line with the perception of the students. Figure 9 also shows that the latter two are congruent with the students in their regard of items *T4.1, C4.1, C4.2* and *A4.1*. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

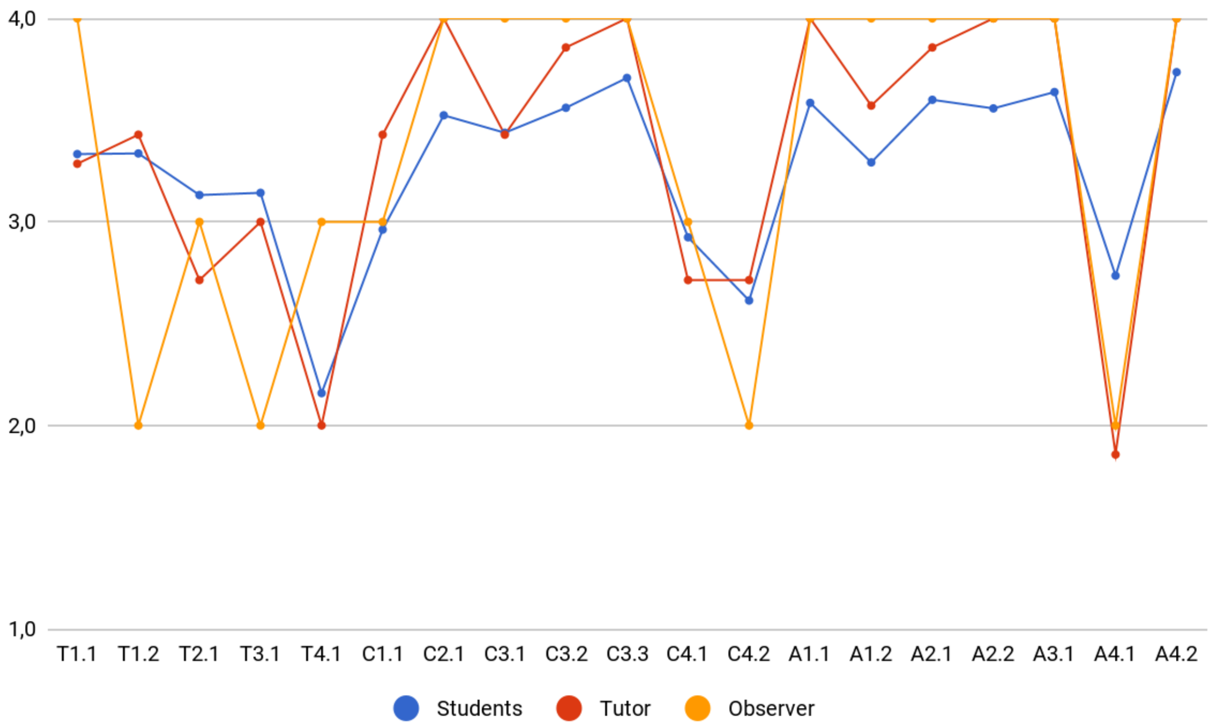

Figure 9 - Responsibility and Ethical Codes - Aggregated Means of Students, Tutor and Observer

Overall, the triangulation of the qualitative evaluation and the threefold quantitative test across seven lessons in total shows that the core building block *Responsibility and Ethical Codes* addresses the 12 sub-competences of *Gestaltungskompetenz* through its learning activities. Particularly, three sub-competences can be addressed more prominently in this building block. However, as this is only one lesson of 14 lessons in total, these sub-competences might also be addressed more in other building blocks.

6.4.5.2 - Evaluation of the Core Building Block Technology as Problem-Solver!?

The core building block *Technology as Problem-Solver!?* is described in detail in chapter 3. In brief, this building block is centred around a series of short theatre plays. These plays are improvised by small groups of participants who all face the same problem as the local water supply is harmful to health. Each group faces this scenario in a different age of mankind. The following table identifies the activities that correspond to the 12 learning outcomes on module level, see Table 14.

Table 14

Technology as Problem-Solver!? - Learning Activities Corresponding to the Learning Outcomes on Module Level

Learning Outcomes on Module Level	**Learning Activities of the Building Block *Technology as Problem Solver!?***
T1 - Perspective-Taking	Each group deals with the same scenario in a different age of mankind. Therefore, the participants consider the different perspectives on technology, individuals, nature, society and democracy and on how they relate to each other.
T2 - Anticipating	One of the key findings of this building block is that all technologies will have unforeseen effects and cause future problems which themselves may then only be solved through a new technology and so on. In addition, for the future scenario, a broad range of mostly dystopian futures is anticipated.
T3 - Gaining Interdisciplinary Knowledge	The analysis of a common problem such as ensuring a healthy water supply shows that this is a rather complex issue where different needs, interests and values are conflicting. Thus, one insight is that there is not one simple solution by one discipline.
T4 - Dealing with Incomplete and Overly complex Informations	The scenario of an unhealthy water supply is already ridden with incomplete and overly complex information. Despite this complexity, the participants need to come up with an improvised theater play that shows how they want to deal with the problem.
C1 - Cooperating	The scenario already shows that cooperation is needed on societal level in order to deal with problems of water supply. The participants practice cooperation by jointly working out an improvised theater play which will display societal cooperation.
C2 - Coping with Dilemmas of Decision-Making	The scenario makes it clear from the start that not taking a decision is not an option as a healthy water supply is needed in order to survive. Next, the participants have to identify possible solutions and select several of them which they will put on stage.
C3 - Participating	Small exercises make the participants comfortable to play theater as every participant is expected to take part in the improvised theater plays. Thus, many students experience themself participating in something what they are not used to.
C4 - Motivating	This building block addresses a central part of our life but few people have sufficient knowledge on how the water supply actually works within their area. The participants therefore are motivated to especially question the technologies that are readily available.
A1 - Reflecting Principles	The water supply is a complex issue where principles and values are involved which are often mutually exclusive with each other. In addition, any form of water supply is based on various dominating power principles which are reflected in the building block.
A2 - Acting Morally	The scenario is open to free interpretation by participants and they are not expected to come up with particularly moral solutions in their theater plays. However, the theater plays are discussed within the whole group so that moral actions may be identified.

A3 - Acting Independently	The participants improvise a theater play where they will present the way how they want to deal with the situation. The subsequent analysis of their theater play helps to unveil the choices and backgrounds that they brought into their theater play.
A4 - Supporting Others	All humans need a healthy water supply in order to survive. In the discussion after the presentation of the theater plays, the question is addressed how much influence the current power/economic relations have and should have in the distribution of water.

The qualitative evaluation has shown that each learning outcome on module level is addressed through the learning activities of the core building block *Technology as Problem-Solver!?* The means of the students for the perception-based test show similar results for each item of the test and for every conduction of the building block, see Figure 10. Therefore, the participants of this building block perceive themselves as using the 12 sub-competences of *Gestaltungskompetenz* which are adapted as learning outcomes on module level for the *Blue Engineering Course*. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

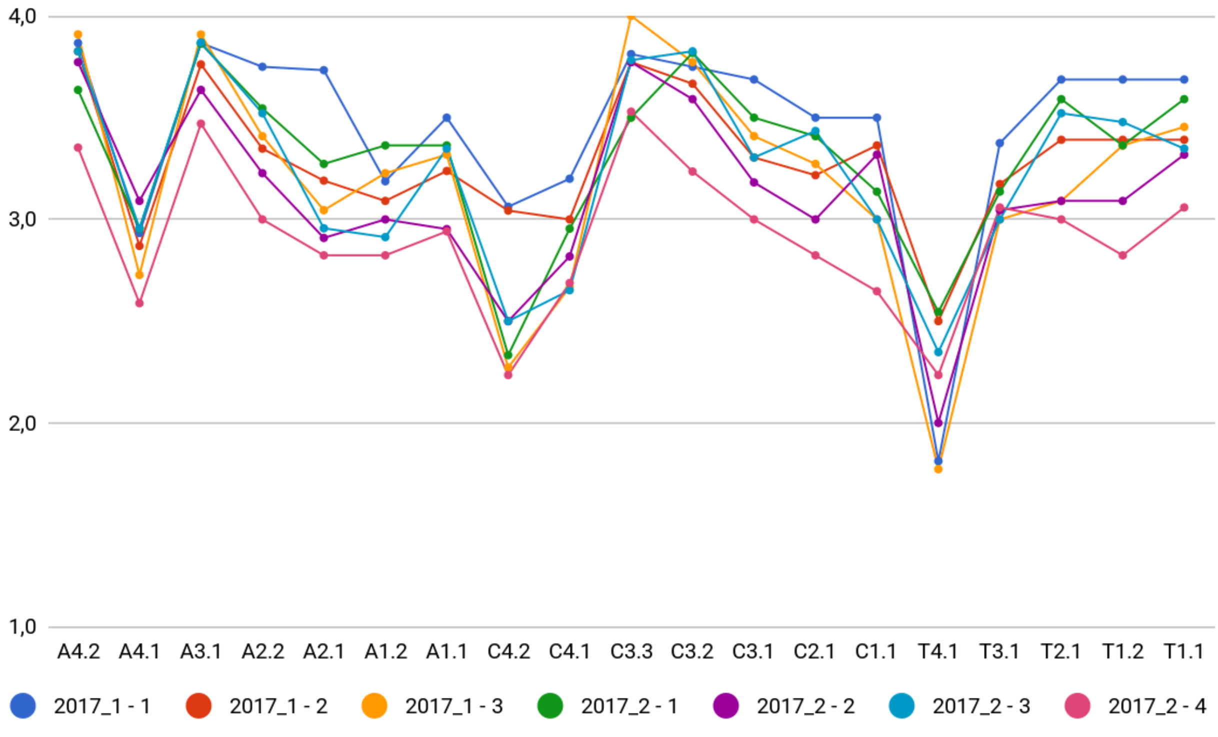

Figure 10 - Technology as Problem-Solver!? - Students' Means for Each Conduction of the Building Block in different sub-groups for different semesters

With regard to the items, this figure presents a similar case as for the core building block *Responsibility and Ethical Codes* which is analyzed in the preceding section. The same four items visibly stick out. For item *T4.1*, which addresses the dealing with incomplete and overly complex information, a similar explanation might be given. The self-motivation and the motivation of others is asked in items *C4.1* and *C4.2.* This is an issue that is not actively addressed in this building block and an incorporation is not a simple task. However, not every building block needs to address all learning outcomes on module level as long as they are sufficiently addressed across the entire semester. Item *A4.1* addresses the situation of disadvantaged and non-privileged people which is actually addressed quite clearly within the building block as the access to clean water is a central issue. In addition, the question of who suffers from pollution in contrast to the question of who pollutes is also clearly addressed.

Overall, the participants clearly responded that they are using the 12 sub-competences. This is further underlined as the mean is 3,2 on a 4-point Likert-scale across all items and across all conductions.

A comparison of these results with the means of the tutors and the five observations of the observer is in line with the perception of the students. Figure 11 shows that the mean of the observer is similar to the mean of the students in regard of items *T4.1, C4.1, C4.2* and *A4.1.* In contrast, the means of the tutor clearly shows that she is too optimistic about what is happening during the lesson. The means of items *T1.2* and *T2.1* of the external observer differ greatly from the perception of the students. No plausible explanation can be given for this as temporal and spatial effect are clearly addressed in this building block. With regard to the appreciation of other opinions, it can be pointed out that the students perceive themselves at a similar level as in the other two core building blocks. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

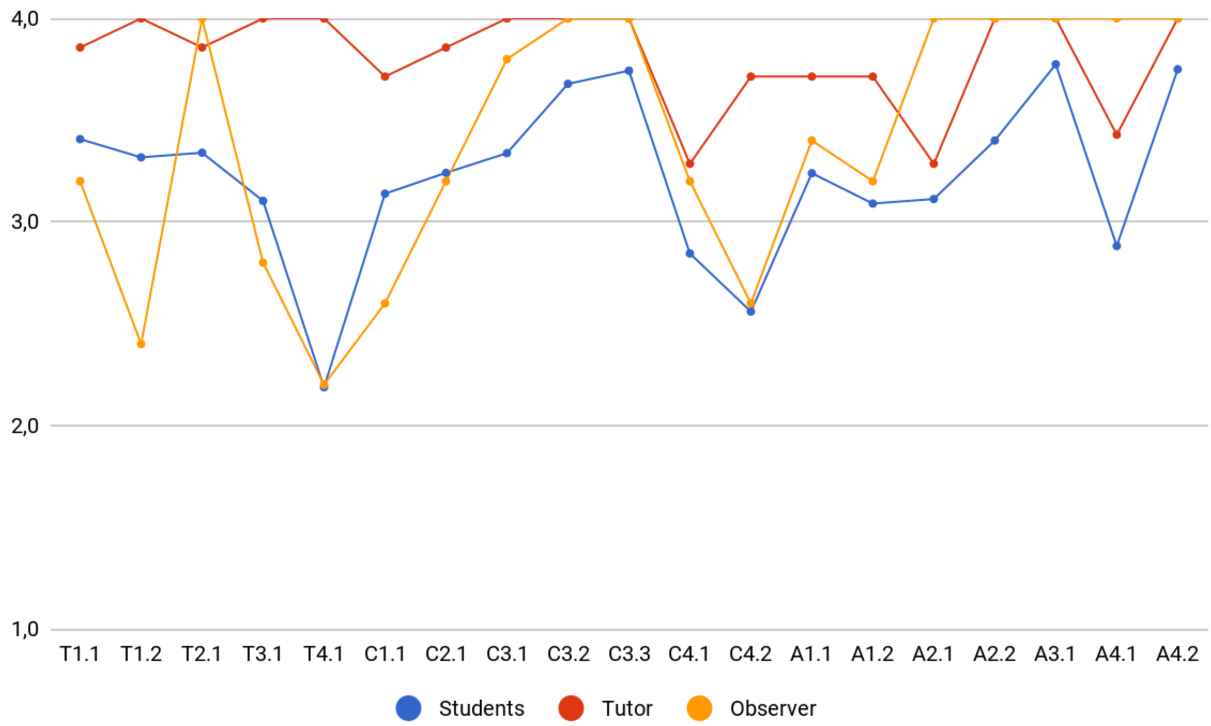

Figure 11 - Technology as Problem-Solver!? - Aggregated Means of Students, Tutor and Observer

The triangulation of the qualitative evaluation and the threefold quantitative test across seven lessons shows that the core building block *Technology as Problem-Solver!?* addresses the 12 sub-competences of *Gestaltungskompetenz* through its learning activities. It is only again the same three sub-competences which could be addressed more prominently in this building block. This particularly applies to sub-competence *A4 - Supporting Others* as this is a central part of the building block.

6.4.5.3 - Evaluation of the Core Building Block The Productivistic Worldview

The core building block *The Productivistic Worldview* is described in detail in chapter 3. It is based on the essay of the same title by Otto Ullrich (Ullrich n.d.). The participants analyze and discuss the various key issues of this essay. This is done in a combination of individual work, small group work and whole group discussions. Thus, the concrete learning activities are not the central aspect but only the content of the essay and its proper analysis. Subsequently, the following table will not focus on the concrete activities that correspond to the learning outcomes on module level but rather on the content of the activities, see Table 15.

Table 15

The Productivistic Worldview - Learning Activities Corresponding to the Learning Outcomes on Module Level

Learning Outcomes on Module Level	**Learning Activities of the Building Block *The Productivistic Worldview***
T1 - Perspective-Taking	The essay and its analysis confront the participants with several perspectives - from the inside and outside of academia - on the current reciprocal relation of technology, individuals, nature and society as well as their historical development.
T2 - Anticipating	The essay and analysis first unveil the historical conditions of the present. Building upon this, the essay forecasts the current developments into the future. This view is contrasted with the proposition of several concrete actions that can be done today.
T3 - Gaining Interdisciplinary Knowledge	The essay in itself addresses an interdisciplinary topic. Because of its language and style, it is not a typical philosophical text. However, it is written before this background and follows typical essay structures of the humanities including its overall format.
T4 - Dealing with Incomplete and Overly Complex Informations	The essay focuses on the development of western society since the beginning of industrialisation which is an overly complex topic in itself. It is is broken down into several aspects such as the working conditions and the society-nature relations.
C1 - Cooperating	The participants cooperate in small groups as well as within the whole group in order to jointly analyze the essay. In addition, the essay analysis the high level of cooperation that was needed to shape the current society despite its focus on individualisation.
C2 - Coping with Dilemmas of Decision-Making	At the beginning of the essay, three guiding principles are introduced along with their negative counterpart that is environment/environmental destruction, justice/injustice and happiness/unhappiness. They are seen as central dilemmas.
C3 - Participating	The essay analyzes the role of the individual within western society along with its limits to take action according to one's own responsibility. Overall, it calls for a democratization of society so that people will have the chance to take part in decisions.
C4 - Motivating	As the essay is fairly easy to read for people who are not used to reading philosophical texts, the participants might feel motivated to continue reading these kinds of texts. In addition, the text proposes several concrete actions that individuals can do.

A1 - Reflecting Principles	The whole essay in itself is a comprehensive analysis of the factors that dominate the current reciprocal relations of technology, individuals, nature, society and democracy. In addition, it provides a brief historical background of our society.
A2 - Acting Morally	The critical analysis of the current reciprocal relations of technology, individuals, nature, society and democracy is the primary object of this essay. Building upon this analysis, the essay might become the basis for others to act morally.
A3 - Acting Independently	The essay provides a thorough analysis and a series of concrete propositions on what to do. In addition, engineering students might get motivated to reflect and analyze upon what is happening in their private lives and at work.
A4 - Supporting Others	The essay takes a clear standpoint regarding the people that are currently disadvantaged and provides historical reasons. It calls for an end of discrimination so that everybody will have the chance to live happily in a just world that considers nature.

The qualitative evaluation has shown that each learning outcome on module level is addressed through the learning activities of the core building block *The Productivistic Worldview*. The means of the students for the perception-based test show similar results for each item of the test and for every conduction of the building block, see Figure 12. The test results clearly show that the participants of this building block perceive themselves as using the 12 sub-competences of *Gestaltungskompetenz*. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

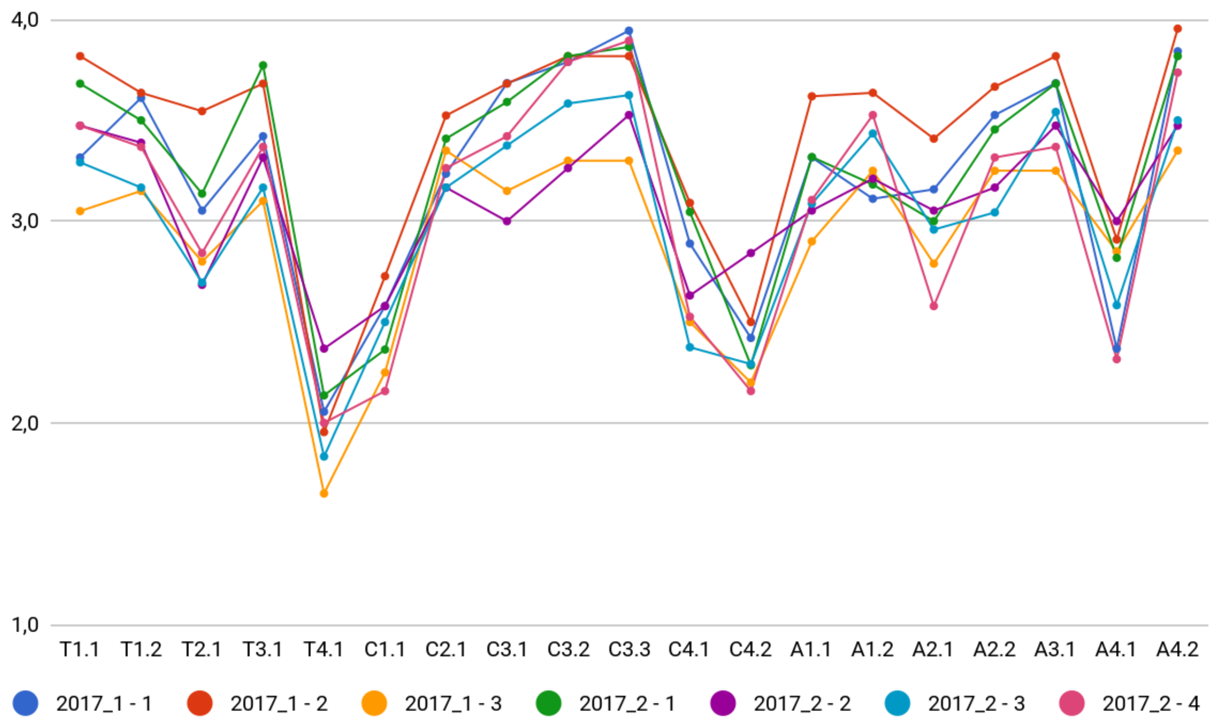

Figure 12 - The Productivistic Worldview - Student's Means for Each Conduction of the Building Block

The same four items as in the previous two analyzed building blocks clearly stand out. For item *T4.1 - Overcomplex and Incomplete Information*, again a similar explanation can be given. It seems, that the students linked this questions directly to the learning activities of the building block itself and not to the complex and incomplete information, which the content of the essay addresses. The self-motivation and the motivation of others are asked in items *C4.1* and *C4.2*. This is an issue that is not actively addressed and it is not primarily intended by the building block. Instead, it provides a clear analysis of the present state of society. Item *A4.1* addresses the situation of disadvantaged and non-privileged people which is actually addressed quite clearly in the essay itself. Therefore, this just needs to be addressed more directly during the lesson. Apart from these four sub-competences, the participants clearly responded that they are using the 12 sub-competences during the lesson. This is further underlined as the mean is 3,1 on a 4-point Likert-scale across all items and across all conductions. Item *C1.1 - Cooperation* is comparatively lower than in the other two building blocks. This may not surprise as this building block does not focus on fostering cooperation.

A comparison of these results with the means of the tutor and the one-time observation of the observer is, generally speaking, in line with the perception of the students. Figure 13 also shows that the mean of the tutor is similar to the mean of the students in regard to items *T4.1, C4.1, C4.2* and *A4.1.* In contrast, the mean of the observer fluctuates at several items. The explanation for this might be that the observer is not sufficiently familiar with the essay so that she does not accurately perceive what the students are dealing with. In addition, it should be noted that this is only a one-time observation. The dots mark the students' means, which is is the only calculated value. The lines connecting the dots have only been added to improve a visible identification of a general spread. Each item was assessed on 4-point Likert-Scale ranging from *1 - low agreement* to *4 - high agreement*.

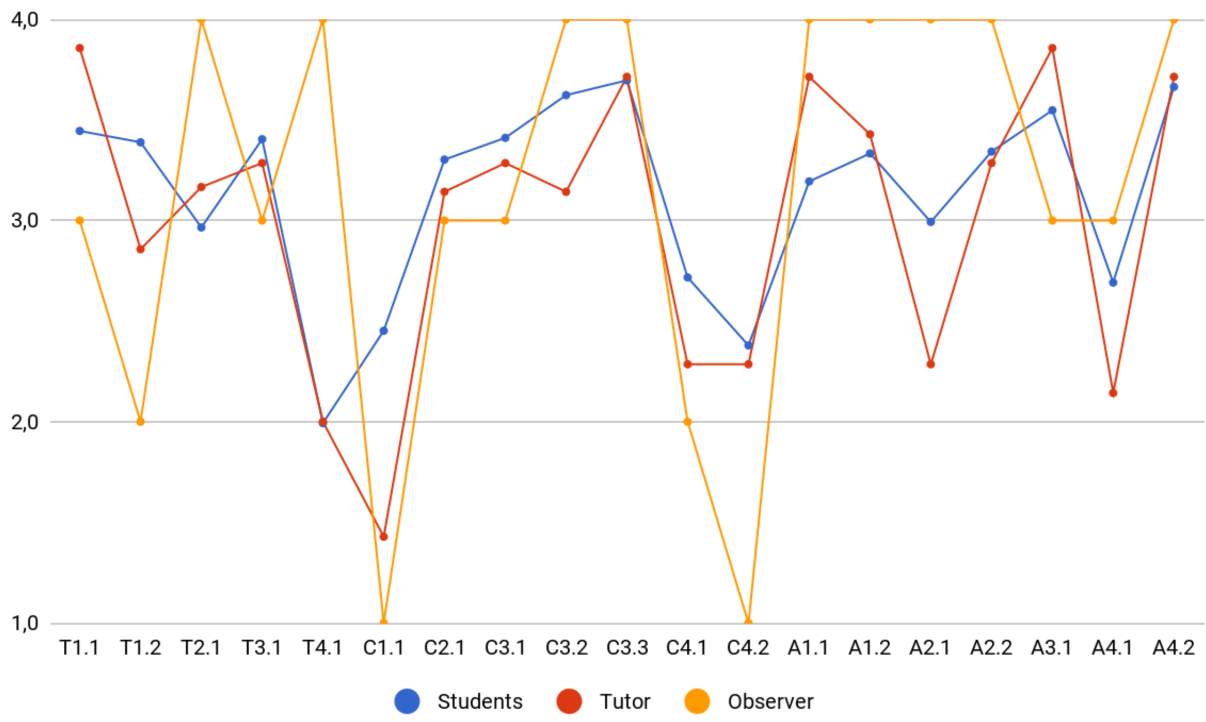

Figure 13 - The Productivistic Worldview - Aggregated Means of Students, Tutor and Observer

Overall, the triangulation of the qualitative evaluation and the threefold quantitative test across seven lessons shows that the core building block *The Productivistic Worldview* addresses the 12 sub-competences of *Gestaltungskompetenz* through its learning activities. It is only again the same three sub-competences which can be addressed more prominently in this building block. This particularly applies to sub-competence *A4 - Supporting Others* as this covers a central part of the essay.

6.4.5.4 - Comparison of the Results of the Perception-Based Test Taken During the Three Selected Core Building Blocks and at the End of the Blue Engineering Course in Winter-Semester 2017/2018

The three selected core building blocks are part of the first third of the *Blue Engineering Course*. Here, the tutors conduct the building blocks and the participants are only involved as participants. It is during this phase when the perception-based test was first issued at the end of each of the three lessons. In addition, a slightly adapted perception-based test was issued at the end of the course during the last lesson with the objective to look back at the whole winter semester 2017/2018. Therefore, the students not only participated in the core building blocks, but have also conducted an existing building block for their fellow students as well as designed, conducted and documented a new building block. Furthermore, several more topics have been covered other than the three topics of the core building blocks. The following figure shows the student's means for the three selected core building blocks as well as the student's mean at the end of the semester, see Figure 14. The lines connecting the dots have only been added to improve a visible identification of a general spread.

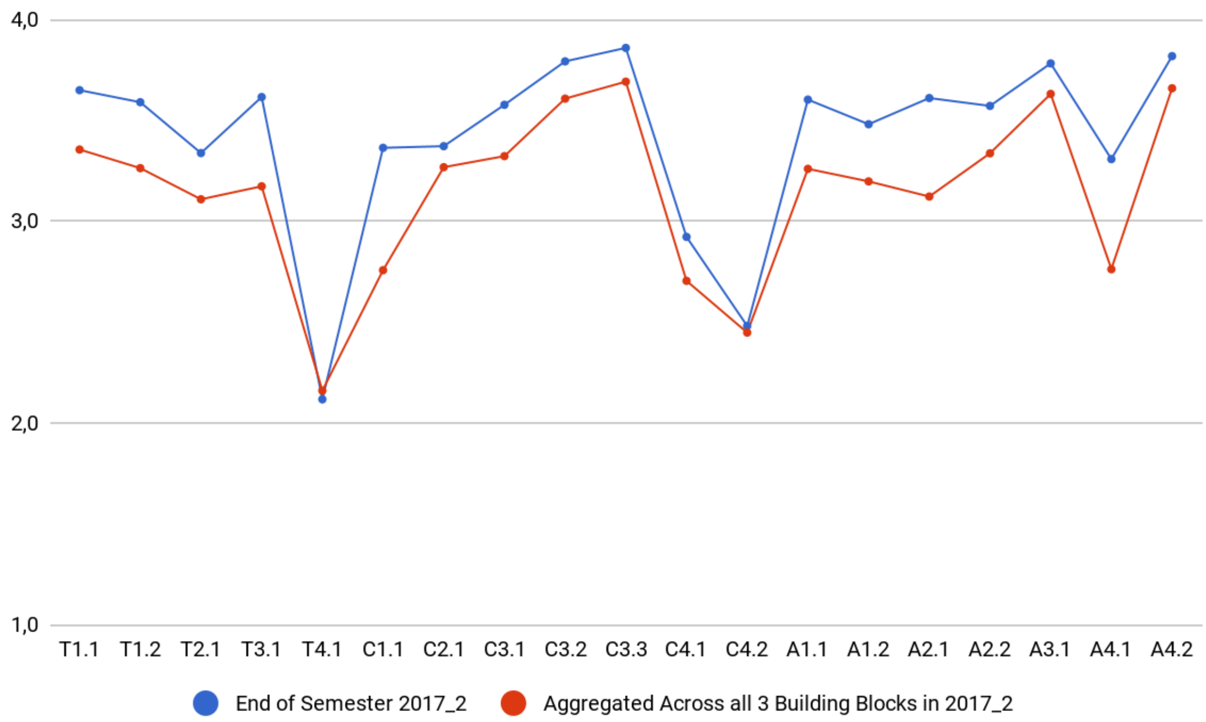

Figure 14 - Comparison of Student's Means for Aggregated Core Building Blocks and End of Winter Semester 2017/2018

The figure clearly shows that the students perceive themselves using the 12 underlying sub-competences across the whole semester. They even perceive that they have used them more across the whole semester than during the three selected building blocks alone. Item *T4.1* which addresses the sub-competence *T4 - Dealing with Overly Complex and Incomplete Information* is still comparatively low with a mean of around 2.1 on a 4-point Likert-scale. Apparently, the students do not have the impression that they have dealt with overly complex or incomplete information neither during the core building blocks nor across the whole semester. As described above, it seems possible that the students assessed this item not with regard to the content but rather related to the learning activities themselves.

Items *C4.1* and *C4.2* underline again that the sub-competence of (self-)motivation is not properly addressed during the entire course. However, the conduction of an existing building block as well as the creation of a new building block can be subsumed under this sub-competence. Nonetheless, in both cases, a future adaption of the course is desirable. In contrast, there is a clearly visible difference between the means of item *A4.1*. This shows that the situation of disadvantaged people is addressed at other points during the *Blue Engineering Course* and not primarily in the selected core building blocks. Especially two core building blocks which are conducted by the students seem responsible for this increase, that is, *Gender, Diversity and Technology* as well as *Work, Society and Labour Unions*.

6.4.5.5 - Cronbach's Alpha of the Perception-Based Test

The concept, calculation and limitations of Cronbach's Alpha are introduced in detail in the following sub-chapter on the comparative self-assessment test. For now, it suffices to understand Cronbach's Alpha as a measure for the internal consistency of a single test. Therefore, it is not feasible to aggregate the alpha values across the core building blocks or across the two semesters.

In total, there are seven independent tests, two for each core building block and the test issued at the end of winter semester 2017/2018. The following table gives the values of Cronbach's Alpha for each test, see Table 16.

Table 16
Cronbach's Alpha for Each Perception-Based Test

	Responsibility and Ethical Codes	Technology as Problem-Solver!?	The Productivistic Worldview	Test at the End of the Semester
2017_1	0,89	0,85	0,88	
2017_2	0,81	0,91	0,84	0,94

The values of Cronbach's Alpha for the seven tests range from 0,81 till 0,94. This shows a very good internal consistency of the perception-based test as Alpha values above 0,8 are generally recognized as good and values around 0,9 as excellent. Therefore, the preconditions for a reliable test are met.

The mean of Cronbach's Alpha across all of the seven independent tests is 0,87. Therefore, it can be assumed that the 19 test items are only little redundant or not redundant. Overall, the questionnaire of the perception-based test may be considered as a reliable test to measure if students perceive themselves using *Gestaltungskompetenz.*

6.4.6 - Conclusion

The overarching research question for this sub-chapter asks whether the students use the 12 sub-competences of *Gestaltungskompetenz* within the *Blue Engineering Course.* This research question is answered through a triangulation of a qualitative evaluation of three selected core building blocks and a quantitative evaluation over the course of two consecutive semesters. The criteria for this triangulation were the 12 learning outcomes on module level which are a course-specific adaptation of the 12 sub-competences of *Gestaltungskompetenz*.

A qualitative evaluation addresses *the first specific research question which asked for the learning activities that correspond to the 12 learning outcomes on module level.* The qualitative evaluation consisted of an analysis of the learning activities described in the documentation of the three core building blocks. Each selected building block clearly addressed each learning outcome on module level. In addition, the previous sub-chapter on the qualitative evaluation of the whole course provides numerous other examples how the learning activities and learning assessments correspond to the learning outcomes on module level.

The second specific research question asked for a quantitative test that is able to measure the use of the 12 sub-competences of Gestaltungskompetenz. The design of a perception-based test is inspired by the design of an evidence-based test (Helmke et al. 2018) which condensed the key findings of John Hattie's evidence-based approach to teaching and learning (Hattie 2008, 2012). For this perception-based test, the 12 learning outcomes on module level are adapted as 19 items through an iterative process. This perception-based test shows good to excellent values of Cronbach's Alpha so that the test has a satisfying internal consistency which is the precondition for any reliable test.

The third specific research question asked for a concrete use of the perception-based test and an analysis of its finding. The test was issued at the end of three selected core building block for two semesters. It was filled out by the students, the responsible tutor as well as an external observer. In addition, the test was issued to the students at the end of the second semester. The results of the quantitative evaluation show that the students as well as the tutors and external observer have a similar perception of what is happening during class and almost all 12 sub-competences are equally used during each building block as well as across the whole semester. Only three sub-competences stick out negatively. It seems that the item that corresponds to sub-competence *T4 - Dealing with Incomplete and Overly Complex Information* is not precise enough in its formulation. However, as the students have perceived in all of the respective building blocks and across all of the conductions that they had not to deal with incomplete and overly complex information it may also hint, that the students do not perceive the presented information in particular and their surroundings in general as “incomplete” and overly complex. Furthermore, it seems that the sub-competence *C4 - Motivating* is neither properly addressed in the three building blocks nor across the whole semester. Learning activities that correspond to this sub-competence can easily be included more properly in single building blocks and across the whole semester. In addition, maybe the formulation of the items needs to be reconsidered as the conduction of an existing building block as well as the creation of a new building block corresponds to this sub-competence. Sub-competence *A4 - Supporting Others* is not properly addressed during the three core building blocks, however, the student’s mean at the end of the semester shows that this sub-competence is addressed across the whole semester. However, a strengthening of this sub-competence is deemed desirable by the persons in charge of the course.

The triangulation of a qualitative evaluation and a quantitative evaluation shows that the 12 sub-competences of *Gestaltungskompetenz* are implemented in the learning activities and learning assessments of the course. The students perceive themselves as working towards the 12 learning outcomes on module level which are aligned with the learning activities and learning assessments of the *Blue Engineering Course.*

6.5 - Comparative Self-Assessment of Students based on the Learning Outcomes on Module Level

This sub-chapter will describe a quantitative evaluation of the *Blue Engineering Course* which will focus on a comparative self-assessment of the students. The questionnaire is based on the 12 learning outcomes on module level which were designed in chapter 5. The comparative self-assessment is undertaken through two different types of a *pre-post*-assessment for six consecutive semesters. With the collected data, first, the means for each item and each semester will be calculated and analyzed. Next, the collected data will be analyzed through a t-test which will show that generally speaking the self-assessment at the beginning of a course is significantly different from the self-assessment at the end of a course. Next, the comparative self-assessment gains will be calculated which will indicate robust gains in all of the 12 learning outcomes on module level. Next, the data analysis will be concluded by calculating Cronbach’s Alpha. This will indicate the reliability of the self-assessment questionnaire with regard to *Gestaltungskompetenz*. Therefore, it is reasonable to calculate a comparative gain with regard to *Gestaltungskompetenz* as this is the overarching key competence comprising all of the 12 sub-competences.

6.5.1 - Research Question and Research Design

The overall research question for this sub-chapter can be phrased as follows:

- Do the participants of the *Blue Engineering Course* acquire a higher level of *Gestaltungskompetenz* by attending the course?

This overarching research question is broken down into the following set of three research questions:

- How to generate test items for a comparative self-assessment test out of the 12 learning outcomes of the *Blue Engineering Course* on module level?
- Do the participants self-assess themselves significantly different at the beginning and at the end of the course? How large is the learning gain for each item throughout the course?
- Is the self-assessment questionnaire a reliable test for the overall *Gestaltungskompetenz* of students? What is the comparative self-assessment gain of *Gestaltungskompetenz* of the students?

The research design is inspired by a series of papers (Raupach et al. 2011; Raupach et al. 2012; Schiekirka et al. 2013; Schiekirka et al. 2014) published within the field of medical education. Here, the authors use the method of comparative self-assessment as part of the program evaluation of a medical school. Several courses are described with learning outcomes which are then used as part of the evaluation by adapting them as test items. These items are used in a comparative self-assessment of the students where they assess their competence level. The results of the self-assessments at the beginning of a course are then compared with the self-assessments at the end of the course. At first, these were actual tests at the beginning and at the end of a semester, but then their research showed that a single test at the end is sufficient enough and yields similar results. This reduced testing is based on a test at the end of a semester with paired items, where the students, first, are asked to self-assess their competence level as it is seen now and second, how they assess their competence level looking back at the beginning of a semester (Schiekirka et al. 2014). Overall, the tool of a comparative self-assessment test only yields reliable results on a group level and not on an individual level (Schiekirka et al. 2013). Therefore, it seems save to use this method to evaluate the *Blue Engineering Course* on module level.

All research questions are addressed by a common questionnaire through which the students self-assess their own competences with regard to the 12 learning outcomes on module level. These 12 learning outcomes of the *Blue Engineering Course* are the result of a design down process which specified the two learning outcomes on general level. The 12 sub-competences of *Gestaltungskompetenz* formed a second component of this design process. See chapter 5. However, the learning outcomes on module level are still too abstract to be used as test items. Therefore, they are precisioned in order to represent concrete situations and competences that students can associate with. The 12 learning outcomes on module level function as the basis for developing the items of the questionnaire. Each item is to be answered on a 6-Point Likert-Scale where students assess their own competences ranging from *1 - low agreement* to *6 - high agreement*.

The questionnaire is used for a comparative self-assessment of the students. By filling out the questionnaire the students self-assess their level of competence for each item at two different points in time. These two self-assessments are then compared with each other. As the evaluation aims at the module level of the course, the students will self-assess themselves at the beginning of the course (*pre*) and at the end of the course (*post*). For this, two different types of data collections are used:

- One set of data is collected by distributing the questionnaire to students at the beginning of a semester (*prepre*) as well as at the end of a semester (*pospost*).
- A second set of data is collected through one single questionnaire which is handed out in the last lesson of a semester. Here, the students assess their competences looking back at the beginning of the course (*then*) and how they perceive their competences now at the end of the course (*postthen)*.

To differentiate between the two types of data collection the terms *prepre* and *postpost* as well as *then* and *postthen* are used. The terms *pre* and *post* refer to the respective points in both types of data collection. The data is collected three times for each of the two types in different semesters, that is for six semesters in total, see Table 18 in sub-chapter 6.5.4.

Through the use of a two-tailed paired samples t-test (Student 1908), it is calculated if there is a significant difference between self-assessed competences at the beginning of a course (*prepre/then*) in comparison with the self-assessed competences at the end of a course (*postpost/postthen*). There are two mathematical preconditions of a t-test. First, the sample has to be interval-scaled, and second, it exhibits normally distributed values. In addition, the two samples need to be homoscedastic. However, the t-test is a robust test, so that even violations of these preconditions are acceptable if the samples of the two groups have a similar size (*n1* ~ *n2*) and are not too small (*n1* > *30; n2* > 30) (Rasch et al. 2010). In order to ensure samples of similar size, the *prepre-postpost*-assessment asks the students to generate an individual code, so that only matching *prepre* and *postpost* questionnaires are considered in calculating the t-test. This measure is not necessary for the *then-postthen*-assessment. Only matched pairs with no missing values are used to calculate the t-test. The formula for the dependent t-test for paired samples is:

$$t = \frac{\bar{X}_D - \mu_0}{\frac{s_D}{\sqrt{n}}}$$

As briefly described in chapter 4, the concept of learning outcomes, their implementation and assessment are widely accepted within medical education. Therefore, it is not surprising that a simple quantitative tool to measure the learning gains was developed within this field of higher education. The concept of the comparative self-assessment gain calculates the aggregated learning gain for each item of a questionnaire (Raupach et al. 2011). The precondition for this formula is, that the Likert-Scale is arranged from *1- high agreement* to *6 - low agreement*. The formula and this arrangement of the Likert-Scale reflect that increasing one's own competence-level is more difficult when the students are already on a high level (Raupach et al. 2011)., e.g. the same gain of 50% occurs in moving from 5,0 to 3,0 as well as in improving from 2,0 to 1,5.

$$Competence\ Gain\ in\ \% \ = \frac{mean_{pre} - mean_{post}}{mean_{pre} - 1} \times 100$$

The concept and formula of Cronbach's Alpha is widely used to measure the internal consistency of a test (Cronbach 1951). The internal consistency is based on the intercorrelations of the items of the questionnaire. The internal consistency of the items is a necessary but not sufficient condition to measure the homogeneity or unidimensionality of the test (Tavakol and Dennick 2011). This difference is further underlined as not only one-dimensional tests may yield a high value of Cronbach's Alpha but multidimensional tests may also show high results (Cortina 1993). In addition, due to its formula, the value of Cronbach's Alpha will inevitably increase as the number of items increases. Therefore, a high number of items, that is above 20, should not be used as this may result in a high value of Cronbach's Alpha although the test will comprise more than one subscale. Overall, a Cronbach's Alpha above 0,9 may indicate a redundancy of the test items rather than the desired internal consistency (Streiner 2003). These limitations of the formula of Cronbach's Alpha will need to be considered when designing the questionnaire of the comparative self-assessment test. As there is a total of 12 sub-competences this will result in at least 12 items if *Gestaltungskompetenz* is to be measured through a unidimensional test. As a result, most of the sub-competences will need to be measured through one single item. This option is chosen for this research project. The alternative would be to design a special set of items for every one of the 12 sub-competences and to calculate Cronbach's Alpha for every sub-competence separately. Missing values will be ignored in the calculation of Cronbach's Alpha. The formula for the calculation of Cronbach's Alpha is:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

6.5.2 - Problem Area

The *Blue Engineering Course* aims at providing a learning environment which is co-created by the participants and through this co-creation they may acquire the 12 sub-competences of *Gestaltungskompetenz*. An adaptation of these sub-competences is used as 12 learning outcomes on module level. Therefore, the participants are not expected to acquire these competences through one single activity, but through a series of activities which are integrated in each lesson and span over the course of one whole semester. Consequently, it suggests itself to evaluate any competence gain by facilitating a comparison test between the beginning of a semester with the end of a semester.

The preceding sub-chapter with its perception-based test has shown, that the participants perceive themselves as applying these sub-competences in the evaluated core building blocks as well as over the course of a semester. This use of the 12 sub-competences has also been observed from the outside by the tutors running the course as well as an external observer. In addition, the qualitative evaluation of the activities and assessments associated with the learning outcomes on module level has shown that the participants not only make use of the sub-competences within the core building blocks but also across the whole semester. Therefore, the students apply these sub-competences widely across the whole *Blue Engineering Course*. However, it remains unclear if they actually acquire a more professional use of these sub-competences through attending the course and if they reach a higher competence level.

6.5.3 - Design of the Comparative Self-Assessment Test

The learning outcomes on module level provide a robust basis to create items for a comparative self-assessment test. In total, there are 12 learning outcomes on module level which are adapted from the 12 sub-competences of *Gestaltungskompetenz*. Thus, a minimum of 12 test items is required to represent the various facets of *Gestaltungskompetenz*. The number of items was limited to around 20 items for the reasons given above. This restriction was further necessary as the test would also include items aiming at other test objectives like an overall review of the course and student attitudes which are not part of this research project. These additional elements would regularly change, while the items measuring the sub-competences would remain the same over time.

In chapter 5, the design process and development of the learning outcomes on the various levels are described in detail. The design of the test items was part and parcel of this process. Apart from the persons in charge of the course, a number of people have been involved in this iterative process, including two persons in charge of the quantitative evaluation of courses and study programs for the whole of *Technische Universität Berlin*. The learning outcomes on module level have been finalised during summer semester 2015 so that the corresponding items were also only finalised at that point in time. This explains why the first two semesters of the testing period are missing one, or respectively three items, of the final 17 test items.

The premises for the comparative self-assessment test was to design at least one test item linked to each of the 12 learning outcomes on module level. For this, the rather complex learning outcomes on module level were freely associated by the team with concrete course activities and assessments. This collection for every learning outcome was than analyzed and clustered. Next, suitable test items were generated and internally tested. The creation of the test items also comprised two pre-tests with the student tutors of the course as well as former participants of the course. In addition, as described above, the design of the learning outcomes and items of the questionnaire also underwent expert reviews by the extended core team that was also involved the design down process of the learning outcomes, see sub-chapter 5.1. In addition, the concept was also presented and discussed at three conferences (Baier and Meyer 2015; Baier 2015; Baier 2017a).

Overall, the learning outcomes on module level are all linked with at least one item. The learning outcomes *T1-BE, T2-BE, T4-BE, C3-BE* and *A1-BE* are linked with two test item as they are more complex learning outcomes or have been judged more essential for the *Blue Engineering Course*. The items have been designed in German and the comparative self-assessment test was also issued in German. It is only for the documentation of this research project, that the items have been translated into English by the author, see Table 17.

Table 17
Items of the Comparative Self-Assessment Test
Comparison of Sub-Competences of *Gestaltungskompetenz*, Learning Outcomes of the *Blue Engineering Course* on Module Level and Items of the Comparative Self-Assessment Test.

Sub-Competences of *Gestaltungskompetenz* (de Haan 2010)	**Learning Outcomes of the Blue Engineering Course on Module Level**	**Items of the Comparative Self-Assessment Test**
T1 - Perspective-Taking - to gather knowledge in a spirit of openness to the world, integrating new perspectives	T1-BE - Students take perspectives, change points of view and gather diverse forms of knowledge (i.e. scientific, traditional, common sense) from various actors on the spatial and temporal effects of technology on individuals, society and nature.	T1.1 - argue from different points of view T1.2 - describe the influence of technology on nature and society
T2 - Anticipating - to think and act in a forward-looking manner	T2-BE - Students anticipate spatial and temporal effects of technology on individuals, society and nature.	T2.1 - consider present and future effects of one's own actions T2.2 - describe the local and global effects of technology

T3 - Gaining Interdisciplinary Knowledge - to acquire knowledge and to act in an interdisciplinary manner	T3-BE - Students gain knowledge of the reciprocal relations between technology, individuals, nature and society through inter- and transdisciplinary approaches.	T3.1 - find and incorporate knowledge outside of my own discipline
T4 - Dealing with Incomplete and Overly Complex Informations - to deal with incomplete and overly complex information	T4-BE - Students deal with incomplete and overly complex information on the reciprocal relations between technology, individuals, nature and society and the risks, dangers and uncertainties which arise from them.	T4.1 - choose an option, although possible consequences are unknown T4.2 - taking a decision despite conflicting aims
C1 - Cooperating - to co-operate in decision-making processes	C1-BE - Students cooperate for a democratic decision-making with regard to process, result and implementation.	C1.1 - reflect upon a group process with respect to process and result
C2 - Coping with Dilemmas of Decision-Making - to cope with individual dilemmatic situation of decision-making	C2-BE - Students cope with dilemmas of decision-making when values and aims are conflicting.	C2.1 - mediate conflicts of goals and values with others
C3 - Participating - to participate in collective decision-making processes	C3-BE - Students participate at collective decision-making processes.	C3.1 - constructively introduce my point of view in a group discussion
C4 - Motivating - to motivate oneself as well as others to become active	C4-BE - Students motivate oneself and others to democratize the reciprocal relations between technology, individuals, nature and society.	C4.1 - spread knowledge towards other students C4.2 - prepare a didactical unit on a complex topic
A1 - Reflecting Principles - to reflect upon one's own principles and those of others	A1-BE - Students reflect principles which control the reciprocal relations of technology, individuals, nature and society.	A1.1 - know one's own attitude and values towards technology A1.2 - put oneself in the position of others to understand their motives
A2 - Acting Morally - to refer to the idea of equity in decision-making and planning actions	A2-BE - Students identify the underlying values which shape the reciprocal relations of technology, nature, individuals and society and to use them to act morally.	A2.1 - act according to one's own attitudes and values
A3 - **Acting Independently** - to plan and act autonomously	A3-BE - Students plan independently and act autonomously according to one's own values.	A3.1 - prepare one's own problem statement

A4 - **Supporting Others** - to show empathy for and solidarity with the disadvantaged	A4-BE - Students support others who are disadvantaged due to the dominating design of the reciprocal relations between technology, individuals, nature and society.	A4.1 - identify causes of social inequalities

The items remained unchanged over the whole testing period. Every item was to be assessed on a 6-point Likert-Scale ranging from *1 - low agreement* to *6 - high agreement*. The same test was given out for the *prepre*-assessment as well as the *postpost*-assessment. For the *then-postthen*-assessment, every sub-competence had a pair of items. The first item asked the students to self-assess their competence level as it is now (*postthen*). The second item asked to self-assess themselves looking back at the beginning of the course (*then*). The comparative self-assessment test were designed through EvaSys, Version 7.1, which is the evaluation software provided by the Strategic Controlling Working Group of *Technische Universität Berlin*, see Appendix - Comparative Self-Assessment - Questionnaires.

6.5.4 - Data Collection

The data collection for the comparative self-assessment took place in six consecutive semesters, see Table 18. The first type of data collection, the *prepre/postpost* assessment, took place in three consecutive semesters starting in winter semester 2014/2015 including summer semester 2015 and winter semester 2015/2016. The second type of data collection, the *then/postthen*-assessment took place in the following three semesters starting in summer semester 2016 including winter semester 2016/2017 and summer semester 2017. In total, the comparative self-assessment stretched over six semesters. The following naming convention is used to identify the six semesters: The suffix *_1* stands for the summer semester while suffix *_2* stands for winter semester, e.g. *2014_2* is the winter semester of 2014/2015 and *2015_1* is the following summer semester of 2015.

The comparative self-assessment by the students was done through a paper test distributed during one of the lessons of the *Blue Engineering Course*. The test of the *prepre/postpost*-assessment was given out during the second lesson of the course and during the last lesson of the course respectively. The *then-postthen*-assessment was given out only during the last lesson of the course in each semester respectively.

Before filling out the test, the students were assured that the test is totally anonymous and is neither intended to evaluate the individual performance, nor is it part of the student's assessment. Instead, the purpose of the test was clearly stated, that is to evaluate only the course. No further explanation was given to the students. The students were given enough time to fill out the test during the lesson. The participation in the comparative self-assessment was voluntary.

There is no mandatory attendance in the course. As there is no attendance list, the return percentage of distributed tests cannot be given for the persons present in the room. However, it was the impression of the persons in charge of the course, that in all of the semesters the students readily participated and most of them filled out the tests. The filled-out tests were scanned through EvaSys, Version 7.1. All collected data is listed in Appendix - Comparative Self-Assessment Test - Data Collection.

Across the six semesters, the number of aggregated *pre*-tests is 365, which is the sum of all returned *prepre*-tests and *then*-tests. The number of aggregated *post*-tests is 279, which is the sum of returned *postpost*-tests or *postthen*-tests. The return rate is given in relation to the students who registered for examination in each semester and is 83 % for the aggregated *pre*-tests and 63 % for the aggregated *post*-tests. The first three semesters show a return rate of over 100 %, which is caused by the method of measuring the return rate: The *prepre*-test is distributed at the beginning of the course, where students still attend the course but who will not register for examination, however, the return rate is given in relation to the number of registered participants, see Table 18. Overall, the return rate can be seen as very satisfactory.

Table 18

Participants and Return Rate of Comparative Self-Assessment

This table gives the number of participants of the Blue Engineering Course registered for examination for each semester. It further gives the number of returned tests from the beginning and end of each semester. In addition, the table gives the response rate which sets the number of participants in relation to the number of returned tests. At the end of the table the aggregated number are presented.

	2014_2		**2015_1**		**2015_2**	
participants	74		78		66	
prepre	75	101 %	79	101 %	69	104 %
postpost	46	62 %	49	63 %	40	61 %
	2016_1		**2016_2**		**2017_1**	
participants	78		57		86	
then	44	56 %	36	63 %	62	72 %
postthen	44	56 %	37	65 %	63	73 %
	prepre	**postpost**	**then**	**postthen**	**pre**	**post**
participants	218		221		439	
returned tests	223	135	142	144	365	279
return rate mean	102 %	62 %	64 %	65 %	83 %	64 %

6.5.5 - Data Analysis

6.5.5.1 - Mean and Confidence Interval for Each Item of Each Semester

The comparative self-assessment is based on a comparison of means which is further expanded through a t-test, a calculation of the comparative self-assessment gain and the calculation of Cronbach's Alpha which is based basically on the standard deviation of different subsets of the data. The 6-point Likert-scale was arranged from *1 - low agreement* to *6 - high agreement* so that a high value will indicate a high self-assessment of the participants' competence. The formulas used for the following data analysis as well as the data analysis are given in Appendix - Comparative Self-Assessment Test - Data Analysis.

To provide an overview of the collected data, the following table lists the mean of each item for the beginning and the end of each semester, see Table 19. In addition, the confidence interval for a confidence level of 95% is given for each item respectively. This table clearly shows that in each item and an in every semester there is an increase in the self-assessed competence level of the students. In the following sections, these data will be further analyzed.

Table 19

Pre Mean and Post Mean with Confidence Interval of 95 % for each item and Semester

Item	2014_2	2015_1	2015_2	2016_1	2016_2	2017_1
T1.1 - pre	4,0 ± 0,2	4,1 ± 0,2	4,6 ± 0,2	4,2 ± 0,3	4,3 ± 0,4	4,3 ± 0,2
- post	4,7 ± 0,3	5,0 ± 0,2	5,1 ± 0,2	4,9 ± 0,3	4,7 ± 0,3	4,9 ± 0,2
T1.2 - pre	3,6 ± 0,3	3,7 ± 0,2	4,0 ± 0,2	3,5 ± 0,3	3,8 ± 0,3	4,0 ± 0,2
- post	4,9 ± 0,2	4,8 ± 0,2	4,7 ± 0,3	4,8 ± 0,3	4,6 ± 0,4	5,0 ± 0,2
T2.1 - pre	4,2 ± 0,2	4,1 ± 0,2	4,6 ± 0,2	3,9 ± 0,2	4,0 ± 0,4	4,3 ± 0,2
- post	4,8 ± 0,2	4,9 ± 0,2	4,9 ± 0,2	5,0 ± 0,2	5,1 ± 0,3	5,1 ± 0,2
T2.2 - pre		3,8 ± 0,2	4,1 ± 0,3	3,7 ± 0,3	3,8 ± 0,3	3,9 ± 0,2
- post		4,6 ± 0,3	4,6 ± 0,2	5,1 ± 0,2	4,8 ± 0,3	5,1 ± 0,2
T3.1 - pre	4,2 ± 0,2	4,1 ± 0,2	4,3 ± 0,2	4,2 ± 0,3	4,2 ± 0,3	4,4 ± 0,2
- post	4,8 ± 0,2	4,8 ± 0,2	4,8 ± 0,3	4,7 ± 0,2	4,8 ± 0,2	4,9 ± 0,2
T4.1 - pre	3,8 ± 0,2	3,6 ± 0,2	4,0 ± 0,2	3,7 ± 0,3	3,6 ± 0,3	4,1 ± 0,2
- post	4,3 ± 0,3	4,6 ± 0,2	4,6 ± 0,2	4,3 ± 0,3	4,0 ± 0,4	4,5 ± 0,2
T4.2 - pre		3,6 ± 0,2	4,1 ± 0,2	4,0 ± 0,3	3,8 ± 0,4	4,0 ± 0,2
- post		4,5 ± 0,3	4,4 ± 0,3	4,5 ± 0,2	4,1 ± 0,4	4,4 ± 0,2
C1.1 - pre	3,8 ± 0,2	3,8 ± 0,2	4,3 ± 0,2	4,1 ± 0,3	4,1 ± 0,3	4,4 ± 0,2
- post	4,5 ± 0,2	4,8 ± 0,2	5,0 ± 0,2	4,7 ± 0,3	4,9 ± 0,3	5,0 ± 0,2
C2.1 - pre	3,8 ± 0,2	3,8 ± 0,2	4,3 ± 0,2	4,0 ± 0,3	4,0 ± 0,3	4,4 ± 0,2
- post	4,4 ± 0,3	4,7 ± 0,2	4,6 ± 0,3	4,6 ± 0,2	4,6 ± 0,2	4,9 ± 0,2
C3.1 - pre	4,3 ± 0,2	4,2 ± 0,2	4,5 ± 0,2	4,0 ± 0,4	3,6 ± 0,4	4,3 ± 0,3
- post	4,9 ± 0,3	4,9 ± 0,2	4,7 ± 0,2	4,6 ± 0,3	4,4 ± 0,3	4,8 ± 0,2
C4.1 - pre	3,7 ± 0,3	3,6 ± 0,3	4,0 ± 0,3	4,0 ± 0,4	4,1 ± 0,4	4,3 ± 0,3
- post	4,6 ± 0,2	4,8 ± 0,2	4,7 ± 0,3	4,6 ± 0,3	4,6 ± 0,3	4,9 ± 0,2
C4.2 - pre	3,6 ± 0,2	3,3 ± 0,2	4,0 ± 0,3	4,0 ± 0,3	4,1 ± 0,4	4,4 ± 0,2
- post	4,5 ± 0,2	4,4 ± 0,2	4,5 ± 0,3	4,5 ± 0,3	4,7 ± 0,3	4,8 ± 0,2
A1.1 - pre	4,1 ± 0,2	4,2 ± 0,2	4,6 ± 0,2	3,7 ± 0,3	4,1 ± 0,4	4,1 ± 0,2
- post	4,7 ± 0,2	4,9 ± 0,2	5,0 ± 0,2	4,7 ± 0,2	4,9 ± 0,3	4,8 ± 0,2
A1.2 - pre	4,3 ± 0,2	4,2 ± 0,2	4,4 ± 0,2	4,4 ± 0,3	4,4 ± 0,4	4,7 ± 0,2
- post	4,9 ± 0,3	5,0 ± 0,2	4,8 ± 0,3	5,0 ± 0,3	4,8 ± 0,3	5,1 ± 0,2
A2.1 - pre	4,3 ± 0,2	4,3 ± 0,2	4,8 ± 0,3	4,5 ± 0,3	4,1 ± 0,3	4,7 ± 0,2
- post	5,1 ± 0,2	5,0 ± 0,2	4,9 ± 0,3	5,0 ± 0,2	4,6 ± 0,3	5,0 ± 0,2
A3.1 - pre	3,8 ± 0,2	3,7 ± 0,2	4,3 ± 0,3	4,3 ± 0,3	4,1 ± 0,3	4,6 ± 0,2
- post	4,5 ± 0,3	4,7 ± 0,2	4,8 ± 0,3	4,8 ± 0,2	4,5 ± 0,2	4,9 ± 0,2
A4.1 - pre			4,1 ± 0,2	3,9 ± 0,3	3,9 ± 0,4	4,0 ± 0,2
- post			4,5 ± 0,3	4,6 ± 0,3	4,7 ± 0,3	4,6 ± 0,2

6.5.5.2 - T-Test for Each Item of Each Semester

The use of a two-tailed paired samples t-test will indicate whether there is a significant difference between the self-assessed competences at the beginning and at the end of each semester. Commonly, a difference is judged significant if the *p* value of the t-test is $p < 0,05$ and highly significant if $p < 0,01$. Table 20 shows the *p* values calculated through the t-test for each item and each semester. In addition, this table lists the number of matched pairs for each item and each semester as this number differs according to the number of returned tests.

Table 20

Two-Tailed T-Test, Number of Matched Participants n and p Values for Each Item and Semester. p < 0,01 in white; 0,05 **>** p > 0,01 in light gray; p > 0,05 in dark gray

	2014_2		**2015_1**		**2015_2**		**2016_1**		**2016_2**		**2017_1**	
	n	p	n	p	n	p	n	p	n	p	n	p
T1.1	35	<0,01	36	<0,01	32	0,01	44	<0,01	36	0,03	62	<0,01
T1.2	36	<0,01	36	<0,01	31	<0,01	42	<0,01	36	0,01	62	<0,01
T2.1	35	0,01	37	<0,01	31	0,12	43	<0,01	36	<0,01	63	<0,01
T2.2			37	<0,01	32	0,01	44	<0,01	36	<0,01	63	<0,01
T3.1	36	<0,01	37	<0,01	32	<0,01	43	<0,01	35	<0,01	63	<0,01
T4.1	37	0,03	37	<0,01	31	<0,01	44	<0,01	36	<0,01	62	<0,01
T4.2			35	<0,01	32	0,26	44	<0,01	32	0,22	63	<0,01
C1.1	35	0,01	37	<0,01	32	<0,01	43	<0,01	34	<0,01	63	<0,01
C2.1	37	0,02	37	<0,01	32	0,05	43	<0,01	34	<0,01	63	<0,01
C3.1	36	<0,01	36	<0,01	32	0,61	44	<0,01	36	<0,01	62	<0,01
C4.1	37	<0,01	37	<0,01	30	<0,01	42	<0,01	36	<0,01	63	<0,01
C4.2	36	<0,01	37	<0,01	32	0,01	44	<0,01	33	<0,01	63	<0,01
A1.1	36	<0,01	36	<0,01	32	0,01	43	<0,01	35	<0,01	63	<0,01
A1.2	37	<0,01	36	<0,01	32	0,21	44	<0,01	32	0,10	63	<0,01
A2.1	37	<0,01	36	<0,01	31	0,78	44	<0,01	35	<0,01	63	<0,01
A3.1	36	<0,01	36	<0,01	32	0,02	44	<0,01	36	0,04	62	<0,01
A4.1					30	0,04	43	<0,01	34	<0,01	63	<0,01

Overall, the difference between the self-assessment taken at the beginning of a semester and at the end of a semester can be categorized as highly significant. There are only a few items in some semesters where $p > 0{,}01$. However, there is not one item that has systematically higher p values across all semesters. The same applies to the count of $p > 0{,}05$ within one semester. There is only one semester that shows for five items higher p values. Possible reasons for this deviance in winter semester 2015/2016 have been discussed among the persons in charge of the course, but overall the semester has been judged as a semester with little differences in comparison to the other semesters.

6.5.5.3 - Comparison of Means for Each Item for the Aggregated Prepre-/Then- and Post/Postthen-Semesters

The data collection for the *prepre-postpost*-assessment was done in the same way for each of the three semesters. Therefore, it is save to aggregate the three semesters so that the aggregated means for the *prepre*-assessment can be set in relation to the aggregated means for the post-assessment. The following figure shows the aggregated *prepre*-mean and aggregated post-mean of each item, see Figure 15. The lines connecting the dots have only been added to improve a visible identification of a general spread.

Figure 15 clearly indicates that the students self-assess themselves considerable competence gains across all 17 items. Moreover, it shows that the competence gain for each item is around 0,7 on a 6-point Likert-scale. Thus, the participants have a similar positive increase for each item. Following that the t-test for each item and each semester mostly has been highly significant, the difference between the aggregated *prepre-postpost*-semesters is also highly significant for all items but one. However, item *A.4.1 - Supporting Others* has a value of $p < 0{,}05$ which makes the difference between the *prepre*-assessment and the *postpost*-assessment still significant. This item was added later on to the comparative self-assessment test so that it has only been tested in the winter semester of 2015/2016 and not in the two preceding semesters. This reason may account for the slightly higher p value.

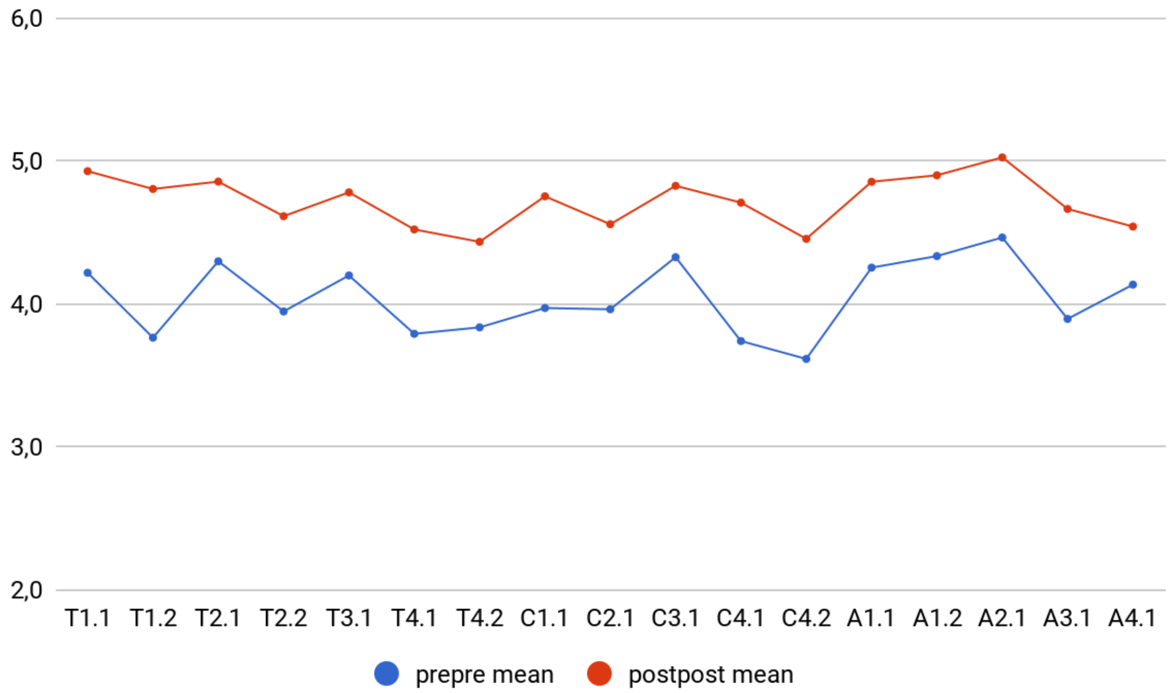

Figure 15 - Aggregated Means for Prepre-Postpost-Assessment for Each Item

This procedure was repeated for the *then-postthen*-assessment. The following figure shows the aggregated *then*-mean and aggregated *postthen*-mean of each item, see Figure 16. The lines connecting the dots have only been added to improve a visible identification of a general spread.

Figure clearly indicates that the students self-assess themselves considerable competence gains across all 17 items. Moreover, it shows that the competence gain for each item is around 0,6 on a 6-point Likert-scale which is only slightly less than with the *prepre-postpost*-assessment. However, the participants still have a similar positive increase for each item. As the t-test for each item and each semester of the *then-postthen*-assessment has been highly significant for most of the items, the difference between the aggregated *then-postthen*-semesters is also highly significant for each item with a *p* value of $p < 0{,}01$.

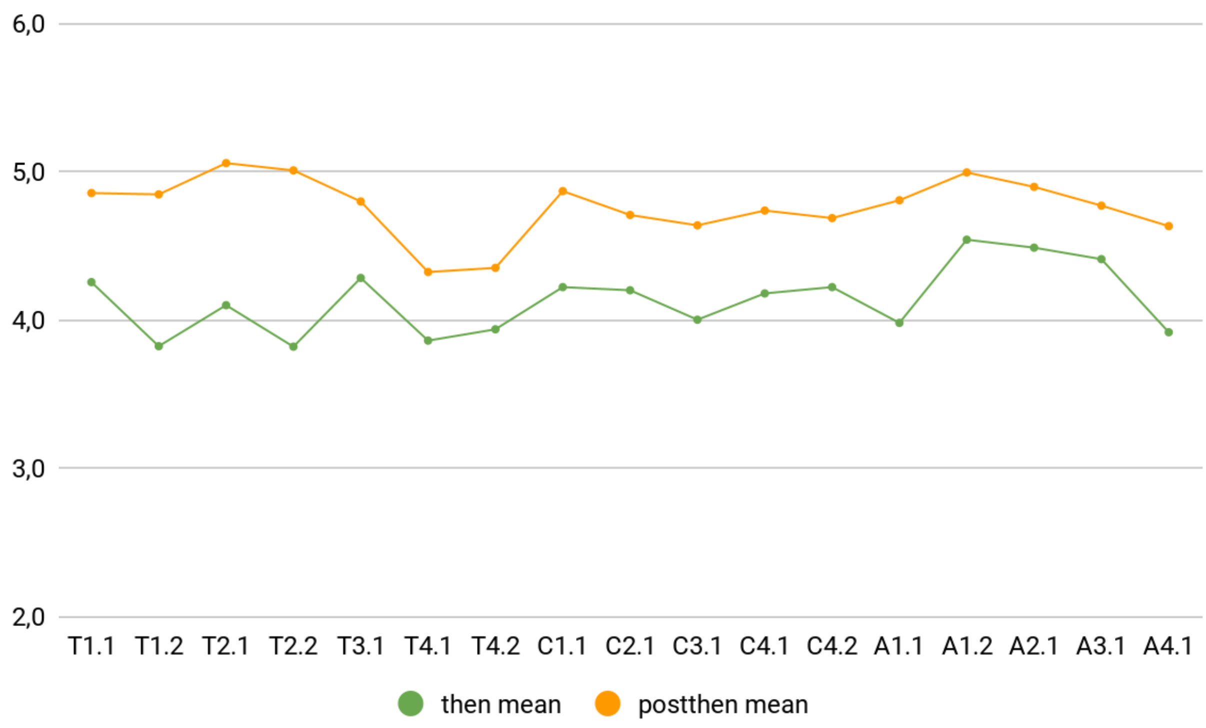

Figure 16 - Aggregated Means for Then-/Postthen-Assessment for Each Item

The following Figure 17 shows the aggregated means of the *prepre-postpost*-assessment for each item as well as the corresponding means of the *then-postthen*-assessment. The lines connecting the dots have only been added to improve a visible identification of a general spread. The lines of the prepre-assessment and of the *then*-assessment almost run parallel. A noticeable difference occurs at the sub-competence *C4 - Motivating* where both items are judged better in the *then*-assessment than in the pre-assessment. Here, the students may substantially overrate their competence level looking back at the beginning of the course. The same accounts for competence *A3 - Acting Independently*.

Correspondingly, the lines of the *postpost*-assessment and the *postthen*-assessment run also almost parallel. The major exception here is competence *T2 - Anticipating* where both items are judged substantially better by the students who participated in the *postthen*-assessment. Here, smaller adaptations in the curriculum may account for this shift.

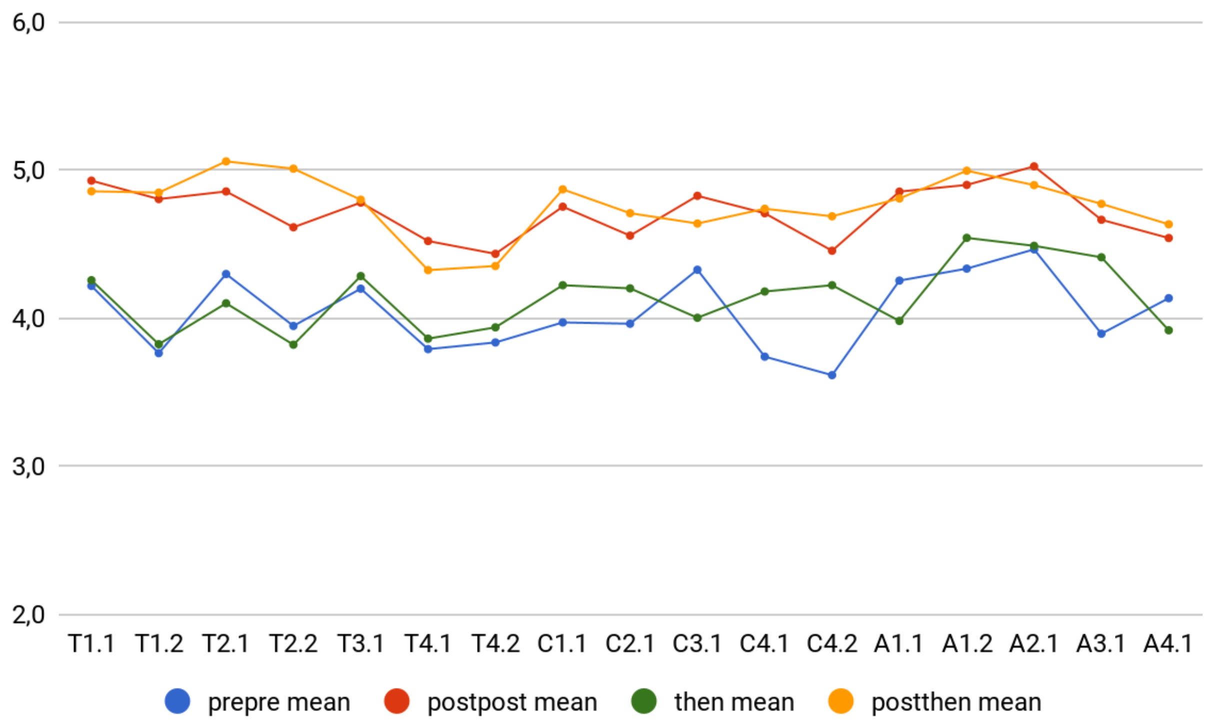

Figure 17 - Aggregated Means for Prepre-/Post-/Then-/Postthen-Assessment for Each Item

6.5.5.4 - Heat Bars for Each Item Across all Semesters

Based on the previous comparison of the aggregated pre*pre-postpost*-assessments for each item and the aggregated *then-postthen*-assessments for each item, it seems possible to aggregate the data for each item across all six semesters. They are summarized as aggregated *pre*-assessment and aggregated *post*-assessment.

The following figure shows the heat bars of the aggregated *pre*-assessment and *post*-assessment, see Figure 18. The color code ranges from *purple 1- low agreement* to *dark green 6 - high agreement.* Therefore, each of the six colors in a single bar shows the relative size of how many students over all of the semesters have chosen this level of competence at the beginning and at the end of their semester. There is a visible shift from *orange - 3* and *yellow - 4 - medium agreement* in the *pre* bars towards *light green - 5* and *dark green - 6 - high agreement* in the *post* bars.

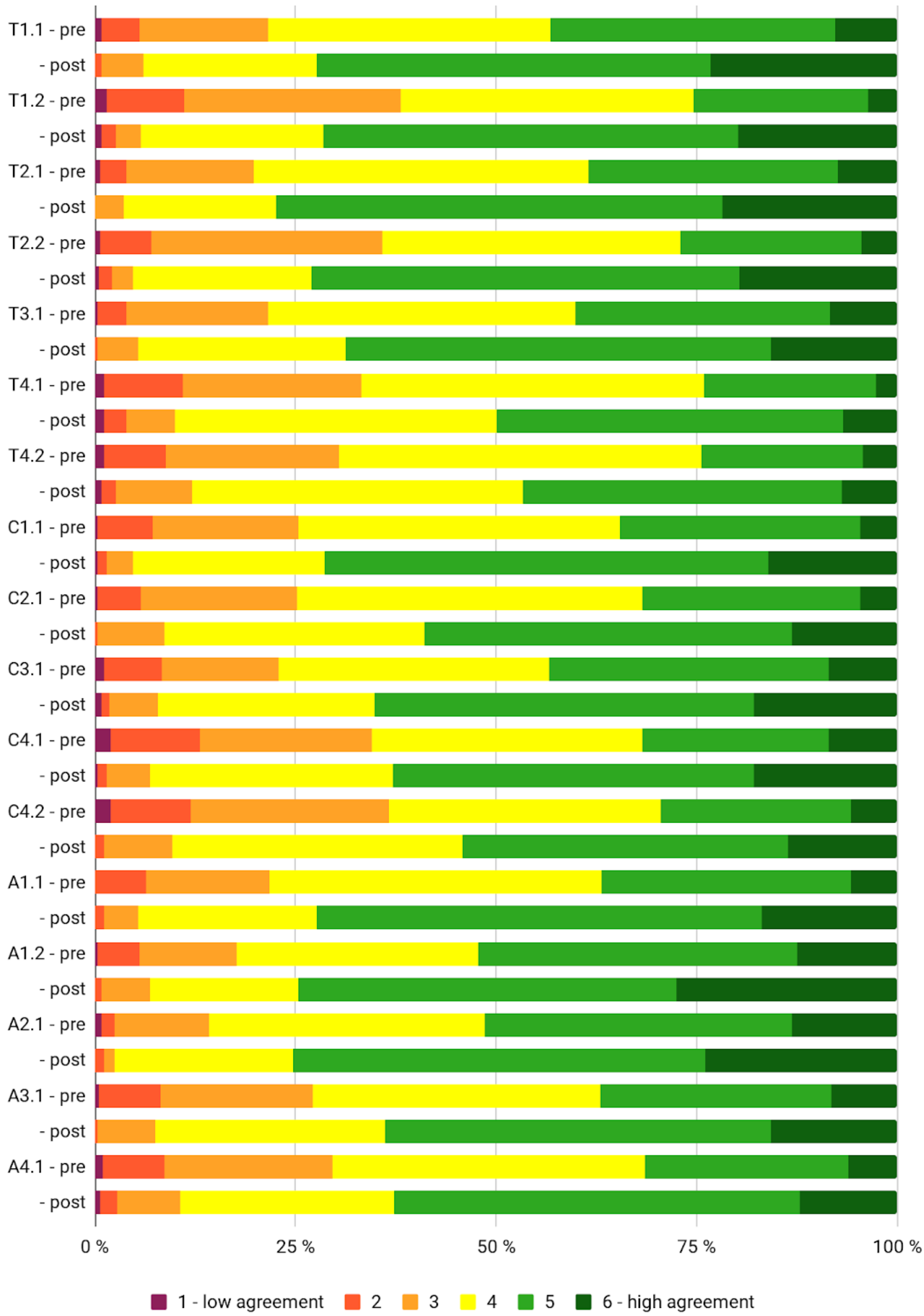

Figure 18 - Heat Bar for Each Item - Relative Comparison of the Aggregated Pre-/Post-Assessment

6.5.5.5 - Comparative Competence Gain for Each Item Across all Semesters

The formula for the comparative self-assessment gain, as given above in section 6.5.1, is based solely on the pre-mean and the post-mean. It makes use of a Likert-scale whose lower values indicate a higher competence while its higher values indicate a lower competence in the respective item. As the questionnaire was designed with a 6-point Likert-scale from *1- low agreement* to *6 - high agreement*, the collected data is recorded in order to calculate the comparative self-assessment gain. The following table 21 shows the comparative self-assessment gain for each item across all semesters. In addition, it shows the aggregated *pre*-mean and the aggregated *post*-mean along with their confidence interval of 95 % as well as the mean difference for each item.

Table 21

Aggregated Pre Mean and Aggregated Post Mean with Confidence Interval of 95 %, Difference of Means and CSA Gain for Each Item of CSA Test

	Aggregated Pre Mean	Aggregated Post Mean	Difference of Means	CSA Gain
T1.1	4,2 ± 0,1	4,9 ± 0,1	0,7	37,2 %
T1.2	3,8 ± 0,1	4,8 ± 0,1	1,0	46,9 %
T2.1	4,2 ± 0,1	5,0 ± 0,1	0,7	41,5 %
T2.2	3,9 ± 0,1	4,9 ± 0,1	1,0	45,9 %
T3.1	4,2 ± 0,1	4,8 ± 0,1	0,6	31,5 %
T4.1	3,8 ± 0,1	4,4 ± 0,1	0,6	27,6 %
T4.2	3,9 ± 0,1	4,4 ± 0,1	0,5	23,5 %
C1.1	4,1 ± 0,1	4,8 ± 0,1	0,7	38,5 %
C2.1	4,1 ± 0,1	4,6 ± 0,1	0,6	29,8 %
C3.1	4,2 ± 0,1	4,7 ± 0,1	0,5	29,4 %
C4.1	3,9 ± 0,1	4,7 ± 0,1	0,8	38,9 %
C4.2	3,8 ± 0,1	4,6 ± 0,1	0,7	33,6 %
A1.1	4,1 ± 0,1	4,8 ± 0,1	0,7	36,8 %
A1.2	4,4 ± 0,1	4,9 ± 0,1	0,5	33,7 %
A2.1	4,5 ± 0,1	5,0 ± 0,1	0,5	31,8 %
A3.1	4,1 ± 0,1	4,7 ± 0,1	0,6	32,7 %
A4.1	4,0 ± 0,1	4,6 ± 0,1	0,6	31,0 %

Overall, the participants show substantial gains across all items. To illustrate this, the following figure 19 sets the aggregated *pre*-mean (blue) and the aggregated *post*-mean (red) measured on the vertical axis on the left in relation with the comparative self-assessment gain (yellow) measured on the vertical axis on the right.

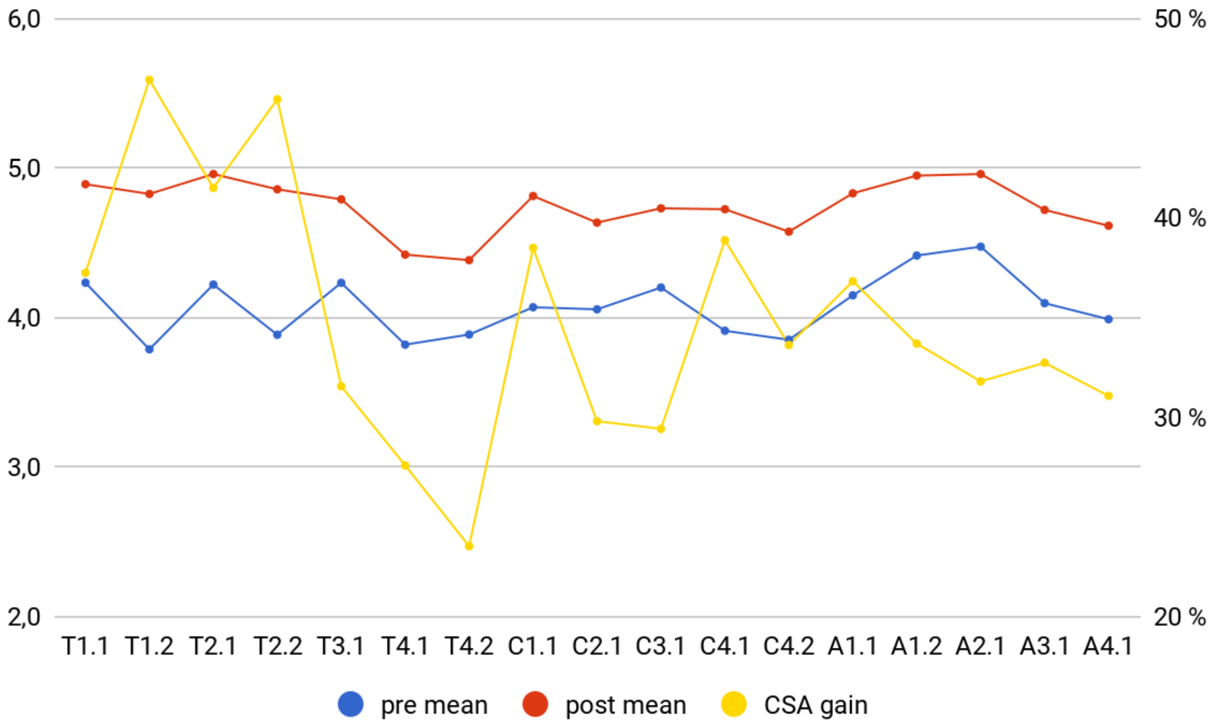

Figure 19 - Aggregated Pre Means, Post Means and CSA Gain for Each Item.

6.5.5.6 - Cronbach's Alpha of the Comparative Self-Assessment Test

Cronbach's Alpha is used to measure the internal consistency of a test. Therefore, it is not feasible to aggregate the test scores across the semesters or the test scores for the test at the beginning of a semester with the tests at the end of a semester. In total, there are 12 independent tests, six from the *prepre-postpost*-assessment and six from the *then-postthen*-assessment as they split up into its two components. The following table 21 gives the values of Cronbach's Alpha for each test and their mean.

Table 22
Cronbach's Alpha for Comparative Self-Assessment Tests and the Mean of all Values of Cronbach's Alpha

	2014_2	**2015_1**	**2015_2**
prepre	0,85	0,83	0,76
postpost	0,85	0,89	0,85
	2016_1	**2016_2**	**2017_1**
then	0,85	0,80	0,85
postthen	0,91	0,83	0,88
Mean of Cronbach's Alpha Across all Tests			**0,84**

The values of Cronbach's Alpha for the 12 tests ranges from 0,76 to 0,89. This shows a very good internal consistency of the comparative self-assessment test as Alpha values above 0,8 are generally recognized as good and values around 0,9 as excellent. Therefore, the preconditions for a reliable test are met.

The mean of Cronbach's Alpha across all of the 12 independent tests is 0,84. Therefore, it can be assumed that the 17 test items are only little redundant or not redundant. Overall, the questionnaire of the comparative self-assessment test may be considered as a reliable source to measure *Gestaltungskompetenz*.

6.5.5.7 - Aggregated Pre-Mean and Aggregated Post-Mean of Gestaltungskompetenz

The p values calculated through a two-tailed paired t-test for each item and each semester are mostly highly significant. This applies also to the direct comparison of the aggregated *pre-post*-tests as well as the aggregated *then-postthen*-test. In addition, the values of Cronbach's Alpha for each test are very good which indicates a high internal consistency of the comparative self-assessment test. Therefore, it seems feasible to calculate the *pre*-mean and *post*-mean across all items for each semester. These aggregated means across all items would indicate how the students self-assess their level of *Gestaltungskompetenz* at the beginning and at the end of each semester. Table 23 shows the *pre-post*-means of the aggregated items for each semester along with their confidence interval of 95 % as well as the difference between means and the comparative self-assessment gain.

Table 23
Aggregated Pre Mean and Aggregated Post Mean with Confidence Interval of 95 %, the Difference of Means and the Comparative Self-Assessment Gain of Gestaltungskompetenz

	Aggregated Pre Mean of Gestaltungskompetenz	**Aggregated Post Mean of Gestaltungskompetenz**	**Difference of Means**	**CSA Gain**
2014_2	4,0 ± 0,3	4,7 ± 0,1	0,7	35,3 %
2015_1	3,9 ± 0,3	4,8 ± 0,1	0,9	42,1 %
2015_2	4,3 ± 0,2	4,7 ± 0,1	0,4	25,9 %
2016_1	4,0 ± 0,3	4,7 ± 0,1	0,7	35,3 %
2016_2	4,0 ± 0,3	4,6 ± 0,1	0,6	32,0 %
2017_1	4,3 ± 0,2	4,9 ± 0,1	0,6	34,0 %
Mean	4,1 ± 0,2	4,7 ± 0,1	0,7	34,1 %

The *pre*-mean across all items and all semesters is 4,07 and the students increase their *Gestaltungskompetenz* on average by 0,67 points to a *post*-mean of 4,74 on a 6-point Likert-scale. This equals a comparative self-assessment gain of around 34 %. Overall with regard to the complexity of competences of an education for sustainable development, this is a satisfactory gain as the students already bring a certain level of competence to the course. More concrete courses as well as more concrete competences, such "I can provide basic life-support", typically will show much higher competence gains (Raupach et al. 2011).

6.5.6 - Conclusion

This sub-chapter provides a quantitative evaluation of the *Blue Engineering Course*. It aimed at clarifying whether the participants reach a higher level of competence through attending the course. The evaluation criteria for this are the learning outcomes on module level which have been adopted as items for a comparative self-assessment test. The evaluation was undertaken as an internal evaluation conducted primarily by the author of this research project.

The leading research question for this sub-chapter may be answered positively: Yes, the participants of the *Blue Engineering Course* acquire a higher level of *Gestaltungskompetenz* through attending the course. In addition, the leading research question for this sub-chapter was broken down into a set of three research questions.

The *generation of test items for a comparative self-assessment test* was reached through an iterative process which involved the persons in charge of the course as well as external experts. The newly generated items reflect the particularities of the course, especially the learning activities and learning assessments. In total, 17 items were generated which are clearly attributable to a single sub-competences of *Gestaltungskompetenz*.

The comparative self-assessment test was issued over six semesters. The students self-assessed themselves a *significantly higher level of competence for each in direct comparison between the beginning and the end of each semester.* This finding is underlined through a difference of means of around 0,7 on a 6-point Likert-scale for each item as well as a t-test of *p* values of $p < 0{,}01$ for almost all items and semesters.

The cross mean of Cronbach's Alpha for all the 12 tests taken is 0,84. This value can be considered excellent. Therefore, the *comparative self-assessment test may be considered as a reliable test for the overall* Gestaltungskompetenz *of students*. The mean of the comparative self-assessment gain of the students is 34 %.

Overall, this sub-chapter is a valuable contribution to the two-fold research question of this whole research project. It clearly shows how the newly generated learning outcomes on module level can be used as part of a quantitative evaluation. In addition, this sub-chapter clearly shows that the participants of the course reach all the learning outcomes on module level of the *Blue Engineering Course* as they significantly increase their self-assessed level of competence of the 12 sub-competences as well as the overarching concept of *Gestaltungskompetenz*.

7 - Summary and Design Principles

7.1 - Research Clarification

This research project was undertaken within the framework of an educational design research as it is described by Plomp (2013). Such a research project results in two types of outcomes:

1) As a design project it yields a concrete and ready to implement solution such as an educational intervention, project or program. It has to be kept in mind, that the design solution is the result of unique process which has successfully worked only in a concrete context.

2) As a research project, the educational design research needs to respect the guiding principles of scientific research (Shavelson et al. 2003) by posing significant questions which are answered through the use of methods that allow for a direct investigation and which are linked back to relevant theory. The comprehensive documentation of an educational research project allows professional scrutiny and critique as the design process is laid out in the open. This may also encourage others to replicate it for their use or to generalize it across research projects. This is further fostered through the formulation of design principles which can be derived from the educational design process. The general format of these design principles is: “In *context Z* the *intervention X* (with certain characteristics) leads to *outcomes Y1, Y2, …, Yn* Plomp (2013).”

As an educational design research, this research project started off with a *research clarification*, followed by a *description of the problem area*, an *analysis* of the relevant theories, the development of a solution through a *design process* and an *evaluation* of its result. In addition, Plomp (2013) lists four quality criteria which an educational design research has to meet: relevance, consistency, practicality and effectiveness.

The *research clarification* introduced and argued for the two research questions of this educational design research project:

> *What are the characteristics of a design process that results in a set of learning outcomes which describe the competences that shall be acquired by attending the* Blue Engineering Course *at* Technische Universität Berlin?
>
> *What are the characteristics of an evaluation that evaluates the* Blue Engineering Course *on module level according to its learning outcomes?*

The expected outcome of the first research question is a set of learning outcomes as well as generalized design principles that may aid others to design learning outcomes for their own courses. The expected outcome of the second research question is the evaluation of the *Blue Engineering Course* according to its learning outcomes on module level as well as design principles on how to conduct an evaluation according to a set of learning outcomes.

Of the four quality criteria of an educational design research it is relevance, which is the dominant criterion with regard to the chapter on research clarification. The research project is highly relevant as it is the first documented design down process of course-specific learning outcomes which describe competences of an (engineering) education for sustainable development.

7.2 - Problem Area - Course Design of the Blue Engineering Course

The design of the *Blue Engineering Course* at *Technische Universität Berlin* is presented as the *problem area* of this research project. The guiding principles for the development and the conduction of the course are: 1) to foster discussion about social and ecological responsibility of engineering which is different on the individual level than on the societal level; 2) to understand and analyze the reciprocal relations of technology, individuals, nature, society and democracy (*TINS-D*), which has later been developed to the *TINS-D Constellation*; 3) to maintain the student-driven character by encouraging democratic co-conduction and co-creation of the course. Due to its content as well as its methods, the *Blue Engineering Course* can be placed within the field of an education for sustainable development. The relevance of such an education, especially within higher education and more so within engineering education, should be apparent to any observer of the current society-nature relations.

7.3 - Analysis - Outcome-Based Education, Frameworks of Learning Outcomes and Competences of an Education for Sustainable Development

The *analysis* chapter covers three interlinked concepts: 1) outcome-based education, 2) frameworks of learning outcomes and 3) competences of an education for sustainable development. Each concept is analyzed through an extensive literature review which starts of with a historical genesis of the term as well as a clarification of the overall terminology. The concept of an outcome-based education is fairly established on a policy level within the field of higher education. The degree of its implementation is still varying, which is also due to the presented contesting variances of an outcome-based education. However, the general ideas of this concept have spread far and receive more and more acceptance within higher education. The five different frameworks of learning outcomes show that this concept may help in order to cluster as well as to describe learning outcomes. It is the *Schaper Taxonomy Table* (Schaper et al. 2013) which was used in the design of the learning outcomes as it is just sufficiently complex in the process dimension with its four levels while addressing not only the cognitive domain in the content dimension but also the affective domain as well as meta-skills and social skills. With regard to the key competences of an education for sustainable development, the literature review shows a general convergence. Therefore, only one single concept is presented in detail: the set of 12 sub-competences of *Gestaltungskompetenz* (Haan 2010). This set of competences was adapted as learning outcomes for the *Blue Engineering Course*. The dominant quality criterion in this chapter for an educational design research is *relevance*, that is in this case the reference of the state-of-the-art scientific knowledge. The comprehensive and systematic literature review for each of the three concepts fulfills this criterion.

7.4 - The Design of the Learning Outcomes of the Blue Engineering Course

The *design* chapter describes the design process of the learning outcomes of the *Blue Engineering Course* as well as the description of these learning outcomes on the various levels, ranging from general level down to activity level. The learning outcomes are designed through a design down process (Spady 1994) was directed by a core team of two lecturers who were also responsible for conducting the course. They were in close contact and discussion all along the design process with the responsible professor, the responsible tutors of the course as well as student member of the *Blue Engineering Initiative* and alumni of the course. The design down process was further assisted by a number of external experts and was discussed at public scientific conferences and workshops.

The actual design down process started off with an acknowledgement and analysis of the broader context of the *Blue Engineering Course* as it might affect the design and description of the learning outcomes. This includes a description of the various laws, decrees and contracts at state level, the guidelines of the responsible accreditation agency and the relevant regulations at *Technische Universität Berlin*. This analysis showed that the context of the *Blue Engineering Course* calls for the inclusion of sustainability in higher education. However, concrete guidelines and contents as well as methods are not explicitly named.

The *Blue Engineering Course* was already established and has been conducted several times when the design down process of the learning outcomes began. Therefore, there was already a set of guiding principles that needed to be considered and incorporated in the description of the learning outcomes. These guiding principles were summarized as two learning outcomes on general level which would express the overall characteristics of the course with regard to content and methods. These two learning outcomes on general level still accurately describe the central design and objectives of the *Blue Engineering Course*.

Merging the 12 abstract sub-competences of *Gestaltungskompetenz* (Haan 2010) with the two equally abstract yet course-specific learning outcomes on general level results in a set of 12 learning outcomes. Each of these learning outcomes on module level represents a general competence that is deemed necessary in order to participate in a sustainable development of society as well as a concrete context in which these competences shall be acquired. These 12 learning outcomes are then also used as the central criteria for the evaluation of the *Blue Engineering Course*.

The design down process is then taken further down to the block level where the 12 learning outcomes on module level are merged with the two-dimensional taxonomy table developed by Schaper et al. (2013). In total, this results in a set of 48 learning outcomes on block level. These are course-specific learning outcomes which differentiate each of the 12 learning outcomes on module level with regard to four process levels: 1) *to remember and to understand*, 2) *to apply*, 3) *to analyse and to evaluate* and 4) *to create*.

These 48 learning outcomes on block level are concrete enough to cluster all of the activities and assessments of the *Blue Engineering Course*, such as designing and documenting a building block. However, they need to be designed down one step further to activity level in order to adequately describe the concrete activities and assessments of the course, such as the various activities take place in one concrete building blocks.

The applicable quality criteria for this part of the educational design research project are *consistency* and *practicality*. The criterion of *consistency* is met as the design down process itself is a very systematic process that starts at a top level (in this case, laws and regulations), and goes level by level further down to activity level. Due to the rigorous design process and its course-specific approach, it can be expected, that the designed learning outcomes are practical. In addition, the chapter on evaluation has further proven the actual practicality of the learning outcomes.

Overall, this leads to the following design principle for the first research question:

In the context of the *Blue Engineering Course* at *Technische Universität Berlin*, the intervention of an iterative multi-stakeholder design down process comprising the following steps lead to the following design principles:

- description and analysis of the regulatory context of the course
- clarification and description two learning outcomes on general level, which reflect the basic characteristics and objectives of the course with regard to content and method
- merging the two course-specific learning outcomes on general level with the 12 rather general sub-competences of *Gestaltungskompetenz* leads to a set of 12 course-specific, rather concrete learning outcomes on module level
- merging the 12 learning outcomes on module level with the *Schaper Taxonomy Table* leads to a set of 48 concrete learning outcomes on block level
- adaptation of the 48 learning outcomes on block level to the concrete course environment with its activities and assessments leads to precise learning outcomes on activity level

Heeding these design principles leads to a framework of learning outcomes for the *Blue Engineering Course* which can be used on module level, block level and activity level. It is the value of this framework, that it is linked back to frameworks of learning outcomes as well as a set of key competences for sustainable development which are in widespread use within the educational sector.

7.5 - Evaluation of the Blue Engineering Course According to its Learning Outcomes on Module Level

The *evaluation* chapter had a twofold objective: 1) to provide an evaluation of the 12 previously developed learning outcomes on module level of the *Blue Engineering Course* with regard to their expected and actual usability as well as usefulness and 2) to design and to conduct an evaluation of the *Blue Engineering Course* based on the 12 learning outcomes on module level. Therefore, the practicality and effectiveness of the 12 learning outcomes on module level are demonstrated by implementing them as the basis for the evaluation of the entire course. These two quality criteria for an educational design research are also applicable for the design of the evaluation.

The evaluation was designed as an internal self-evaluation conducted primarily by the author of this research project who is also responsible for the design and conduction of the *Blue Engineering Course* at *Technische Universität Berlin*. This course served as the object of the evaluation. The purpose of this ex-post evaluation was to generate knowledge about the course in order to legitimise the course in the long run. Therefore, this evaluation is primarily a summative evaluation. However, the findings of this evaluation might also provide a starting point for the further development of the course. The 12 previously generated learning outcomes on module level served as the basic criteria for this evaluation. As the evaluation was split up into three major sub-evaluations, these learning outcomes were adapted accordingly. In addition, a statistical analysis of the participants was undertaken.

The descriptive statistical analysis of the participants of the *Blue Engineering Course* has shown that the number of participants has continually risen. In total, 758 students passed the exam across the 13 semesters from winter semester 2011/2012 until winter semester 2017/2018 which formed the scope of this research project. The course attracted students from a broad range of study programs which generated an interdisciplinary working atmosphere. Roughly one quarter of the participants studied mechanical engineering and roughly one quarter studied industrial engineering. The remaining half of the students had a background in 44 different study programs. About 55 % of the students were enrolled in a master's program and roughly 40 % were enrolled in a bachelor's program.

The qualitative evaluation has shown that each of the 12 learning outcomes on module level is addressed through a broad range of learning activities and learning assessments. Accordingly, the students are required to use the 12 sub-competences of *Gestaltungskompetenz* not only at one single instant during the course but they are required to demonstrate the use of these 12 sub-competences in many instances.

This finding is further underlined through a comprehensive triangulation of three selected core building blocks. First, a qualitative evaluation has shown that each of the selected core building blocks comprises learning activities that contribute towards the 12 learning outcomes on module level. These 12 learning outcomes were then adapted as items of a quantitative questionnaire where the students, the tutors, and an external observer stated what they have perceived during class. The test was issued seven times in total in each of the three selected core building blocks and across two semesters. The results show that the 12 learning outcomes on module level are implemented through learning activities in all three selected core building blocks and that the students, the tutors and the external observer have a similar perception with regard to the use of the 12 sub-competences of *Gestaltungskompetenz* during the lesson.

The comparative self-assessment test of the students is a comprehensive quantitative evaluation. For this, the 12 learning outcomes on module level were adapted as test items where the students would self-assess their competence level at the beginning and the end of a semester. The comparative self-assessment test was issued for three consecutive semesters as a pre-/post-test and for the following three consecutive semesters as a then-/postthen-test. The results show that the students self-assessed significant competence gains in all 12 sub-competences of *Gestaltungskompetenz.*

The qualitative components of the evaluation have shown that the learning activities and learning assessments of the course are constructively aligned with the 12 learning outcomes on module level. In addition, the qualitative evaluations have shown that the students do not have to demonstrate the 12 underlying sub-competences of *Gestaltungskompetenz* through one single activity but acquire these competences continually throughout the entire *Blue Engineering Course*. The quantitative components of the evaluation have underlined this finding as well as a significant increase in the self-assessed level of competence.

This chapter on evaluation provides a robust and comprehensive design in order to evaluate a course according to its learning outcomes on module level. Therefore, it provides an immediate answer to the second research question of this research project. With regard to the first research question, this chapter demonstrated the practicality and effectivity of the learning outcomes on module level as they were used as criteria for the evaluation of the course. In addition, it showed that the design and conduction of the *Blue Engineering Course* helped to acquire the 12 sub-competences *Gestaltungskompetenz*.

Overall, this leads to the following design principle for the second research question:

The evaluation of the *Blue Engineering Course* according to its learning outcomes on module level comprised the following interventions, which may function as design principles:

- qualitative evaluation based on the learning outcomes on module level of the overall design of *Blue Engineering Course* comprising the general content and methods as well the (core) building blocks and the assessments
- a triangulation for three selected core building blocks which comprises a qualitative evaluation according to the learning outcomes on module level as well as perception-based test filled by the participants of the course, the responsible tutor and

an external observer - the items of the perception-based test are derived from the 12 learning outcomes on module level of the course.

- a comparative self-assessment of the students who assess their competence level at the beginning and at the end of a course according to a set of items which has been derived from the 12 learning outcomes on module level

Heeding these design principles leads to a comprehensive evaluation of the course with regard to the acquisition of the 12 sub-competences of *Gestaltungskompetenz* by the participants. The evaluation shows, that the participants continually acquire the 12 sub-competences in a course-specific context. However, the course design is broad enough in order to acquire not only specialized competences but rather a set of general key competences in order to facilitate a sustainable development.

7.6 - Outlook for Further Research

With regard to the first research question, it can be stated that the concept and design of the learning outcomes on the various levels of the *Blue Engineering Course* has reached its final version. In new educational design research projects, this framework can be applied in order to properly describe the learning outcomes of the (core) building blocks as well as the assessment elements of the entire course. This would need to include a rigorous constructive alignment of learning outcomes, learning activities and assessments. These two measures would further increase the overall quality of the course, especially if the respective elements are presented, discussed and further developed with the participants of each lesson and each course. In addition, the presented design down approach based on the use of *Gestaltungskompetenz* as well as the *Schaper Taxonomy Table* might help to further harmonize the description of competences and learning outcomes related to an education for sustainable development.

Based on a detailed description of the learning outcomes of the (core) building blocks, new formats of a quantitative and qualitative evaluation become possible. This would further extend the scope and quality of the perception-based test. In addition, the perception-based test as well as the comparative self-assessment are easily extendable and provide a robust basis so that they may be used for other courses. Especially the comparative self-assessment should be tested in other settings as well and with the objective of testing its validity and reliability. This seems necessary as the competence for self-assessment may not be sufficient. These proposed educational research projects would help extend the scope of the second research question.

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Appendix

Building Blocks

Introductory Building Block

The introductory lesson to the Blue Engineering Course at Technische Universität Berlin has two goals. On the one hand to familiarize the participants with the contents and on the other hand the participants get to know each each other through the interactive work phases and rotations. The introductory building block consists of the building block "Cat Video - Material and Social Requirements of Technology" and "100 Points - Factors of Technology Design", as well as a short lecture by the responsible professor on engineering ethics followed by a discussion and a short lecture presenting the key facts of the course.

Topic	Introduction to the Blue Engineering Course at Technische Universität Berlin
Tags	introduction, engineering ethics, complexity
Competences	Perspective-Taking; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Reflecting Principles
Methods	circle of chairs, mumbling groups, short lecture, combination of building blocks
Duration	180 minutes
Material	20 circles of 5 chairs, projector, name tags, snacks

Plastics

The core building block Plastics gives a broad introduction into that topic through e-learning, a short lecture, an exhibition and a role play. The building block unveils the effects of plastics in nature and in human life. This will lay the ground to address the broader question of how communities organize themselves and decide for and against the use of a technology, and who is involved in these decision-making processes. The e-learning covers the subject of plastics in a very broad way. The exhibition is mainly concerned with the effects of plastics on the oceans and the role play presents the controversial debate on bisphenol A by taking the roles in a TV debate.

Topic	plastics - an overview, especially plastics in the oceans and Bisphenol A
Tags	plastics, plastics in the oceans, BIsphenol A, decision-making
Competences	Perspective-Taking; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Coping with Dilemmas of Decision-Making; Motivating; Reflecting Principles
Methods	short lecturer, group work, exhibition, positioning game, role play
Duration	180 minutes
Material	projector, exhibition posters and artefacts, fact sheets, role drafts

Team-/Topic-Finding

In this lesson the participants will receive information on the preparation of term papers as well as important dates and key data in a short presentation. All are given the opportunity to present suggestions for topics (both their own and those suggested by the student tutors) in an elevator pitch. After the elevator pitches the participants float freely in the room and form groups. After this date, the team- and topic-finding phase is completed.

Topic	the students present their topics and groups themselves accordingly
Tags	open space
Competences	Cooperating; Participating; Motivating; Acting Morally; Acting Independently
Methods	elevator pitch, open space
Duration	90 minutes
Material	open space, all chairs and tables pushed to the walls

TINS-D Constellation

The theoretical grounding of the course will be laid out in a short lecture and after that the participants will use the presented concept themselves. The TINS-D Constellation described the reciprocal relations between technology, individuals, nature, society and democracy. The opposite poles of technology and nature as well as individual and society are in a reciprocal relationship - they are not the same - but they are mutually dependent and constituting each other. Democracy is placed in the middle in order to call for a democratization of the other coordinates All five coordinates are thus in a constant reciprocal relation, so that, for example, technology cannot be understood without individuals and society.

Topic	Introduction to the TINS-D Constellation
Tags	introduction, TINS-D Constellation
Competences	Perspective-Taking; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Coping with Dilemmas of Decision-Making; Reflecting Principles
Methods	positioning activity
Duration	90 minutes
Material	open space, all chairs and tables pushed to the walls

Technology as Problem-Solver!?

The participants of the building block are placed in different ages of mankind. They all face the same problem, that is the water supply is suddenly hazardous to health. They have to come up with solutions which they will present to their fellow students in short theater plays. This building block teaches them that water is a basic human need and at first it is only natural causes that makes water undrinkable. In the course of human history many other possible causes which caused by man himself. Another aspect is that possible solutions to problems often go hand in hand with consequential problems or serve solely to alleviate the symptoms without tackling the causes directly. Furthermore, the module addresses social aspects such as access to clean drinking water as a human right, the distribution of wealth as well as the gap between the polluters, the persons affected and decision-makers. It turns out that the individual epochs have a lot in common and the differences are essentially limited to a growing technologization.

Topic	An improvised theater play of how technology has been used throughout human history to solve a constant problem.
Tags	water, technology, theater play
Competences	Perspective-Taking; Anticipating; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Cooperating; Coping with Dilemmas of Decision-Making; Participating - to participate in collective decision-making processes; Reflecting Principles; Supporting Others
Methods	improvised theater play, discussion
Duration	180 minutes
Material	none

Responsibility and Ethical Codes

Students learn about conflicts of responsibility on the basis of various case studies. These are evaluated, alternative solutions are sought and further solutions are sought with the aid of three different ethical codes/newly created ethical codes. These will then be presented and discussed.

Topic	The responsibility and possibilities for action of engineers are pointed out and discussed on the basis of cases studies and ethical codes.
Tags	responsibility, values, ethics
Competences	Perspective-Taking; Dealing with Incomplete and Overly Complex Information; Cooperating; Coping with Dilemmas of Decision-Making; Participating - to participate in collective decision-making processes; Reflecting Principles; Acting Morally; Acting Independently
Methods	positioning activity, case studies, drawing and presentation of posters
Duration	180 minutes
Material	printed out case studies, posters, pens

The Productivistic Worldview

The text “The Productivistic Worldview” by Otto Ullrich deals with the prevailing "industrial way of life" and problems arising from it. Otto Ullrich divides his text into three sections. Section A is a description of the general problems, Section B deals with possible causes of the problems described in A. Section C shows some possible ways out. His description of the problems go back to the beginning of modern times. He tries to root out the causes of today's problems by describing the consequences of the Enlightenment, modern, experiment-based natural sciences and industrial capitalism. In small groups, the participants deal with individual sections of the text and discuss them together using key questions and terms. The contents of the discussion are then presented to the other participants of the course and discussed.

Topic	Identify and discuss the key aspects of the essay The Productivistic Worldview by Otto Ullrich
Tags	society-nature relations, social-ecological transformation
Competences	Perspective-Taking; Anticipating; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Coping with Dilemmas of Decision-Making; Reflecting Principles; Acting Morally; Acting Independently; Supporting Others
Methods	reading paragraphs, short presentations, discussions
Duration	180 minutes
Material	printed out case studies, posters, pens

Gender, Diversity and Technology

This building block introduces the participants to gender and diversity issues in general and in relation to the nature sciences and technology in particular. It encourages critical reflection of one's own person and behaviour as well as of social inequalities: 1) Lecture by an expert, either women officer or research; 2) The exhibition offers a basic introduction and information on the subject of gender and technology. 3) A short lecture/small group work shows how perspectives of Gender/Diversity Studies can be integrated into technology and natural sciences and how they are related to them. 4) An anti-discrimination exercise raises awareness of social inequalities and privileges.

Topic	Introduction to gender, diversity and technology - including a anti-discrimination excercise
Tags	gender, diversity, technology, anti-discrimination
Competences	Perspective-Taking; Gaining Interdisciplinary Knowledge; Dealing with Incomplete and Overly Complex Information; Coping with Dilemmas of Decision-Making; Participating; Reflecting Principles; Supporting Others
Methods	expert lecture, exhibition, positioning activity
Duration	180 minutes
Material	exhibition, printed out identity cards for activity

Work, Society and Labour Unions

The building block Work, Society and Labour Unions addresses the basic issues related to these three topics. Since engineers usually work as salary-dependent employees, it is deemed essential that they are familiar with the basic ideas of work, aspects of wage labour and working time. In addition, labour law entails various obligations for employees and, above all, rights arising from the Entgeltfortzahlungsgesetz [Continuation Remuneration Act], the Betriebsverfassungsgesetz [Works Constitution Act] and the Koalitionsfreiheit [freedom to form a coalition] that is guaranteed by the Grundgesetz [German Constitution]. In this lesson which is conducted together with a labour union representative, these aspects of work are imparted successively through short presentations by participants. After each short presentation, the trade union secretary supplements and comments on the presentation and then leads to an open question/discussion round.

Topic	Alienated work, working hours/time prosperity, trade unions/ collective bargaining agreements, works constitution law and cooperatives
Tags	work, labour unions, cooperatives
Competences	Perspective-Taking; Gaining Interdisciplinary Knowledge; Coping with Dilemmas of Decision-Making; Reflecting Principles; Supporting Others
Methods	expert lecture, short inputs by students, short films
Duration	180 minutes
Material	none

Appendix

Participants

Appendix - Participants

Semester	Study Program	Degree	Faculty
2011_2	EPT	Bachelor	III
2011_2	EPT	Diplom	III
2011_2	EPT	Bachelor	III
2011_2	EPT	Bachelor	III
2011_2	ET	Bachelor	IV
2011_2	MB	Master	V
2011_2	MB	Master	V
2011_2	MB	Master	V
2011_2	MB	Master	V
2011_2	MB	Bachelor	V
2011_2	MB	Bachelor	V
2011_2	MB	Bachelor	V
2011_2	MB	Master	V
2011_2	PI	Bachelor	V
2011_2	PI	Master	V
2011_2	PI	Bachelor	V
2011_2	PI	Bachelor	V
2011_2	PI	Bachelor	V
2011_2	RES	Master	III
2011_2	SOZ	Bachelor	VI
2011_2	SOZ	Bachelor	VI
2011_2	TUS	Bachelor	III
2011_2	WEWI	Bachelor	V
2011_2	WIING	Master	VII
2012_1	CHEM	Bachelor	II
2012_1	EPT	Bachelor	III
2012_1	EPT	Bachelor	III
2012_1	EPT	Bachelor	III
2012_1	EPT	Bachelor	III
2012_1	EPT	Bachelor	III
2012_1	EPT	Diplom	III
2012_1	GES	Master	III
2012_1	HUFA	Master	V
2012_1	LMT	Diplom	III
2012_1	MB	Bachelor	V
2012_1	MB	Master	V
2012_1	MB	Master	V
2012_1	MB	Bachelor	V
2012_1	MB	Master	V
2012_1	MB	Bachelor	V
2012_1	PI	Bachelor	V
2012_1	PI	Bachelor	V
2012_1	RES	Master	III
2012_1	TUS	Diplom	III
2012_1	VW	Bachelor	V
2012_1	VW	Bachelor	V
2012_1	VW	Bachelor	V
2012_1	WIING	Master	VII
2012_2	BAU	Bachelor	VI
2012_2	BIOT	Master	III
2012_2	EPT	Bachelor	III
2012_2	ET	Bachelor	IV
2012_2	ITM	Bachelor	V
2012_2	ITM	Master	V
2012_2	ITM	Bachelor	V
2012_2	MB	Master	V
2012_2	MB	Bachelor	V
2012_2	MB	Bachelor	V
2012_2	PI	Bachelor	V
2012_2	PI	Master	V
2012_2	PI	Bachelor	V
2012_2	PI	Master	V
2012_2	TUS	Bachelor	III
2012_2	VW	Bachelor	V
2012_2	VW	Bachelor	V
2012_2	VW	Master	V
2013_1	BAU	Bachelor	VI
2013_1	BIOT	Diplom	III
2013_1	BIOT	Bachelor	III
2013_1	EPT	Bachelor	III
2013_1	EPT	Bachelor	III
2013_1	EPT	Bachelor	III
2013_1	FT	Master	V
2013_1	FT	Master	V
2013_1	INF	Bachelor	IV
2013_1	KULT	Bachelor	I
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V
2013_1	MB	Master	V
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V
2013_1	MB	Bachelor	V

Abbreviations	Study Programs
ARCH	Architecture
AUTOS	Automotive Systems Engineering
BAU	Civil Engineering
BIOT	Biotechnology
BMEDT	Bio-Medical Technology
BRAU	Brewery Sciences
CHEM	Chemistry
CHING	Chemical Engineering
ECO	Economics
EPT	Enger- and Process Technology
ET	Electrical Engineering
EVT	Energy and Process Engineering
FT	Automotive Engineering
GEO	Geotechnology
GES	Building and Energy Services Engineering
HUFA	Human Factors
INF	Informatics
ITM	Computational Engineering Sciences
KULT	Culture and Technology
LAPLA	Landscape Architecture
LMT	Food Technology
LRT	Aircraft and Space Engineering
MATH	Mathematics
MB	Mechanical Engineering
MINT	STEM
NAMA	Sustainable Management
NIDI	Natural Sciences in the Information Society
PBVW	Transportation Planning and Operation
PEESE	Process, Energy, and Environmental Systems Engineering
PHYS	Physics
PI	Engineering Sciences
PROT	Production Engineering
RES	Renewable Energy Systems
SMT	Ship and Maritime Engineering
SOZ	Sociology
SRP	City and Regional Planning
TINF	Technical Informatics
TUS	Environmental Protection Engineering
UD	Urban Design
UP	Environmental Planning
VW	Transportation Engineering
WEWI	Materials Sciences
WIING	Industrial Engineering
WIMA	Mathematical Economics
WINF	Business Informatics
WTG	History of Sciences and Technology

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2013_1	MB	Bachelor	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Master	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Master	V					
	2013_1	MB	Bachelor	V					
	2013_1	MB	Bachelor	V					
	2013_1	MINT	Bachelor	II					
	2013_1	PI	Bachelor	V					
	2013_1	PI	Master	V					
	2013_1	PI	Master	V					
	2013_1	PI	Bachelor	V					
	2013_1	TUS	Bachelor	III					
	2013_1	TUS	Diplom	III					
	2013_1	VW	Bachelor	V					
	2013_1	VW	Bachelor	V					
	2013_1	VW	Bachelor	V					
	2013_1	VW	Bachelor	V					
	2013_1	WIING	Master	VII					
	2013_1	WIING	Master	VII					
	2013_1	WIING	Bachelor	VII					
	2013_2	ET	Bachelor	IV					
	2013_2	FT	Master	V					
	2013_2	FT	Master	V					
	2013_2	FT	Master	V					
	2013_2	HUFA	Master	V					
	2013_2	INF	Master	IV					
	2013_2	INF	Master	IV					
	2013_2	ITM	Master	V					
	2013_2	ITM	Bachelor	V					
	2013_2	ITM	Bachelor	V					
	2013_2	ITM	Master	V					
	2013_2	ITM	Master	V					
	2013_2	KULT	Bachelor	I					
	2013_2	LRT	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Bachelor	V					
	2013_2	MB	Master	V					
	2013_2	MB	Master	V					
	2013_2	PHYS	Bachelor	II					
	2013_2	PI	Master	V					
	2013_2	PI	Bachelor	V					
	2013_2	PI	Master	V					
	2013_2	PI	Bachelor	V					
	2013_2	PI	Master	V					
	2013_2	PI	Bachelor	V					
	2013_2	PI	Master	V					
	2013_2	RES	Master	III					
	2013_2	SMT	Master	V					
	2013_2	SRP	Bachelor	VI					
	2013_2	SRP	Bachelor	VI					
	2013_2	SRP	Bachelor	VI					
	2013_2	TINF	Bachelor	IV					
	2013_2	TINF	Bachelor	IV					
	2013_2	VW	Bachelor	V					
	2013_2	WIING	Bachelor	VII					
	2013_2	WIING	Master	VII					
	2013_2	WIING	Bachelor	VII					
	2013_2	WIING	Bachelor	VII					
	2013_2	WIING	Bachelor	VII					
	2014_1	BMEDT	Master	V					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2014_1	EPT	Diplom	III					
	2014_1	EPT	Bachelor	III					
	2014_1	EPT	Diplom	III					
	2014_1	EPT	Diplom	III					
	2014_1	ET	Bachelor	IV					
	2014_1	ET	Bachelor	IV					
	2014_1	ET	Bachelor	IV					
	2014_1	FT	Master	V					
	2014_1	INF	Master	IV					
	2014_1	INF	Bachelor	IV					
	2014_1	ITM	Master	V					
	2014_1	ITM	Bachelor	V					
	2014_1	LRT	Master	V					
	2014_1	MB	Master	V					
	2014_1	MB	Master	V					
	2014_1	MB	Master	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Master	V					
	2014_1	MB	Master	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Master	V					
	2014_1	MB	Master	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Master	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Bachelor	V					
	2014_1	MB	Master	V					
	2014_1	PHYS	Bachelor	II					
	2014_1	PI	Master	V					
	2014_1	PI	Master	V					
	2014_1	RES	Master	III					
	2014_1	SMT	Master	V					
	2014_1	UD	Master	VI					
	2014_1	VW	Bachelor	V					
	2014_1	VW	Master	V					
	2014_1	WEWI	Master	V					
	2014_1	WIING	Master	VII					
	2014_1	WIING	Bachelor	VII					
	2014_1	WIING	Bachelor	VII					
	2014_1	WIING	Bachelor	VII					
	2014_2	ARCH	Bachelor	VI					
	2014_2	AUTOS	Master	IV					
	2014_2	AUTOS	Master	IV					
	2014_2	AUTOS	Master	IV					
	2014_2	BAU	Bachelor	VI					
	2014_2	BIOT	Bachelor	III					
	2014_2	BMEDT	Master	V					
	2014_2	ECO	Bachelor	VII					
	2014_2	GES	Master	III					
	2014_2	INF	Bachelor	IV					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	ITM	Master	V					
	2014_2	LAPLA	Bachelor	VI					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Bachelor	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Bachelor	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Master	V					
	2014_2	MB	Bachelor	V					
	2014_2	PHYS	Master	II					
	2014_2	PI	Master	V					
	2014_2	PI	Bachelor	V					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2014_2	RES	Master	III					
	2014_2	RES	Master	III					
	2014_2	RES	Master	III					
	2014_2	RES	Master	III					
	2014_2	SRP	Master	VI					
	2014_2	TINF	Master	IV					
	2014_2	TINF	Bachelor	IV					
	2014_2	TUS	Bachelor	III					
	2014_2	TUS	Bachelor	III					
	2014_2	VW	Bachelor	V					
	2014_2	VW	Bachelor	V					
	2014_2	VW	Bachelor	V					
	2014_2	VW	Master	V					
	2014_2	VW	Master	V					
	2014_2	VW	Master	V					
	2014_2	WEWI	Bachelor	V					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Master	VII					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Bachelor	VII					
	2014_2	WIING	Master	VII					
	2014_2	WTG	Master	I					
	2015_1	MB	Master	V					
	2015_1	EPT	Bachelor	III					
	2015_1	ITM	Master	V					
	2015_1	SMT	Master	V					
	2015_1	MB	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	WIING	Bachelor	VII					
	2015_1	ITM	Master	V					
	2015_1	PI	Master	V					
	2015_1	MB	Master	V					
	2015_1	MB	Master	V					
	2015_1	PI	Master	V					
	2015_1	HUFA	Master	V					
	2015_1	MB	Master	V					
	2015_1	EVT	Master	III					
	2015_1	WIING	Master	VII					
	2015_1	WIING	Diplom	VII					
	2015_1	WIING	Master	VII					
	2015_1	INF	Master	IV					
	2015_1	LRT	Master	V					
	2015_1	MB	Master	V					
	2015_1	MB	Bachelor	V					
	2015_1	PI	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	PI	Bachelor	V					
	2015_1	INF	Diplom	IV					
	2015_1	WIING	Master	VII					
	2015_1	INF	Master	IV					
	2015_1	TUS	Bachelor	III					
	2015_1	MB	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	HUFA	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	PEESE	Master	III					
	2015_1	MB	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	MB	Master	V					
	2015_1	MB	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	MB	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	MB	Bachelor	V					
	2015_1	VW	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	MB	Master	V					
	2015_1	TUS	Master	III					
	2015_1	WIING	Bachelor	VII					
	2015_1	WIING	Master	VII					
	2015_1	WIING	Bachelor	VII					
	2015_1	BAU	Bachelor	VI					
	2015_1	PI	Bachelor	V					
	2015_1	WIING	Bachelor	VII					
	2015_1	WIING	Master	VII					
	2015_1	MB	Master	V					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2015_1	NIDI	Bachelor	II					
	2015_1	MB	Bachelor	V					
	2015_1	WIING	Master	VII					
	2015_1	MB	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	MB	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	WIING	Bachelor	VII					
	2015_1	VW	Bachelor	V					
	2015_1	ITM	Master	V					
	2015_1	WIING	Master	VII					
	2015_1	VW	Bachelor	V					
	2015_1	MB	Master	V					
	2015_1	MB	Master	V					
	2015_1	PBVW	Master	V					
	2015_1	MB	Master	V					
	2015_1	ITM	Master	V					
	2015_1	KULT	Bachelor	I					
	2015_1	EVT	Master	III					
	2015_1	LRT	Master	V					
	2015_1	MB	Master	V					
	2015_2	WIING	Master	VII					
	2015_2	VW	Bachelor	V					
	2015_2	FT	Master	V					
	2015_2	VW	Bachelor	V					
	2015_2	ET	Master	IV					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	PI	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	ITM	Master	V					
	2015_2	MB	Master	V					
	2015_2	ET	Master	IV					
	2015_2	MB	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	WIING	Bachelor	VII					
	2015_2	LRT	Master	V					
	2015_2	LRT	Master	V					
	2015_2	MB	Bachelor	V					
	2015_2	MB	Master	V					
	2015_2	MB	Master	V					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	MB	Master	V					
	2015_2	PI	Master	V					
	2015_2	ET	Master	IV					
	2015_2	WIING	Bachelor	VII					
	2015_2	MB	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	MB	Master	V					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	MB	Master	V					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	MB	Master	V					
	2015_2	MB	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	ITM	Master	V					
	2015_2	WIING	Bachelor	VII					
	2015_2	WIING	Bachelor	VII					
	2015_2	WEWI	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	BIOT	Bachelor	III					
	2015_2	MB	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	INF	Master	IV					
	2015_2	WIING	Master	VII					
	2015_2	FT	Master	V					
	2015_2	ITM	Bachelor	V					
	2015_2	WIING	Master	VII					
	2015_2	PROT	Master	V					
	2015_2	WIING	Master	VII					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2015_2	BAU	Bachelor	VI					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2015_2	WIING	Master	VII					
	2016_1	ET	Master	IV					
	2016_1	MB	Bachelor	V					
	2016_1	BAU	Master	VI					
	2016_1	WIING	Master	VII					
	2016_1	PROT	Master	V					
	2016_1	MB	Master	V					
	2016_1	GEO	Master	VI					
	2016_1	MB	Master	V					
	2016_1	EPT	Master	III					
	2016_1	NAMA	Master	VII					
	2016_1	TUS	Master	III					
	2016_1	WIING	Bachelor	VII					
	2016_1	MB	Master	V					
	2016_1	FT	Bachelor	V					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Bachelor	VII					
	2016_1	WIING	Master	VII					
	2016_1	MB	Master	V					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Master	VII					
	2016_1	NAMA	Bachelor	VII					
	2016_1	MATH	Bachelor	II					
	2016_1	MB	Master	V					
	2016_1	WIING	Bachelor	VII					
	2016_1	WIING	Bachelor	VII					
	2016_1	GEO	Master	VI					
	2016_1	MB	Bachelor	V					
	2016_1	MINT	Bachelor	II					
	2016_1	WIING	Master	VII					
	2016_1	VW	Master	V					
	2016_1	MB	Master	V					
	2016_1	WINF	Bachelor	IV					
	2016_1	WIING	Bachelor	VII					
	2016_1	RES	Bachelor	III					
	2016_1	MINT	Master	II					
	2016_1	NAMA	Master	VII					
	2016_1	MATH	Master	II					
	2016_1	CHING	Bachelor	II					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Bachelor	VII					
	2016_1	WIING	Master	VII					
	2016_1	VW	Master	V					
	2016_1	FT	Master	V					
	2016_1	WIING	Master	VII					
	2016_1	NAMA	Master	VII					
	2016_1	PI	Master	V					
	2016_1	INF	Master	IV					
	2016_1	BAU	Master	VI					
	2016_1	MB	Bachelor	V					
	2016_1	MB	Bachelor	V					
	2016_1	WIING	Bachelor	VII					
	2016_1	MB	Master	V					
	2016_1	GEO	Master	VI					
	2016_1	MB	Master	V					
	2016_1	GEO	Master	VI					
	2016_1	BAU	Master	VI					
	2016_1	MB	Master	V					
	2016_1	MB	Master	V					
	2016_1	WIMA	Bachelor	II					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Master	VII					
	2016_1	WIING	Master	VII					
	2016_1	MB	Bachelor	V					
	2016_1	PI	Bachelor	V					
	2016_1	MB	Master	V					
	2016_1	MB	Master	V					
	2016_1	FT	Bachelor	V					
	2016_1	ITM	Bachelor	V					
	2016_1	WIING	Bachelor	VII					
	2016_1	WIING	Bachelor	VII					
	2016_1	PROT	Bachelor	V					
	2016_1	INF	Bachelor	IV					
	2016_1	MB	Bachelor	V					
	2016_1	WIING	Bachelor	VII					
	2016_1	WIING	Master	VII					
	2016_1	RES	Master	III					
	2016_1	MINT	Bachelor	II					
	2016_2	WIING	Master	VII					
	2016_2	MB	Master	V					
	2016_2	MB	Master	V					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2016_2	WIING	Master	VII					
	2016_2	MINT	Bachelor	II					
	2016_2	PI	Master	V					
	2016_2	MINT	Bachelor	II					
	2016_2	WIING	Master	VII					
	2016_2	BRAU	Bachelor	III					
	2016_2	MINT	Bachelor	II					
	2016_2	WIING	Master	VII					
	2016_2	EPT	Bachelor	III					
	2016_2	BAU	Bachelor	VI					
	2016_2	WIING	Master	VII					
	2016_2	MB	Master	V					
	2016_2	ITM	Master	V					
	2016_2	ET	Bachelor	IV					
	2016_2	PHYS	Bachelor	II					
	2016_2	MB	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	NAMA	Bachelor	VII					
	2016_2	WIING	Master	VII					
	2016_2	WIING	Master	VII					
	2016_2	NAMA	Bachelor	VII					
	2016_2	ITM	Bachelor	V					
	2016_2	PI	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	MB	Master	V					
	2016_2	MB	Bachelor	V					
	2016_2	ITM	Master	V					
	2016_2	GEO	Bachelor	VI					
	2016_2	ITM	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	MATH	Bachelor	II					
	2016_2	MB	Bachelor	V					
	2016_2	WIING	Master	VII					
	2016_2	MB	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	WIING	Diplom	VII					
	2016_2	MB	Master	V					
	2016_2	EVT	Master	III					
	2016_2	MB	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	MB	Master	V					
	2016_2	WIING	Master	VII					
	2016_2	TINF	Master	IV					
	2016_2	MB	Master	V					
	2016_2	MB	Bachelor	V					
	2016_2	TUS	Bachelor	III					
	2016_2	TUS	Master	III					
	2016_2	WIING	Bachelor	VII					
	2016_2	MB	Master	V					
	2016_2	VW	Bachelor	V					
	2016_2	PBVW	Master	V					
	2016_2	VW	Bachelor	V					
	2016_2	VW	Bachelor	V					
	2016_2	MB	Bachelor	V					
	2017_1	NAMA	Bachelor	VII					
	2017_1	MB	Master	V					
	2017_1	NAMA	Bachelor	VII					
	2017_1	WIING	Master	VII					
	2017_1	INF	Master	IV					
	2017_1	PI	Bachelor	V					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	PROT	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	MB	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	LMT	Bachelor	III					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Bachelor	VII					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2017_1	WIING	Master	VII					
	2017_1	PI	Master	V					
	2017_1	MATH	Bachelor	II					
	2017_1	WIING	Master	VII					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	MB	Master	V					
	2017_1	MB	Master	V					
	2017_1	MB	Master	V					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	MB	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	MB	Master	V					
	2017_1	WIING	Master	VII					
	2017_1	WEWI	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	WIING	Master	VII					
	2017_1	MB	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	MB	Bachelor	V					
	2017_1	WIING	Bachelor	VII					
	2017_1	WIING	Master	VII					
	2017_1	PI	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	BAU	Bachelor	VI					
	2017_1	BAU	Bachelor	VI					
	2017_1	BIOT	Master	III					
	2017_1	GEO	Master	VI					
	2017_1	TUS	Bachelor	III					
	2017_1	WIING	Master	VII					
	2017_1	MB	Master	V					
	2017_1	ET	Master	IV					
	2017_1	WIING	Master	VII					
	2017_1	GEO	Bachelor	VI					
	2017_1	KULT	Bachelor	I					
	2017_1	BRAU	Bachelor	III					
	2017_1	WIING	Master	VII					
	2017_1	MB	Bachelor	V					
	2017_1	SRP	Bachelor	VI					
	2017_1	WIING	Master	VII					
	2017_1	ITM	Bachelor	V					
	2017_1	MB	Bachelor	V					
	2017_1	VW	Bachelor	V					
	2017_1	WIING	Master	VII					
	2017_1	GEO	Bachelor	VI					
	2017_2	VW	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	UP	Master	VI					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	VW	Bachelor	V					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Bachelor	VII					
	2017_2	GEO	Bachelor	VI					
	2017_2	WIING	Master	VII					
	2017_2	GEO	Bachelor	VI					
	2017_2	GES	Master	III					
	2017_2	MINT	Bachelor	II					
	2017_2	GEO	Bachelor	VI					
	2017_2	VW	Bachelor	V					
	2017_2	BRAU	Master	III					
	2017_2	BRAU	Master	III					
	2017_2	GEO	Bachelor	VI					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MINT	Bachelor	II					
	2017_2	MB	Master	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Bachelor	VII					

Appendix - Participants

	Semester	Study Program	Degree	Faculty		Abbreviations	Study Programs		
	2017_2	ITM	Master	V					
	2017_2	WIING	Bachelor	VII					
	2017_2	EPT	Bachelor	III					
	2017_2	BAU	Bachelor	VI					
	2017_2	MB	Bachelor	V					
	2017_2	CHING	Master	II					
	2017_2	WIING	Bachelor	VII					
	2017_2	MINT	Bachelor	II					
	2017_2	ET	Bachelor	IV					
	2017_2	VW	Bachelor	V					
	2017_2	MB	Master	V					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	FT	Master	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	PHYS	Bachelor	II					
	2017_2	WIING	Master	VII					
	2017_2	VW	Bachelor	V					
	2017_2	MINT	Bachelor	II					
	2017_2	WIING	Master	VII					
	2017_2	BIOT	Bachelor	III					
	2017_2	WIING	Bachelor	VII					
	2017_2	MB	Master	V					
	2017_2	MB	Master	V					
	2017_2	MB	Master	V					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	NAMA	Bachelor	VII					
	2017_2	TUS	Bachelor	III					
	2017_2	NAMA	Bachelor	VII					
	2017_2	NAMA	Bachelor	VII					
	2017_2	GEO	Bachelor	VI					
	2017_2	MINT	Bachelor	II					
	2017_2	GEO	Bachelor	VI					
	2017_2	VW	Bachelor	V					
	2017_2	MINT	Bachelor	II					
	2017_2	ITM	Master	V					
	2017_2	VW	Bachelor	V					
	2017_2	MB	Master	V					
	2017_2	MINT	Bachelor	II					
	2017_2	MINT	Bachelor	II					
	2017_2	VW	Bachelor	V					
	2017_2	VW	Bachelor	V					
	2017_2	VW	Bachelor	V					
	2017_2	PI	Master	V					
	2017_2	MB	Bachelor	V					
	2017_2	MINT	Bachelor	II					
	2017_2	MB	Master	V					
	2017_2	MINT	Bachelor	II					
	2017_2	MB	Master	V					
	2017_2	PROT	Master	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Bachelor	V					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	WIING	Master	VII					
	2017_2	MB	Master	V					
	2017_2	MB	Master	V					
	2017_2	WIING	Bachelor	VII					
	2017_2	WIING	Bachelor	VII					
	2017_2	MB	Master	V					
	2017_2	WIING	Bachelor	VII					
	2017_2	ITM	Master	V					
	2017_2	WIING	Master	VII					
	2017_2	MB	Master	V					
	2017_2	NAMA	Bachelor	VII					
	2017_2	WIING	Bachelor	VII					
	2017_2	PI	Bachelor	V					

Appendix

Perception-Based Test

Questionnaires

Blue Engineering Seminar - Beobachter_in

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.
Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

		stimme nicht zu					stimme zu
1.1	Den Studierenden war klar, was sie in der Sitzung lernen sollten		☐	☐	☐	☐	
1.2	Die Teilnehmenden haben sich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden		☐	☐	☐	☐	
1.3	In dieser Sitzung haben die Studierenden etwas dazu gelernt		☐	☐	☐	☐	
1.4	Während der Sitzung haben die Studierenden andere Perspektiven/Standpunkte kennen und schätzen gelernt		☐	☐	☐	☐	
1.5	Die Studierenden waren die Sitzung über aktiv bei der Sache		☐	☐	☐	☐	
1.6	Die Teilnehmenden haben heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert		☐	☐	☐	☐	
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung		☐	☐	☐	☐	
1.8	Die wichtigsten Punkte wurden klar herausgearbeitet		☐	☐	☐	☐	
1.9	Die Studierenden haben sich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt		☐	☐	☐	☐	
1.10	Es wurden Fragen aufgeworfen, die den Studierenden zu denken geben		☐	☐	☐	☐	
1.11	Den Teilnehmenden war jederzeit klar, was sie tun sollten		☐	☐	☐	☐	
1.12	Während der Sitzung haben die Studierenden sich mit ihren Wertvorstellungen befasst		☐	☐	☐	☐	
1.13	Die Studierenden haben sich ermutigt gefühlt, sich an Diskussionen zu beteiligen		☐	☐	☐	☐	
1.14	Der Tutor/die Tutorin verbindet in ihren_seinen Beiträgen die vorherigen Sitzungen mit der aktuellen		☐	☐	☐	☐	
1.15	Die Teilnehmenden haben heute Kenntnisse außerhalb ihrer Fachdisziplin erworben		☐	☐	☐	☐	
1.16	Es gab Raum für Kreativität und neue Ideen		☐	☐	☐	☐	
1.17	Die Sitzung hat die Studierenden motiviert, auch außerhalb des Seminars aktiv zu werden		☐	☐	☐	☐	
1.18	Die Studierenden sind mit dem Ergebnis ihrer Gruppenarbeit zufrieden		☐	☐	☐	☐	
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen		☐	☐	☐	☐	
1.20	Wenn die Studierenden es wollten, konnten sie sich an Diskussionen beteiligen		☐	☐	☐	☐	
1.21	In der Sitzung haben die Studierenden aktiv Bezüge zu früheren Sitzungen hergestellt		☐	☐	☐	☐	
1.22	Die Teilnehmenden haben andere Meinungen, als die ihrige, als Bereicherung erlebt		☐	☐	☐	☐	
1.23	Es gab auch mal was zum Lachen in der Sitzung		☐	☐	☐	☐	
1.24	In der Kleingruppe konnten die Studierenden selbständig ohne die Hilfe des Tutors/der Tutorin arbeiten		☐	☐	☐	☐	
1.25	In der Sitzung mussten die Studierenden mit Wert- und Zielkonflikten umgehen		☐	☐	☐	☐	

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu					stimme zu
1.26	Die Studierenden haben sich heute mit ihrer individuellen Verantwortung auseinandergesetzt		☐	☐	☐	☐	
1.27	Die Teilnehmenden haben heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt		☐	☐	☐	☐	
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen		☐	☐	☐	☐	
1.29	Die Teilnehmenden können Bezüge zwischen den einzelnen Sitzungen erkennen		☐	☐	☐	☐	
1.30	Zusammen mit anderen haben sich die Studierenden mit der gesellschaftlichen Verantwortung auseinandergesetzt		☐	☐	☐	☐	
1.31	Die Teilnehmenden haben sich in dieser Sitzung wohl gefühlt		☐	☐	☐	☐	
1.32	Der Anspruch des Seminars ist für die Teilnehmenden nicht zu schwierig und nicht zu leicht, sondern gerade richtig		☐	☐	☐	☐	
1.33	Die Sitzung war für die Studierenden sehr abwechslungsreich		☐	☐	☐	☐	
1.34	In der Sitzung mussten die Teilnehmenden mit unvollständigen und überkomplexen Informationen umgehen		☐	☐	☐	☐	
1.35	Der Tutor/die Tutorin hat eine lernförderliche Atmosphäre geschaffen		☐	☐	☐	☐	
1.36	Die Teilnehmenden haben heute andere motiviert aktiv zu werden		☐	☐	☐	☐	

2. Persönliche Angaben

2.1 Raum:

☐ H3006 ☐ H3007 ☐ H3008

2.2 Thema:

☐ Verantwortung und Kodizes ☐ Technik als Problemlöser!? ☐ Das Produktivistische Weltbild

Blue Engineering Seminar - Teilnehmende

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

		stimme nicht zu				stimme zu
1.1	Mir war klar, was ich in der Sitzung lernen sollte		☐	☐	☐	☐
1.2	Ich habe mich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden		☐	☐	☐	☐
1.3	Ich habe in dieser Sitzung etwas dazu gelernt		☐	☐	☐	☐
1.4	Während der Sitzung habe ich andere Perspektiven/ Standpunkte kennen und schätzen gelernt		☐	☐	☐	☐
1.5	Ich war die Sitzung über aktiv bei der Sache		☐	☐	☐	☐
1.6	Ich habe heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert		☐	☐	☐	☐
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung		☐	☐	☐	☐
1.8	Ich habe mich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt		☐	☐	☐	☐
1.9	Die wichtigsten Punkte wurden klar herausgearbeitet		☐	☐	☐	☐
1.10	Es wurden Fragen aufgeworfen, die mir zu denken geben		☐	☐	☐	☐
1.11	Mir war jederzeit klar, was ich tun sollte		☐	☐	☐	☐
1.12	Während der Sitzung habe ich mich mit meinen Wertvorstellungen befasst		☐	☐	☐	☐
1.13	Ich habe mich ermutigt gefühlt, mich an Diskussionen zu beteiligen		☐	☐	☐	☐
1.14	Die Tutorin/der Tutor verbindet in ihren_seinen Beiträgen die vorherigen Sitzungen mit der aktuellen		☐	☐	☐	☐
1.15	Ich habe heute Kenntnisse außerhalb meiner Fachdisziplin erworben		☐	☐	☐	☐
1.16	Es gab Raum für Kreativität und neue Ideen		☐	☐	☐	☐
1.17	Die Sitzung hat mich motiviert, auch außerhalb des Seminars aktiv zu werden		☐	☐	☐	☐
1.18	Ich bin mit dem Ergebnis unserer Gruppenarbeit zufrieden		☐	☐	☐	☐
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen		☐	☐	☐	☐
1.20	Wenn ich es wollte, konnte ich mich an Diskussionen beteiligen		☐	☐	☐	☐
1.21	In der Sitzung habe ich aktiv Bezüge zu früheren Sitzungen hergestellt		☐	☐	☐	☐
1.22	Ich habe andere Meinungen, als die meinige, als Bereicherung erlebt		☐	☐	☐	☐
1.23	Es gab auch mal was zum Lachen in der Sitzung		☐	☐	☐	☐
1.24	In der Kleingruppe konnten wir selbständig ohne Hilfe des Tutors/der Tutorin arbeiten		☐	☐	☐	☐
1.25	In der Sitzung musste ich mit Wert- und Zielkonflikten umgehen		☐	☐	☐	☐

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu				stimme zu
1.26	Ich habe mich heute mit meiner individuellen Verantwortung auseinandergesetzt		☐	☐	☐	☐
1.27	Ich habe heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt		☐	☐	☐	☐
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen		☐	☐	☐	☐
1.29	Ich kann Bezüge zwischen den einzelnen Sitzungen erkennen		☐	☐	☐	☐
1.30	Zusammen mit anderen habe ich mich mit der gesellschaftlichen Verantwortung auseinandergesetzt		☐	☐	☐	☐
1.31	Ich habe mich in dieser Sitzung wohl gefühlt		☐	☐	☐	☐
1.32	Der Anspruch des Seminars ist nicht zu schwierig und nicht zu leicht, sondern gerade richtig		☐	☐	☐	☐
1.33	Ich finde die Sitzung war sehr abwechslungsreich		☐	☐	☐	☐
1.34	In der Sitzung musste ich mit unvollständigen und überkomplexen Informationen umgehen		☐	☐	☐	☐
1.35	Der Tutor/die Tutorin hat eine lernförderliche Atmosphäre geschaffen		☐	☐	☐	☐
1.36	Ich habe heute andere motiviert aktiv zu werden		☐	☐	☐	☐

2. Persönliche Angaben

2.1 Raum:
☐ H3006 ☐ H3007 ☐ H3008

2.2 Thema:
☐ Verantwortung und Kodizes ☐ Technik als Problemlöser!? ☐ Das Produktivistische Weltbild

2.3 Studienphase:
☐ Bachelor ☐ Master ☐ Diplom

2.4 Geschlecht:
☐ männlich ☐ weiblich ☐ anderes Geschlecht
☐ keine Angabe

EvaSys		Electric Paper

Blue Engineering Seminar - Tutor_in

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

1.1	Den Studierenden war klar, was sie in der Sitzung lernen sollten	**stimme nicht zu**	☐	☐	☐	☐	**stimme zu**
1.2	Die Teilnehmenden haben sich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden		☐	☐	☐	☐	
1.3	In dieser Sitzung haben die Studierenden etwas dazu gelernt		☐	☐	☐	☐	
1.4	Während der Sitzung haben die Studierenden andere Perspektiven/Standpunkte kennen und schätzen gelernt		☐	☐	☐	☐	
1.5	Die Studierenden waren die Sitzung über aktiv bei der Sache		☐	☐	☐	☐	
1.6	Die Teilnehmenden haben heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert		☐	☐	☐	☐	
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung		☐	☐	☐	☐	
1.8	Die wichtigsten Punkte wurden klar herausgearbeitet		☐	☐	☐	☐	
1.9	Die Studierenden haben sich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt		☐	☐	☐	☐	
1.10	Es wurden Fragen aufgeworfen, die den Studierenden zu denken geben		☐	☐	☐	☐	
1.11	Den Teilnehmenden war jederzeit klar, was sie tun sollten		☐	☐	☐	☐	
1.12	Während der Sitzung haben die Studierenden sich mit ihren Wertvorstellungen befasst		☐	☐	☐	☐	
1.13	Die Studierenden haben sich ermutigt gefühlt, sich an Diskussionen zu beteiligen		☐	☐	☐	☐	
1.14	Ich verbinde in meinen Beiträgen die vorherigen Sitzungen mit der aktuellen		☐	☐	☐	☐	
1.15	Die Teilnehmenden haben heute Kenntnisse außerhalb ihrer Fachdisziplin erworben		☐	☐	☐	☐	
1.16	Es gab Raum für Kreativität und neue Ideen		☐	☐	☐	☐	
1.17	Die Sitzung hat die Studierenden motiviert, auch außerhalb des Seminars aktiv zu werden		☐	☐	☐	☐	
1.18	Die Studierenden sind mit dem Ergebnis ihrer Gruppenarbeit zufrieden		☐	☐	☐	☐	
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen		☐	☐	☐	☐	
1.20	Wenn die Studierenden es wollten, konnten sie sich an Diskussionen beteiligen		☐	☐	☐	☐	
1.21	In der Sitzung haben die Studierenden aktiv Bezüge zu früheren Sitzungen hergestellt		☐	☐	☐	☐	
1.22	Die Teilnehmenden haben andere Meinungen, als die ihrige, als Bereicherung erlebt		☐	☐	☐	☐	
1.23	Es gab auch mal was zum Lachen in der Sitzung		☐	☐	☐	☐	
1.24	In der Kleingruppe konnten die Studierenden selbständig ohne meine Hilfe arbeiten		☐	☐	☐	☐	
1.25	In der Sitzung mussten die Studierenden mit Wert- und Zielkonflikten umgehen		☐	☐	☐	☐	

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu					stimme zu
1.26	Die Studierenden haben sich heute mit ihrer individuellen Verantwortung auseinandergesetzt		☐	☐	☐	☐	
1.27	Die Teilnehmenden haben heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt		☐	☐	☐	☐	
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen		☐	☐	☐	☐	
1.29	Die Teilnehmenden können Bezüge zwischen den einzelnen Sitzungen erkennen		☐	☐	☐	☐	
1.30	Zusammen mit anderen haben sich die Studierenden mit der gesellschaftlichen Verantwortung auseinandergesetzt		☐	☐	☐	☐	
1.31	Die Teilnehmenden haben sich in dieser Sitzung wohl gefühlt		☐	☐	☐	☐	
1.32	Der Anspruch des Seminars ist für die Teilnehmenden nicht zu schwierig und nicht zu leicht, sondern gerade richtig		☐	☐	☐	☐	
1.33	Die Sitzung war für die Studierenden sehr abwechslungsreich		☐	☐	☐	☐	
1.34	In der Sitzung mussten die Teilnehmenden mit unvollständigen und überkomplexen Informationen umgehen		☐	☐	☐	☐	
1.35	Ich habe eine lernförderliche Atmosphäre geschaffen		☐	☐	☐	☐	
1.36	Die Teilnehmenden haben heute andere motiviert aktiv zu werden		☐	☐	☐	☐	

2. Persönliche Angaben

2.1 Raum:
☐ H3006 ☐ H3007 ☐ H3008

2.2 Thema:
☐ Verantwortung und Kodizes ☐ Technik als Problemlöser!? ☐ Das Produktivistische Weltbild

Blue Engineering Seminar - Beobachter_in

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

		stimme nicht zu			stimme zu
1.1	Den Studierenden war klar, was sie in der Sitzung lernen sollten	☐	☐	☐	☐
1.2	Die Teilnehmenden haben sich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden	☐	☐	☐	☐
1.3	In dieser Sitzung haben die Studierenden etwas dazu gelernt	☐	☐	☐	☐
1.4	Während der Sitzung haben die Studierenden andere Perspektiven/Standpunkte kennen und schätzen gelernt	☐	☐	☐	☐
1.5	Die Studierenden waren die Sitzung über aktiv bei der Sache	☐	☐	☐	☐
1.6	Die Teilnehmenden haben heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert	☐	☐	☐	☐
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung	☐	☐	☐	☐
1.8	Die wichtigsten Punkte wurden klar herausgearbeitet	☐	☐	☐	☐
1.9	Die Studierenden haben sich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt	☐	☐	☐	☐
1.10	Es wurden Fragen aufgeworfen, die den Studierenden zu denken geben	☐	☐	☐	☐
1.11	Den Teilnehmenden war jederzeit klar, was sie tun sollten	☐	☐	☐	☐
1.12	Während der Sitzung haben die Studierenden sich mit ihren Wertvorstellungen befasst	☐	☐	☐	☐
1.13	Die Studierenden haben sich ermutigt gefühlt, sich an Diskussionen zu beteiligen	☐	☐	☐	☐
1.14	Der Tutor/die Tutorin verbindet in ihren_seinen Beiträgen die vorherigen Sitzungen mit der aktuellen	☐	☐	☐	☐
1.15	Die Teilnehmenden haben heute Kenntnisse außerhalb ihrer Fachdisziplin erworben	☐	☐	☐	☐
1.16	Es gab Raum für Kreativität und neue Ideen	☐	☐	☐	☐
1.17	Die Sitzung hat die Studierenden motiviert, auch außerhalb des Seminars aktiv zu werden	☐	☐	☐	☐
1.18	Die Studierenden sind mit dem Ergebnis ihrer Gruppenarbeit zufrieden	☐	☐	☐	☐
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen	☐	☐	☐	☐
1.20	Wenn die Studierenden es wollten, konnten sie sich an Diskussionen beteiligen	☐	☐	☐	☐
1.21	In der Sitzung haben die Studierenden aktiv Bezüge zu früheren Sitzungen hergestellt	☐	☐	☐	☐
1.22	Die Teilnehmenden haben andere Meinungen, als die ihrige, als Bereicherung erlebt	☐	☐	☐	☐
1.23	Es gab auch mal was zum Lachen in der Sitzung	☐	☐	☐	☐
1.24	In der Kleingruppe konnten die Studierenden selbständig ohne die Hilfe des Tutors/der Tutorin arbeiten	☐	☐	☐	☐
1.25	In der Sitzung mussten die Studierenden mit Wert- und Zielkonflikten umgehen	☐	☐	☐	☐

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu			stimme zu
1.26	Die Studierenden haben sich heute mit ihrer individuellen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.27	Die Teilnehmenden haben heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt	☐	☐	☐	☐
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen	☐	☐	☐	☐
1.29	Die Teilnehmenden können Bezüge zwischen den einzelnen Sitzungen erkennen	☐	☐	☐	☐
1.30	Zusammen mit anderen haben sich die Studierenden mit der gesellschaftlichen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.31	Die Teilnehmenden haben sich in dieser Sitzung wohl gefühlt	☐	☐	☐	☐
1.32	Der Anspruch des Seminars ist für die Teilnehmenden nicht zu schwierig und nicht zu leicht, sondern gerade richtig	☐	☐	☐	☐
1.33	Die Sitzung war für die Studierenden sehr abwechslungsreich	☐	☐	☐	☐
1.34	In der Sitzung mussten die Teilnehmenden mit unvollständigen und überkomplexen Informationen umgehen	☐	☐	☐	☐
1.35	Der Tutor/die Tutorin hat eine lernförderliche Atmosphäre geschaffen	☐	☐	☐	☐
1.36	Die Teilnehmenden haben heute andere motiviert aktiv zu werden	☐	☐	☐	☐

2. Persönliche Angaben

2.1 Datum:

☐ 06. Nov ☐ 13. Nov ☐ 20. Nov
☐ 27. Nov

2.2 Thema:

☐ Verantwortung und Kodizes ☐ Technik als Problemlöser!? ☐ Das Produktivistische Weltbild

EvaSys	Wintersemester 2017/2018	Electric Paper

Blue Engineering Seminar - Teilnehmende

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

		stimme nicht zu			stimme zu
1.1	Mir war klar, was ich in der Sitzung lernen sollte	☐	☐	☐	☐
1.2	Ich habe mich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden	☐	☐	☐	☐
1.3	Ich habe in dieser Sitzung etwas dazu gelernt	☐	☐	☐	☐
1.4	Während der Sitzung habe ich andere Perspektiven/ Standpunkte kennen und schätzen gelernt	☐	☐	☐	☐
1.5	Ich war die Sitzung über aktiv bei der Sache	☐	☐	☐	☐
1.6	Ich habe heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert	☐	☐	☐	☐
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung	☐	☐	☐	☐
1.8	Ich habe mich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt	☐	☐	☐	☐
1.9	Die wichtigsten Punkte wurden klar herausgearbeitet	☐	☐	☐	☐
1.10	Es wurden Fragen aufgeworfen, die mir zu denken geben	☐	☐	☐	☐
1.11	Mir war jederzeit klar, was ich tun sollte	☐	☐	☐	☐
1.12	Während der Sitzung habe ich mich mit meinen Wertvorstellungen befasst	☐	☐	☐	☐
1.13	Ich habe mich ermutigt gefühlt, mich an Diskussionen zu beteiligen	☐	☐	☐	☐
1.14	Die Tutorin/der Tutor verbindet in ihren_seinen Beiträgen die vorherigen Sitzungen mit der aktuellen	☐	☐	☐	☐
1.15	Ich habe heute Kenntnisse außerhalb meiner Fachdisziplin erworben	☐	☐	☐	☐
1.16	Es gab Raum für Kreativität und neue Ideen	☐	☐	☐	☐
1.17	Die Sitzung hat mich motiviert, auch außerhalb des Seminars aktiv zu werden	☐	☐	☐	☐
1.18	Ich bin mit dem Ergebnis unserer Gruppenarbeit zufrieden	☐	☐	☐	☐
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen	☐	☐	☐	☐
1.20	Wenn ich es wollte, konnte ich mich an Diskussionen beteiligen	☐	☐	☐	☐
1.21	In der Sitzung habe ich aktiv Bezüge zu früheren Sitzungen hergestellt	☐	☐	☐	☐
1.22	Ich habe andere Meinungen, als die meinige, als Bereicherung erlebt	☐	☐	☐	☐
1.23	Es gab auch mal was zum Lachen in der Sitzung	☐	☐	☐	☐
1.24	In der Kleingruppe konnten wir selbständig ohne Hilfe des Tutors/der Tutorin arbeiten	☐	☐	☐	☐
1.25	In der Sitzung musste ich mit Wert- und Zielkonflikten umgehen	☐	☐	☐	☐

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu			stimme zu
1.26	Ich habe mich heute mit meiner individuellen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.27	Ich habe heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt	☐	☐	☐	☐
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen	☐	☐	☐	☐
1.29	Ich kann Bezüge zwischen den einzelnen Sitzungen erkennen	☐	☐	☐	☐
1.30	Zusammen mit anderen habe ich mich mit der gesellschaftlichen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.31	Ich habe mich in dieser Sitzung wohl gefühlt	☐	☐	☐	☐
1.32	Der Anspruch des Seminars ist nicht zu schwierig und nicht zu leicht, sondern gerade richtig	☐	☐	☐	☐
1.33	Ich finde die Sitzung war sehr abwechslungsreich	☐	☐	☐	☐
1.34	In der Sitzung musste ich mit unvollständigen und überkomplexen Informationen umgehen	☐	☐	☐	☐
1.35	Der Tutor/die Tutorin hat eine lernförderliche Atmosphäre geschaffen	☐	☐	☐	☐
1.36	Ich habe heute andere motiviert aktiv zu werden	☐	☐	☐	☐

2. Persönliche Angaben

2.1 Datum:
- ☐ 06. Nov
- ☐ 13. Nov
- ☐ 20. Nov
- ☐ 27. Nov

2.2 Thema:
- ☐ Verantwortung und Kodizes
- ☐ Technik als Problemlöser!?
- ☐ Das Produktivistische Weltbild

2.3 Studienphase:
- ☐ Bachelor
- ☐ Master
- ☐ Diplom

2.4 Geschlecht:
- ☐ männlich
- ☐ weiblich
- ☐ anderes Geschlecht
- ☐ keine Angabe

Blue Engineering Seminar - Tutor_in

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation der Grundbausteine

1.1	Den Studierenden war klar, was sie in der Sitzung lernen sollten	**stimme nicht zu** ☐	☐	☐	☐	**stimme zu**
1.2	Die Teilnehmenden haben sich heute mit der Situation von Menschen befasst, die aktuell benachteiligt werden	☐	☐	☐	☐	
1.3	In dieser Sitzung haben die Studierenden etwas dazu gelernt	☐	☐	☐	☐	
1.4	Während der Sitzung haben die Studierenden andere Perspektiven/Standpunkte kennen und schätzen gelernt	☐	☐	☐	☐	
1.5	Die Studierenden waren die Sitzung über aktiv bei der Sache	☐	☐	☐	☐	
1.6	Die Teilnehmenden haben heute über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert	☐	☐	☐	☐	
1.7	Es gab eine klare Zeitstruktur für die gesamte Sitzung	☐	☐	☐	☐	
1.8	Die wichtigsten Punkte wurden klar herausgearbeitet	☐	☐	☐	☐	
1.9	Die Studierenden haben sich heute mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt	☐	☐	☐	☐	
1.10	Es wurden Fragen aufgeworfen, die den Studierenden zu denken geben	☐	☐	☐	☐	
1.11	Den Teilnehmenden war jederzeit klar, was sie tun sollten	☐	☐	☐	☐	
1.12	Während der Sitzung haben die Studierenden sich mit ihren Wertvorstellungen befasst	☐	☐	☐	☐	
1.13	Die Studierenden haben sich ermutigt gefühlt, sich an Diskussionen zu beteiligen	☐	☐	☐	☐	
1.14	Ich verbinde in meinen Beiträgen die vorherigen Sitzungen mit der aktuellen	☐	☐	☐	☐	
1.15	Die Teilnehmenden haben heute Kenntnisse außerhalb ihrer Fachdisziplin erworben	☐	☐	☐	☐	
1.16	Es gab Raum für Kreativität und neue Ideen	☐	☐	☐	☐	
1.17	Die Sitzung hat die Studierenden motiviert, auch außerhalb des Seminars aktiv zu werden	☐	☐	☐	☐	
1.18	Die Studierenden sind mit dem Ergebnis ihrer Gruppenarbeit zufrieden	☐	☐	☐	☐	
1.19	Mit Redebeiträgen wurde in der Sitzung wertschätzend umgegangen	☐	☐	☐	☐	
1.20	Wenn die Studierenden es wollten, konnten sie sich an Diskussionen beteiligen	☐	☐	☐	☐	
1.21	In der Sitzung haben die Studierenden aktiv Bezüge zu früheren Sitzungen hergestellt	☐	☐	☐	☐	
1.22	Die Teilnehmenden haben andere Meinungen, als die ihrige, als Bereicherung erlebt	☐	☐	☐	☐	
1.23	Es gab auch mal was zum Lachen in der Sitzung	☐	☐	☐	☐	
1.24	In der Kleingruppe konnten die Studierenden selbständig ohne meine Hilfe arbeiten	☐	☐	☐	☐	
1.25	In der Sitzung mussten die Studierenden mit Wert- und Zielkonflikten umgehen	☐	☐	☐	☐	

1. Evaluation der Grundbausteine [Fortsetzung]

		stimme nicht zu				stimme zu
1.26	Die Studierenden haben sich heute mit ihrer individuellen Verantwortung auseinandergesetzt	☐	☐	☐	☐	
1.27	Die Teilnehmenden haben heute gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt	☐	☐	☐	☐	
1.28	Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen	☐	☐	☐	☐	
1.29	Die Teilnehmenden können Bezüge zwischen den einzelnen Sitzungen erkennen	☐	☐	☐	☐	
1.30	Zusammen mit anderen haben sich die Studierenden mit der gesellschaftlichen Verantwortung auseinandergesetzt	☐	☐	☐	☐	
1.31	Die Teilnehmenden haben sich in dieser Sitzung wohl gefühlt	☐	☐	☐	☐	
1.32	Der Anspruch des Seminars ist für die Teilnehmenden nicht zu schwierig und nicht zu leicht, sondern gerade richtig	☐	☐	☐	☐	
1.33	Die Sitzung war für die Studierenden sehr abwechslungsreich	☐	☐	☐	☐	
1.34	In der Sitzung mussten die Teilnehmenden mit unvollständigen und überkomplexen Informationen umgehen	☐	☐	☐	☐	
1.35	Ich habe eine lernförderliche Atmosphäre geschaffen	☐	☐	☐	☐	
1.36	Die Teilnehmenden haben heute andere motiviert aktiv zu werden	☐	☐	☐	☐	

2. Persönliche Angaben

2.1 Datum:

☐ 06. Nov ☐ 13. Nov ☐ 20. Nov
☐ 27. Nov

2.2 Thema:

☐ Verantwortung und Kodizes ☐ Technik als Problemlöser!? ☐ Das Produktivistische Weltbild

EvaSys	Abschlussbefragung 2017/2018	Electric Paper

Blue Engineering Seminar - Teilnehmende

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Evaluation des Blue Engineering Seminars

1.1	Mir war klar, was ich im Seminar lernen sollte	☐	☐	☐	☐
1.2	Ich habe mich im Seminar mit der Situation von Menschen befasst, die aktuell benachteiligt werden	☐	☐	☐	☐
1.3	Ich habe in diesem Seminar etwas dazu gelernt	☐	☐	☐	☐
1.4	Während des Seminars habe ich andere Perspektiven/ Standpunkte kennen und schätzen gelernt	☐	☐	☐	☐
1.5	Ich war das Seminar über aktiv bei der Sache	☐	☐	☐	☐
1.6	Ich habe im Seminar über die verschiedenen Leitbilder und Einstellungen von Menschen reflektiert	☐	☐	☐	☐
1.7	Es gab eine klare Zeitstruktur für das gesamte Seminar	☐	☐	☐	☐
1.8	Ich habe mich im Seminar mit den räumlichen und zeitlichen Folgen von Technik auseinandergesetzt	☐	☐	☐	☐
1.9	Die wichtigsten Punkte wurden klar herausgearbeitet	☐	☐	☐	☐
1.10	Es wurden Fragen aufgeworfen, die mir zu denken geben	☐	☐	☐	☐
1.11	Mir war jederzeit klar, was ich tun sollte	☐	☐	☐	☐
1.12	Während des Seminars habe ich mich mit meinen Wertvorstellungen befasst	☐	☐	☐	☐
1.13	Ich habe mich ermutigt gefühlt, mich an Diskussionen zu beteiligen	☐	☐	☐	☐
1.14	Die Tutor_innen verbinden in ihren Beiträgen die vorherigen Sitzungen mit der jeweils aktuellen	☐	☐	☐	☐
1.15	Ich habe im Seminar Kenntnisse außerhalb meiner Fachdisziplin erworben	☐	☐	☐	☐
1.16	Es gab Raum für Kreativität und neue Ideen	☐	☐	☐	☐
1.17	Das Seminar hat mich motiviert, auch außerhalb des Seminars aktiv zu werden	☐	☐	☐	☐
1.18	Ich bin mit dem Ergebnis meiner Semesterarbeit zufrieden	☐	☐	☐	☐
1.19	Mit Redebeiträgen wurde im Seminar wertschätzend umgegangen	☐	☐	☐	☐
1.20	Wenn ich es wollte, konnte ich mich an Diskussionen beteiligen	☐	☐	☐	☐
1.21	Im Seminar habe ich aktiv Bezüge zwischen den einzelnen Sitzungen hergestellt	☐	☐	☐	☐
1.22	Ich habe andere Meinungen, als die meinige, als Bereicherung erlebt	☐	☐	☐	☐
1.23	Es gab auch mal was zum Lachen im Seminar	☐	☐	☐	☐
1.24	In der Semesterarbeitsgruppe konnten wir selbständig ohne Hilfe des Tutors/der Tutorin arbeiten	☐	☐	☐	☐
1.25	Im Seminar musste ich mit Wert- und Zielkonflikten umgehen	☐	☐	☐	☐

1. Evaluation des Blue Engineering Seminars [Fortsetzung]

1.26 Ich habe mich im Seminar mit meiner individuellen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.27 Ich habe im Seminar gemeinsam mit anderen Entscheidungen getroffen und diese umgesetzt	☐	☐	☐	☐
1.28 Wenn gewünscht, konnte sich jede_r Teilnehmer_in an Diskussionen beteiligen	☐	☐	☐	☐
1.29 Ich kann Bezüge zwischen den einzelnen Sitzungen erkennen	☐	☐	☐	☐
1.30 Zusammen mit anderen habe ich mich mit der gesellschaftlichen Verantwortung auseinandergesetzt	☐	☐	☐	☐
1.31 Ich habe mich im Seminar wohl gefühlt	☐	☐	☐	☐
1.32 Der Anspruch des Seminars ist nicht zu schwierig und nicht zu leicht, sondern gerade richtig	☐	☐	☐	☐
1.33 Ich finde das Seminar war sehr abwechslungsreich	☐	☐	☐	☐
1.34 Im Seminar musste ich mit unvollständigen und überkomplexen Informationen umgehen	☐	☐	☐	☐
1.35 Die Tutor_innen haben eine lernförderliche Atmosphäre geschaffen	☐	☐	☐	☐
1.36 Durch das Seminar habe ich andere motiviert aktiv zu werden	☐	☐	☐	☐
1.37 Die Diskussionskultur im Seminar hebt sich positiv von anderen Diskussionskulturen ab.	☐	☐	☐	☐
1.38 Ich habe das Konzept der Werkzeuge verstanden	☐	☐	☐	☐
1.39 Das System mit Melden/die Moderation durch die Teilnehmenden selbst fördert gleichberechtigte Diskussionen	☐	☐	☐	☐
1.40 Ich habe das Konzept der Werkzeuge verstanden	☐	☐	☐	☐
1.41 Die TING-D Konstellation hilft mir gesellschaftliche Prozesse zu analysieren	☐	☐	☐	☐
1.42 Ich nutze Werkzeuge in meinem Alltag, z.B. bei Diskussionen mit Freund_innen	☐	☐	☐	☐
1.43 Das Seminar war strukturiert und organisiert	☐	☐	☐	☐
1.44 Das Lernjournal hat mir geholfen, das Seminar zu reflektieren	☐	☐	☐	☐
1.45 Meine Einstellungen haben sich durch das Seminar geändert.	☐	☐	☐	☐
1.46 Das Lernjournal habe ich einfach nur schnell zusammengeschrieben, weil ich was abgeben musste.	☐	☐	☐	☐
1.47 Durch das Seminar hat sich mein Verhalten geändert.	☐	☐	☐	☐

2. Persönliche Angaben

2.1 Studiengang:

- ☐ Ingenieurwissenschaften
- ☐ Mathematik, Naturwissenschaften, Informatik
- ☐ Geistes-/ Gesellschaftswissenschaften
- ☐ Planungswissenschaften/Architektur
- ☐ Wirtschaftsingenieurwesen/ Wirtschaftswissenschaften

2.2 Studienphase:

- ☐ Bachelor
- ☐ Master
- ☐ Diplom

2.3 Geschlecht:

- ☐ männlich
- ☐ weiblich
- ☐ anderes Geschlecht
- ☐ keine Angabe

Appendix

Perception-Based Test

Data Collection

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_1	Beobachterin	TAP	4	3	4	3	3	3	3	4	4	4	4	3	3	4	4	4	4	4	4
2017_1	Beobachterin	VK	4	2	3	2	3	3	4	4	4	4	3	2	4	4	4	4	4	2	4
2017_1	Beobachterin	PW	3	2	4	3	4	1	3	3	4	4	2	1	4	4	4	4	3	3	4
2017_1	Studierende	VK	4	4	4		1	3	4	4	4	4	4	4	4	4	4	4	4	3	4
2017_1	Studierende	VK	4	4	3	4	4	4	4	3	3	3	3	3	4	3	4	4	3	3	4
2017_1	Studierende	VK	4	4	1	4	4	4	4	4	4	4	4	1	4	4	4	4	4	1	4
2017_1	Studierende	VK	4	4	1	4	1	2	3	4	4	4	4	1	4	4	4		3		4
2017_1	Studierende	VK	4	4	2	1	3	3	4	3	4		3	3	4	3	3	3	4	2	4
2017_1	Studierende	VK	4	3	3	3	1	3	4	4	4	4	2	2	3	2	3	4	4	3	4
2017_1	Studierende	VK	4	4	3	4	1	4	3	4	4	3	3	3	4	4	2	4	4	3	3
2017_1	Studierende	VK	4	4	4	4	2	3	4	4	4	4	4	3	4	4		4	4	4	4
2017_1	Studierende	VK	4	3	3	4	3	2	3	2	4	4	3	2	3	3	3	3	3	4	4
2017_1	Studierende	VK	4	4	4	4	3	3	3	3	3	3	4	4	3	3	4	4	4	3	4
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2017_1	Studierende	VK	4	4	4	3	4	4	4	4	3	4	4		4	4	4	4	4	4	4
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2017_1	Studierende	VK	4	4	2	4	1	2	4	3	4	4	3	4	3	4	4	4	4	4	4
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2017_1	Studierende	VK	4	3	4	3	3	3	4	4	4	4	3	3	4	4	4	4	4	3	4
2017_1	Studierende	VK	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4		4	4	4
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2017_1	Studierende	VK	4	4	3	4	1	4	4	4	4	4	4	3	4	4	4	4	4	3	4
2017_1	Studierende	VK	4	4	3	2	4	3	4	3	3	4	3		4	4	4	4	4	2	4
2017_1	Studierende	VK	4	4	4	4	1	3	4	4	4	4	3	2	4	4	4	3	4	2	4
2017_1	Studierende	VK	4	3	4	4	1	4	2	4	4	4			4	4	3	4	4	1	4
2017_1	Studierende	VK	4	4	4	3	1	2	4	4	4	4	3	2	3	4	3	4	4	3	4
2017_1	Studierende	VK	4	4	3		2	3	3		3	4	3	1		2		4	4	1	4
2017_1	Studierende	VK	4	4	4	4	1	4	4	4	4	4	4	4	4	3	4	4	4	4	
2017_1	Studierende	VK	4	4	3	4	2	3	4	4	4	4	4	3	4	4	4	4	4	3	4
2017_1	Studierende	VK	4	3	3	4	3	1	3	4	4	4	4		4	3	3	4	4	3	4
2017_1	Studierende	VK	4	3	4	4	1	2	4	4	4	4	4	1	4	3	4	4	4	4	4
2017_1	Studierende	VK	4	4	3	4	3	3	4	4	3	4	3	3	4	4	4	4	2	4	4
2017_1	Studierende	VK	4	3	3	2	2	3	4	3	4	4	2	2	3	3	4	3	4	2	4
2017_1	Studierende	VK	4	4	3	2	2	3	2	2	4	4	2	1	1	3	3	4	2	3	4
2017_1	Studierende	TAP	4	4	4	3	1	4	3	4	4	4	4	4	4	4	4	4		4	4
2017_1	Studierende	TAP	4	4	4	4	4	3	4	4	4	4	4	4	4	4		4	4	4	4
2017_1	Studierende	TAP	4	4	4	4	4	4	4	4	4	4	4	2	4	4	4	4	4	3	4
2017_1	Studierende	TAP	4	4	3	3	2	4	3	3	3	3	2	3	3	2	4	3	3	2	4
2017_1	Studierende	TAP	4	4	4	3	1	3	4	4	4	4	3	3	4	4	4	4	4	4	4
2017_1	Studierende	TAP	4	4	4	3	1	2	2	3	4	4	3	3	2	3	2	4	4	4	4
2017_1	Studierende	TAP	4	3	3	2	1	3	4	3	3	4	2	2	3	3	4	3	3	2	4
2017_1	Studierende	TAP	4	4	3	4	2	3	4	3	4	4	2	1	3	4	4	4	4	1	4
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2017_1	Studierende	TAP	4	4	4	3	2	4	4	4	4	4	3	3	4	3	3	4	4	3	4
2017_1	Studierende	TAP	4	4	4	3	1	3	2	4	4	4	2	2	3	4	3	4	4	1	4
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2017_1	Studierende	TAP	4	3	3	3	2	3	3	4	4	4	2	3	3	2	3	3	4	2	4
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2017_1	Studierende	TAP	4	3	3	3	2	4	3	4	4	4	3	1	3	3	4	3	4	3	4
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2017_1	Studierende	TAP	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_1	Studierende	TAP	4	3	4	4	4	3	4	4	4	4	4	2	4	4	4	4	4	2	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_1	Studierende	TAP	4	4	3	4	1	4	3	3	4	4	4	3	4	3	4	4	4	3	4
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2017_1	Studierende	TAP	4	2	3	2	4	4	4	4	3	4	3	2	4	4	2	2	4	1	4
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2017_1	Studierende	PW	4	4	3	4	2	3	3	4	3	4	2	2	4	4	4	4	4	4	4
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2017_1	Studierende	VK	3	3	3	4	3	3	4	3	4	4	4	4	3	4	3	4	4	4	4
2017_1	Studierende	VK	3	2	3	3	2	4	3	2	2	3	2	2	3	3	3	3	4	4	3
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2017_1	Studierende	VK	3	4	2	2	3	3	4	3	4	4	3	3	4	2	3	4	4	3	4
2017_1	Studierende	VK	3	4	3	4	1	4	4	4	4	4	4	3	4	4	4	4	4	3	4
2017_1	Studierende	VK	3	3	2	3	3	3	4	3	3	4	3	3	4	2	4	4	3	2	3
2017_1	Studierende	VK	3	4	4	3	1	4	4	3	3	4	3	3	4	4	4	4	4	2	4
2017_1	Studierende	VK	3	4	3	2	1	3	4	4	4	4	2	4	4	4	4	4	4	2	4
2017_1	Studierende	VK	3	1	1	3	2	2	3	3	4	4	3	2	2	2	4	4	3	2	4
2017_1	Studierende	VK	3	3	4	3	2	4	3	4	4	4	2	2	3	3	4	3	3	3	4
2017_1	Studierende	VK	3	4	4	3	1	4	4	4	4	4	2	1	4	4	4	3	4	3	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_1	Studierende	VK	3	2		2	1	1	4	2	3	4	2	1	4	3	3	3	4	3	4
2017_1	Studierende	VK	3	3	3	4	3	3	3	4	3	4	3	3	4	3	3	3	4	2	4
2017_1	Studierende	VK	3	3	3	4	1	3	4	4	4	4	3	3	4	4	4	4	4	3	3
2017_1	Studierende	VK	3	4	3	3	4	2	4	4	4	4	4	2	4	3	3	4	4	3	3
2017_1	Studierende	TAP	3	4	4	4	3	4	4	4	4	4		2	4	3	4	4	4	2	
2017_1	Studierende	TAP	3	4	4	4	3	4	4	3	4	3	4	3	4	3	4	4	4	2	3
2017_1	Studierende	TAP	3	2	3	4	1	3	4	4	3	3	3	4	3	2	4	3	4		3
2017_1	Studierende	TAP	3	3	3	3	3	3	4	2	3	4	3	2	3	3	3	3	4	3	4
2017_1	Studierende	TAP	3	4	4	4	3	3	4	4	3	4	4	2	4	3	4	4	4	4	4
2017_1	Studierende	TAP	3	1	2	1	1	1	3	4	4	4	1	2	4	3	2	3	4	1	4
2017_1	Studierende	TAP	3	3	2	3	1	3	3	3	4	4	2	2	3	3	2	3	4	2	4
2017_1	Studierende	TAP	3	3	4	3	2	3	4	4	4	4	4	4	4	3	4	3	4	2	4
2017_1	Studierende	TAP	3	3	3	3	3	3	3	3	4	4	2	3	2	2	3	3	4	2	4
2017_1	Studierende	TAP	3	4	4	3	1	4	4	4	4	4	4	3	4	3	4	4	4	3	4
2017_1	Studierende	TAP	3	4	2	4	3	2	3	4	4	4	2	3	3	3	2	4	3	2	3
2017_1	Studierende	TAP	3	3	2	4	1	4	3	4	4	4	3	1	3	4	2	4	4	3	4
2017_1	Studierende	TAP	3	3	3	1	2	3	1	2	4	4	2	2	3	3	2	3	4	3	4
2017_1	Studierende	TAP	3	3	4	3	3	4	2	3	4	4	3	3	4	3	4	4	3	3	4
2017_1	Studierende	TAP	3	3	3	4		3	3	4	4	4	2	4	3	2	3	3		3	4
2017_1	Studierende	TAP	3	3	4	3	3	3	3	3	4	4	2	3		3	3	4	4	4	4
2017_1	Studierende	TAP	3	3	3	3	3		3	3	3	3	3	3	3	3		3	3	3	3
2017_1	Studierende	TAP	3	4	3	3	1	3	3	4	4	3	3	3	3	3	4	3	4	2	4
2017_1	Studierende	TAP	3	3	4	4	2	3	4	3	4	4	4	3	3	4	4	4	4	3	4
2017_1	Studierende	TAP	3	3	3	4	3	3	3	4	4	4	3	4	4	4	3	3	4	2	4
2017_1	Studierende	TAP	3	3	3	3	2	3	3	4	4	4	2	2	3	2	2	3	4	2	4
2017_1	Studierende	PW	3	3	4	4	1	3	4	4	4	3	2	2	4	3	3	3	4	4	4
2017_1	Studierende	PW	3	4	3	4	1	4	4	4	4	4	3	2	4	4	4	4	4	2	4
2017_1	Studierende	PW	3	4	2	4	1	1	4	4	4	4	2	2	3	4	3	3	4	2	4
2017_1	Studierende	PW	3	4	4	4	2	4	4	4	4	4	4	2	3	3	4	4	4	4	4
2017_1	Studierende	PW	3	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3
2017_1	Studierende	PW	3	3	3	3	4	2	4	4	4	4	3	3	3	3	4	4	3	2	3
2017_1	Studierende	PW	3	3	4	4	3	3	4	4	3	3	3	3	3	4	3	4	4	4	3
2017_1	Studierende	PW	3	3	4	4	1	1	3	3	4	4	3	1	4	4	3	4	4	4	4
2017_1	Studierende	PW	3	3	2	4	1	3	4	3	4	4	3	2	3	3	4	4	3	4	4
2017_1	Studierende	PW	3	3	4	3	2	1	3	3	3	3	2	2	2	3	1	3	3	1	3
2017_1	Studierende	PW	3	4	3	2	1	2	4	4	4	4	2	1	4	3	2	4	4	3	3
2017_1	Studierende	PW	3	2	4	4	1	3	4	3	3	3	4	4	2	3	4	4	4	4	4
2017_1	Studierende	PW	3	3	3	4	2	2	4	3	3	3	3	3	3	4	3	3	3	2	4
2017_1	Studierende	PW	3	2	2	3	2	2	3	2	3	2	2	2	2	2	2	3	3	2	3
2017_1	Studierende	PW	3	3	3	3	2	4	2	3	4	4	1	1	1	3	3	4	4	1	4
2017_1	Studierende	PW	3	3	3	4	1	2	3	4	4	4	3	3	3	2	2	3	3	3	4
2017_1	Studierende	PW	3	3	2	2	2	2	4	4	3	4	2	3	3	3	3	4	3	1	4
2017_1	Studierende	PW	3	2	3	3	2	1	2	4	3	4	2	1	3	3	1	3	3	3	4
2017_1	Studierende	PW	3		2	3	2	1		4	4	4		1	3		3	3	4	1	4
2017_1	Studierende	PW	3	4	2	4	1	2	2	3	4	4	3	2	1	3	2	4	4	3	4
2017_1-X	Studierende		3	3	3	3	1	3	3	3	3	4	3	4	3	4	4	4	3	3	3
2017_1-X	Studierende		3	3	4	4	1	3	3	2	4	3	2	3	4	3	2	3	4	2	4
2017_1-X	Studierende		3	3	3	4	4	3		4	2	4	3	2	3	3		3	4	3	4
2017_1	Studierende	VK	2	3	2	2	1	2	4	4	3	4	2	2	4	3	4	4	4	4	4
2017_1	Studierende	VK	2	3	3	4	2	2	3	4	4	3	3	2	3	3	3	4	4	1	4
2017_1	Studierende	VK	2	3	3	4	4	4	1	1	1	1	3	4	3	3	2	2	1	3	1
2017_1	Studierende	VK	2	3	4	4	2	1	4	4	3	4	3	1	2	2	4	4	4	3	4
2017_1	Studierende	TAP	2	3	4	3	2	3	2	3	3	4	3	3	2	1	4	3	4	4	4
2017_1	Studierende	TAP	2	4	2	3	1	4	3	3	4	4	2	3	2	3	3	3	4	3	4
2017_1	Studierende	PW	2	3	1	1	1	1	3	4	4	4	1	1	2	3	1	3	4	1	4
2017_1	Studierende	PW	2	2	3	2	2	2	2	2	1	1	3	2	2	2		2	1	3	3
2017_1	Studierende	PW	2	2	2	3	2	3	3	1	1	1	3	3	3	2	3	2	2	3	1
2017_1	Studierende	PW	2	3	3	2	2	4	2	4	4	4	3	4	3	3	3	4	4	3	4
2017_1	Studierende	VK	1	1	1	2	2	2			1	2	2	3	1	2	1	1	1	2	2
2017_1	Studierende	VK	1	2	2	2	3	2	2	2	2	2	3	2	1	2	1	2	3	3	2
2017_1	Studierende	TAP	1	4	2	1	1	4	2	3	4	4	1	1	1	4	1	2	4	3	4
2017_1	Studierende	TAP	1	2	2	1	3	1	1	2	1	2	2	3	2	1	2	1	1	2	1
2017_1	Studierende	PW	1	2	2	2	4	2	2	4	1	1	1	4	3	2	3	2	1	3	1
2017_1	Studierende	PW	1	4	4	4	3	2	3	2	4	4	2	1	3	4	3	3	4	3	4
2017_1	Studierende	PW	1	4	4	3	3	1	4	3	4	4	2	1	4	1	4	3	3	1	4
2017_1-X	Studierende		1	1	1	1			1	1	1	2	1		1	1			1	2	
2017_1	Studierende	VK		2	3	3	3	3		3	3	3	3	3	4	3	4	3		2	3
2017_1	Studierende	VK		4	3	4	1		4	3	4	4	4		4	3	4	4		3	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_1-X	Studierende			4	3	4	3	2	3	4	4	4	2	2	3	3	3	4	4	3	4
2017_1	Tutorinnen	TAP	4	4	4	4	4	4	4	4	4	4	2	4	4	4	2	4	4	4	4
2017_1	Tutorinnen	VK	4	4	4	4	3	4	4	3	4	4	3	2	4	4	4	4	4	2	4
2017_1	Tutorinnen	VK	4	4	3	4	3	2	4	4	4	4	3	3	4	4	4	4	4	2	4
2017_1	Tutorinnen	PW	4	3	4	4	3	2	4	3	3	4	3	4	3	4	2	4	4	2	4
2017_1	Tutorinnen	TAP	4	4	4	4	4	2	4	4	4	4	3	4	3	4	3	4	4	3	4
2017_1	Tutorinnen	PW	4	3	2	3	2	1	3	3	2	3	2	1	4	3	1	4	4	3	3
2017_1	Tutorinnen	PW	4	3		3	2	2	4	3	3	3	2	2	4	4	3	2	3	1	3
2017_1	Tutorinnen	TAP	3	4	3	4	4	4	4	4	4	4	3	4	4	3	3	4	4	1	4
2017_1	Tutorinnen	VK	3	3	3	4	3	3	4	3	4	4	3	3	4	4	4	4	4	2	4
2017_2	Abschluss		4	4	4	3	2	3	4	4	4	4	3	2	3	4	4	4	4	3	4
2017_2	Abschluss		4	4	4	4	2	4	4	4	4	4	3	3	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	3	4	2	4	3	4	4	4	4	2	3	3	4	4	4	4	4
2017_2	Abschluss		4	3	3	4	4	3	3	3	4	4	4	3	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	4	4	3	4	4	4	3	3	4	4	4	4	4	4	3
2017_2	Abschluss		4	4	3	4	3	4	4	4	4	4	4	2	4	3	3	4	4	4	4
2017_2	Abschluss		4	3	3	4	2	3	4	4	4	4	4	3	3	3	4	4	4	3	4
2017_2	Abschluss		4	4	4	4	3	4	3	4	4	4	4	3	4	4	4	3	4	4	4
2017_2	Abschluss		4	3	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	3	4
2017_2	Abschluss		4	4	2	4	4	4	4	3	4	4	2	3	4	4	4	3	4	4	4
2017_2	Abschluss		4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_2	Abschluss		4	3	3	3	1	3	2	3	3	3	4	1	4	4	3	3	3	4	3
2017_2	Abschluss		4	3	4	4	4	3	3	3	4	4	3	3	4	3	3	3	4	4	4
2017_2	Abschluss		4	4	3	4	1	2	4	4	4	4	2	2	4	4	4	4	4	4	4
2017_2	Abschluss		4	3	3	4	2	4	2	4	4	4	3	3	3	3	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	3	4	4	4	4	4	3	3	3	4	4	4	4	4	4
2017_2	Abschluss		4	4	3	4	2	4	4	4	4	4	3	2	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	2	2	4	3	4	4	4	4	3	1	3	3	4	3	4	3	4
2017_2	Abschluss		4	4	3	4	1	2	2	3	3	4	2	2	3	4	3	3	4	2	4
2017_2	Abschluss		4	3	4	3	2	3	3	4	4	4	3	3	4	4	3	4	4	4	4
2017_2	Abschluss		4	4	4	4	4	3	4	3	4	4	3	3	4	3	3	4	4	3	4
2017_2	Abschluss		4	4	3	3	1	4	4	2	4	4	3	2	3	4	4	4	4	2	4
2017_2	Abschluss		4	4	3	3	3	3	4	4	4	4	4	3	4	4	4	3	3	4	3
2017_2	Abschluss		4	3	4	3	1	3	3	4	4	4	2	3	3	3	4	4	4	3	4
2017_2	Abschluss		4	3	3	4	1	4	2	3	3	4	2	2	4	3	3	4	4	3	4
2017_2	Abschluss		4	4	4	4	1	3	3	4	4	4	3	3	4	4	3	4	4	4	4
2017_2	Abschluss		4	4	3	4	2	4	4	3	3	3	3	3	4	4	4	4	4	3	3
2017_2	Abschluss		4	3	4	4	2	4	3	4	4	4	3	2	4	3	4	3	4	3	4
2017_2	Abschluss		4	3	2	4	4	3	3	3	4	4	3	2	4	3	3	3	4	4	4
2017_2	Abschluss		4	4	2	3	2	3	3	4	4	4	2	2	4	3	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	1	3	3	4	4	4	3	1	4	4	4	4	4	3	4
2017_2	Abschluss		4	3	3	3	2	4	4	4	4	4	3	3	4	3	4	4	3	4	4
2017_2	Abschluss		4	3	3	3	2	4	4	4	4	4	3	3	4	3	4	4	3	4	4
2017_2	Abschluss		4	4	4	4	2	4	4	4	4	4	2	2	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	3	4	4	3	3	3	3	3	4	3	3	4	4	4	3
2017_2	Abschluss		4	4	3	4	1	4	3	4	3	4	4	4	4	3	4	4	4	3	4
2017_2	Abschluss		4	4	3	4	2	3	4	4	3	3	4	4	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	3	4	1	4	3	3	4	4	2	2	4	4	3	4	4	3	4
2017_2	Abschluss		4	4	4	2	1	3	4	4	4	4	2	1	4	2	2	3	4	3	4
2017_2	Abschluss		4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	1	3	3	4	4	4	2	2	4	3	2	4	4	3	3
2017_2	Abschluss		4	4	3	3	1	4	4	3	4	4	3	1	3	4	4	4	4	1	4
2017_2	Abschluss		4	4	3	4	1	4	4	3	3	4	3	3	4	4	4	4	3	4	4
2017_2	Abschluss		4	4	4	4	2	3	3	4	4	4	3	2	4	4	4	4	4	3	4
2017_2	Abschluss		4	3	4	4	2	2	3	3	4	4	2	2	2	2	3	4	4	3	4
2017_2	Abschluss		4	4	4	4	2	3	3	3	4	4	3	2	4	4	4	4	4	4	4
2017_2	Abschluss		4	4	4	3	1	4	4	3	4	3	2	2	4	4	3	3	4	3	4
2017_2	Abschluss		4	4	4	4	1	4	4	4	4	4	3	3	4	3	4	4	4	4	4
2017_2	Abschluss		4	4	4	4	1	4	4	4	4	4	4	3	4	4	4	4	4	3	4
2017_2	Abschluss		3	3	4	4	2	3	3	3	3	4	3	2	4	3	4	3	4	4	4
2017_2	Abschluss		3	4	3	3	3	4	4	4	4	4	3	3	3	4	4	4	4	4	4
2017_2	Abschluss		3	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_2	Abschluss		3	3	2	3	3	3	2	4	4	3	3	2	3	3	2	2	4	2	2
2017_2	Abschluss		3	4	4	4	2	3	4	3	4	4	4	4	4	4	4	4	4	3	4
2017_2	Abschluss		3	3	3	4	2	3	2	3	3	3	2	3	3	4	3	3	4	2	3
2017_2	Abschluss		3	4	4	4	2	4	4	4	4	4	3	2	4	4	3	3	4	4	4
2017_2	Abschluss		3	3	3	3	2	3	2	4	4	4	2	1	3	2	4	3	3	2	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_2	Abschluss		3	4	4	4	2	4	2	3	4	4	3	2	4	4	4	4	4	3	4
2017_2	Abschluss		3	3	3	4	2	3	3	4	4	4	2	2	4	3	3	3	3	3	4
2017_2	Abschluss		3	3	4	4	1	3	2	1	4	4	1	2	3	4	3	2	4	2	3
2017_2	Abschluss		3	2	4	4	2	4	4	3	4	4	2	1	4	3	4	4	4	4	4
2017_2	Abschluss		3	4	4	4	1	3	4	4	4	4	4	3	3	3	4	4	4	3	4
2017_2	Abschluss		3	3	4	4	1	2	4	4	3	4	1	1	4	4	4	4	3	4	3
2017_2	Abschluss		3	4	3	4	1	2	3	3	3	4	2	1	3	3	3	3	2	3	4
2017_2	Abschluss		3	3	1	3	1	2	3	3	4	3	3	3	2	3	3	1	1	3	4
2017_2	Abschluss		3	3	3	4	4	4	4	4	4	4	4	2	4	4	4	3	4	2	4
2017_2	Abschluss		3	4	3	4	3	2	4	4	3	4	3	2	4		4	3	4	2	4
2017_2	Abschluss		3	4	3	3	3	3	4	4	3	4	3	4	4	4	4	3	4	4	4
2017_2	Abschluss		3	4	3	3	3	3	4	3	3	4	4	3	4	4	4	4	4	3	3
2017_2	Abschluss		3	4		3	3	3	4	3		3	3	4	3	4	3	4	3	4	4
2017_2	Abschluss		3	3	1	3	2	3	2	3	4	4	2	1	2	2	2	2	4	3	4
2017_2	Abschluss		3	4	4	4	1	2	3	4	4	4	4	4	4	2	4	4	4	3	4
2017_2	Abschluss		3	3	2	2	4	4	3	3	3	2	2	2	3	3	3	3	3	3	2
2017_2	Abschluss		3	3	4	2	1	4	2	4	4	4	1	2	2	3	3	3	4	3	4
2017_2	Abschluss		3	1	3	3	1	2	3	3	4	4	3	3	2	3	4	3	3	2	4
2017_2	Abschluss		3	3	4	3			3	4	4	4	4		3	4			3	3	
2017_2	Abschluss			4	1	3	1	4	3	4	4	4		2	3	2	4	3	4	1	4
2017_2	Beobachterin	TAP	4	2	4	3	2	3	3	3	4	4	3	1	3	3	4	4	4	4	4
2017_2	Beobachterin	TAP	3	3	4	3	2	2	4	4	4	4	3	3	4	3	4	4	4	4	4
2017_2	Beobachterin	TAP	3	2	4	3	2	3	3	4	4	4	3	3	3	3	4	4	4	4	4
2017_2	Beobachterin	TAP	2	2	4	2	2	2	3	4	4	4	3	3	4	3	4	4	4	4	4
2017_2	Studierende	VK	4	2	3	4	2	3	4	3	4	4	3	3	3	3	4	3	3	1	3
2017_2	Studierende	VK	3	3	4	2	2	2	4	3	4	4	2	2	3	3	4	4	4	2	4
2017_2	Studierende	VK	3	4	4	2	2	3	4	4	4	4	3	3	4	4	4	3	4	2	4
2017_2	Tutorinnen	VK	4	3	1	2	1	4	4	2	3	4	3	3	4	3	4	4	4	2	4
2017_2	Studierende	VK	4	4	4	4	2	4	4	3	4	4	4	2	4	4	4	4	4	4	4
2017_2	Studierende	VK	4	4	3	4	1	3	4	3	4	4	3	4	3	4	4	4	4	3	4
2017_2	Studierende	VK	4	4	3	4	2	4	4	3	4	4	3	4	4	3	3	4	4	3	4
2017_2	Studierende	VK	4	4	4	4	1	4	4	4	4	4	3	4	4	4	4	4	4	4	4
2017_2	Studierende	VK	4	3	3	4	4	4	4	4	4	4	3	4	4	3	4	4	4	3	3
2017_2	Studierende	VK	3	3	2	3	3	1	3	4	4	4	2	2	3	2	3	4	4	2	4
2017_2	Studierende	VK	3	4	2	4	3	2	4	3	4	4	3	2	4	3	3	4	4	4	4
2017_2	Studierende	VK	3	3	2	3	3	4	4	4	4	4	2	3	4	4	4	4	4	3	4
2017_2	Studierende	VK	3	3	4	3	1	3	3	3	4	4	3	3	4	3	4	3	4	2	4
2017_2	Studierende	VK	3	4	4	4	1	4	4	4	4	4	2	3	4	4	4	4	4	4	4
2017_2	Studierende	VK	2	3	2	4	1	3	4	4	4	4	4	4	4	4	4	4	4	2	4
2017_2	Studierende	VK	2	3	4	3	2	2	4	4	4	4	2	2	4	4	4	3	4	1	4
2017_2	Studierende	TAP	4	4	4	2	1	3	1	4	4	4	3	2	3	3	3	4	4	3	2
2017_2	Studierende	TAP	4	4	4	4	3	3	3	4	4	4	3	1	4	4	4	4	4	4	4
2017_2	Studierende	TAP	4	2	4	4	2	4	3	3	3	4	3	3	3	4	4	4	4	3	4
2017_2	Studierende	TAP	4	3	3	3	2	1	3	3	3	4	2	2	2	3	3	3	3	2	4
2017_2	Studierende	TAP	4	3	4	4	3	3	4	4	3	3	4	3	4	3	3	4	4	3	2
2017_2	Studierende	TAP	4	4	3	4	2	4	4	3	4	4	4	3	4	4	4	4	4	3	4
2017_2	Studierende	TAP	4	4	4	3	3	4	3	3	4	4	2	3	3	3	3	3	4	4	4
2017_2	Studierende	TAP	4	2	4	4	3	2	3	2	4	3	3		2	2	3	2	4	2	3
2017_2	Studierende	TAP	4	4	3	3	2	3	2	4	4	4	3	4	3	3	4	4	4	2	4
2017_2	Studierende	TAP	4	3	4	2	3	3	3	1	4	4	2	2	3	3	3	3	4	3	4
2017_2	Studierende	TAP	4	4	3	3	1	4	3	3	4	4	2	2	4	3	3	3	4	2	4
2017_2	Studierende	TAP	4	4	3	4	3	4	4	4	4	4	3	3	4	3	3	4	4	3	4
2017_2	Studierende	TAP	4	4	3	3	2	3	4	4	4	4	3	2	4	4	4	4	4	4	4
2017_2	Studierende	TAP	4	4	3	4	1	1	4	4	4	4	2	2	4	2	4	3	4	4	4
2017_2	Studierende	TAP	4	4	4	4	4	2	4	3	4	4	3	2	3	4	3	4	4	4	4
2017_2	Studierende	TAP	4	3	4	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2017_2	Studierende	TAP	4	4	4	4	4	3	4	4	4	4	2	3	4	4	3	4	4	4	4
2017_2	Studierende	TAP	4	4	3	2	1	4	4	3	4	4	4	3	4	3	3	4	4	4	4
2017_2	Studierende	TAP	4	2	3	1	3	3	3	3	3	4	1		2	2	3	3	4	3	4
2017_2	Studierende	TAP	4	3	4	4	4	3	4	3	4	4	4	4	4	3	3	4	4	4	4
2017_2	Studierende	TAP	4	4	4	4	2	4	3	4	4	4	3	2	3	3	3	3	4	3	4
2017_2	Studierende	TAP	4	3	3	2	2	2	3	4	4	4	3	2	4	4	3	3	4	4	4
2017_2	Studierende	TAP	4	4	4	2	3	4	4	3	4	4	4	4	2	4	3	4	4	4	4
2017_2	Studierende	TAP	4	4	4	3	3	4	4	3	4	4	4	3	4	3	3	4	4	3	4
2017_2	Studierende	TAP	4	4	4	3	2	4	4	4	4	4	3	3	4	3	3	4	4	3	4
2017_2	Studierende	TAP	4	4	4	3	3	4	4	4	4	4	2	2	4	3	3	4	4	4	4
2017_2	Studierende	TAP	4	2	3	4	3	3	4	3	4	4	3	4	3	3	4	3	4	4	4
2017_2	Studierende	TAP	4	4	4	3	2	2	3	4	4	4	3	3	4	3	3	4	4	3	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_2	Studierende	TAP	4	2	4	3	1	3	3	3	4	4	2	1	4	4	4	4	4	3	4
2017_2	Studierende	TAP	4	4	4	4	3	4	4	3	4	4	3	3	2	3	3	4	4	2	4
2017_2	Studierende	TAP	4	4	2	2	3	2	3	4	4	2	4	1	3	4	4	4	4	3	3
2017_2	Studierende	TAP	4	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_2	Studierende	TAP	4	4	4	4	3	4	3	4	4	3	3	4	4	4	4	4	3	4	3
2017_2	Studierende	TAP	4	4	4	4	3	4	4	4	4	3	3	3	4	3	4	4	4	4	4
2017_2	Studierende	TAP	4	4	3	4	1	2	4	2	4	4	3	1	3	3	3	3	4	1	4
2017_2	Studierende	TAP	4	3	4	3	1	2	4	4	4	3	3	1	4	4	4	3	3	4	3
2017_2	Studierende	TAP	4	4	4	3	4	2	4	4	4	4	4	2	3	4	3	4	4	3	4
2017_2	Studierende	TAP	4	3	4	4	4	4	4	4	4	3	4	2	4	4	4	4	4	4	4
2017_2	Studierende	TAP	4	2	2	3	2	3	3	3	3	4	3	2	4	3	3	3	4	3	4
2017_2	Studierende	TAP	4	3	3	2	2	3	3	3	3	3	2	2	3	3	2	3	3	3	3
2017_2	Studierende	TAP	4	4	4	2	1	4	3	4	3	4	4	1	3	2	4	3	4	1	4
2017_2	Studierende	TAP	4	3	2	3	1	4	3	4	4	4	4	3	3	3	3	3	4	4	4
2017_2	Studierende	TAP	4	4	4	4	4	4	4	3	4	4	4	4		4	4	4	4	4	4
2017_2	Studierende	TAP	4	2	4	2	1	3	2	3	4	4	2	3	2	3	2	4	4	3	4
2017_2	Studierende	TAP	4	3	3	3	4	3	4	3	4	4	3	2	3	2	3	4	4	4	4
2017_2	Studierende	PW	4	4	3	4	3	3	4	4	4	4	3	2	4	4	2	4	4	3	4
2017_2	Studierende	PW	4	4	2	4	3	1	4	4	4	4	1	1	3	4	2	4	3	2	4
2017_2	Studierende	PW	4	3	3	2	1	1	4	3	4	4	2	3	3	4	3	3	2	2	4
2017_2	Studierende	PW	4	3	2	3	2	2	3	3	4	4	2	2	2	3	2	3	4	2	4
2017_2	Studierende	PW	4	4	2	4	3	3	3	4	4	4	3	2	4	3	4	4	4	4	4
2017_2	Studierende	PW	4	3	3	3	1	2	2	4	4	4	3	2	3	2	2	3	4	3	4
2017_2	Studierende	PW	4	4	3	2	1	3	3	4	4	4	3	1	4	4	3	3	3	4	4
2017_2	Studierende	PW	4	3	3	3	2	1	2	3	4	4	2	2	2	3	2	3	4	1	4
2017_2	Studierende	PW	4	2	4	3	1	2	2	4	4	4	2	3	3	3	3	3	3	3	4
2017_2	Studierende	PW	4	3	2	4	1	2	3	4	4	4	3	2	3	4	2	4	3	3	4
2017_2	Studierende	PW	4	3	3	3	1	4	3	4	4	4	1	1	3	3	3	3	4	3	4
2017_2	Studierende	PW	4	4	4	4	2	4	4	4	4	4	3	4	4	4	4	4	4	4	4
2017_2	Studierende	PW	4	4	2	4	1	2	3	4	4	4	3	1	3	4	3	4	4	2	4
2017_2	Studierende	PW	4	3	4	3	3	2	4	3	3	4	3	2	4	4	4	3	4	2	4
2017_2	Studierende	PW	4	4	3	3	2	4	4	4	4	4	2	1	4	3	3	4	3	2	3
2017_2	Studierende	PW	4	3	1	3	1	2	3	1	4	3	1	1		2	2		3	3	3
2017_2	Studierende	PW	4	3	3	4	2	3	3	4	3	4	4	2	4	4	3	2	4	3	4
2017_2	Studierende	PW	4	3	3	4	2	2	4	3	4	4	3	4	3	3	4	4	4	4	4
2017_2	Studierende	PW	4	4	1	4	3	1		4	4	4	2	1	2	3	4	2	4	4	4
2017_2	Studierende	PW	4	4	3	3	2	2	4	4	3	4	2	3	4	3	3	3	3	3	4
2017_2	Studierende	PW	4		3	3	3	3	4	4	3	3	4	4	3	3	2	3	4	4	3
2017_2	Studierende	PW	4	3	2	3	3	2	3	4	4	4	2	4	4	4	3	3	4	3	3
2017_2	Studierende	PW	4	4	4	4	2	4	4	4	2	4	4	3	4	4	4	4	3	4	3
2017_2	Studierende	PW	4	3	3	3	3	3	3	3	3	4	3	2	3	4	4		3	3	4
2017_2	Studierende	PW	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_2	Studierende	PW	4	4	1	4	4	2	3	2	4	4	1	1	3	3	2	4	4	3	4
2017_2	Studierende	PW	4	4	2	3	4	3	4	3	3	4	3	3	3	4	3	4	4	3	3
2017_2	Studierende	PW	4	4	2	4	1	2	4	4	4	4	4	4	4	4	3	3	4	3	4
2017_2	Studierende	PW	4	4	4	4	2	2	4	4	4	4	3	3	4	3	4	4	4	3	4
2017_2	Studierende	PW	4	4	3	4	1	2	3	3	2	3	4	4	3	4	4	4	4	3	4
2017_2	Studierende	PW	4	4	4	3	1	4	4	3	4	4	3	2	3	4	4	4	4	4	4
2017_2	Studierende	PW	4	4	3	4	2	2	3	4	4	4	4	2	3	3	3	4	4	2	4
2017_2	Studierende	PW	4	4	4	4	3	1	3	3	4	4	3	2	4	3	1	4	4	2	3
2017_2	Studierende	PW	4	4	2	4	1	1	2	4	4	4	4	2	4	4	3	3	3	2	4
2017_2	Studierende	PW	4	4	4	4	2	1	3	3	4	4	4	1	3	4	3	2	4	1	4
2017_2	Studierende	PW	4	4	4	4	1	2	4	3	4	4	2	2	4	4	4	4	4	4	4
2017_2	Studierende	PW	4	4	4	3	1	3	4	4	4	4	4	2	4	3	4	4	4	4	4
2017_2	Studierende	PW	4	4	1	3	1	4	4	2	4	4	3	3	3	3	3	3	4	3	4
2017_2	Studierende	PW	4	4	3	4	3	4	4	4	4	4	3	3	2	4	3	4	4	3	4
2017_2	Studierende	PW	4	3	3	4	2	3	4	4	4	4	3	3	4	4	4	3	4	4	4
2017_2	Studierende	PW	4	4	4	4	4	3	4	2	4	4	3	2	3	2		4	4	3	4
2017_2	Studierende	PW	4	4	3	3	1	2	4	4	4	4	2	3	3	3	1	4	4	2	4
2017_2	Studierende	PW	4	4	4	4	3	3	4	4	4	4	3	3	4	4	4	4	4	4	4
2017_2	Studierende	PW	4	3	3	3	2	1	2	4	3	4	2	2	4	3	3	3	4	2	4
2017_2	Studierende	PW	4	4	2	4	2	2	3	4	4	4	3	2	4	2	2	3	4	3	4
2017_2	Studierende	PW	4	4	3	3	4	4	3	3	4	4	3	3	3	4	4	4	4	4	4
2017_2	Studierende	PW	4	4	3	4	2	2	4	4	4	4	3	3	3	3	4	3	3	3	4
2017_2-X	Studierende		4	3	4	4	1	2	4	4	4	4	1	3	4	4	4	4	3	3	4
2017_2-X	Studierende		4	3	4	2		3	4	3	2	3	3		4	3	4		3	3	4
2017_2-X	Studierende		4	3	3	4			2	3	4	4	2		1	3			4	2	
2017_2	Tutorinnen	VK	2	4	3	3	1	4	4	4	4	4	3	3	4	3	4	4	4	2	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_2	Studierende	VK	4	3	4	3	4	4	4	4	4	3	3	4	4	3	3	4	4	4	3
2017_2	Studierende	VK	4	3	3	2	1	1	3	4	4	4	4	4	3	3	4	4	4	3	4
2017_2	Studierende	VK	4	4	4	3	3	2	4	3	3	4	2	2	4	3	4	4	3	3	4
2017_2	Studierende	VK	4	4	3	3	3	3	4	3	4	4	3	3	3	3	4	3	4	2	4
2017_2	Studierende	VK	3	2	2	3	2	2	3	2	3	4	2	2	3	2	4	3	3	2	3
2017_2	Studierende	VK	3	3	3	1	3	2	3	4	1	3	3	3	4	3	4	4	3	4	4
2017_2	Studierende	VK	3	2	2	2	2	2	1	2	1	1	2	3	2	2	2	1	1	1	1
2017_2	Studierende	VK	3	2	3	4	3	3	3	4	2	2	3	3	4	2	3	3	4	3	4
2017_2	Studierende	VK	3	3	4	3	2	3	3	3	3	4	3	3	4	3	4	3	3	3	4
2017_2	Studierende	VK	3	2	2	2	3	3	2	3	3	3	3	3	3	2	3	3	3	2	4
2017_2	Studierende	VK	2	3	4	2	1	3	1	3	3	3	2	3	3	4	3	3	4	4	4
2017_2	Tutorinnen	VK	3	3	2	2	2	4	4	4	4	4	2	2	4	4	3	4	4	2	4
2017_2	Studierende	VK	4	3	3	4	4	3	3	2	3	3	2	2	3	3	2		3	2	4
2017_2	Studierende	VK	4	4	3	2	1	3	4	3	3	4	3	3	4	4	4	4	3	3	3
2017_2	Studierende	VK	4	3	4	3	3	3	3	4	4	4	3	4	4	4	4	4	4	3	4
2017_2	Studierende	VK	4	4	3	3	4	3	3	4	3	4	4	3	3	4	3	4	3	3	3
2017_2	Studierende	VK	4	3	4	4	1	4	4	4	4	4	2	1	4	4	4	4	4	3	3
2017_2	Studierende	VK	4	3	4	4	1	3	4	4	3	3	4	3	4	4	4	4	3	3	3
2017_2	Studierende	VK	3	2	4	3	1	3	2	4	4	4	2	1	4	3	4	4	4	1	4
2017_2	Studierende	VK	3	4	3	1	1	2	2	3	4	4	1	4	4	4	4	4	4	3	4
2017_2	Studierende	VK	3	4	3	2	1	3	4	3	4	4	3	2	4	4	4	3	4	2	4
2017_2	Studierende	TAP	3	3	3	2	1	3	2	3	4	4	3	3	3	3	4	3	3	3	4
2017_2	Studierende	TAP	3	3	2	3	2	3	3	3	3	4	4	3	3	2	3	3	3	3	3
2017_2	Studierende	TAP	3	3	4	4	2	2	3	4	4	4	3	3	4	4	4	4	4	2	4
2017_2	Studierende	TAP	3	3	3	3	4	3	4	4	4	4	2	2	4	2	4	4	4	2	4
2017_2	Studierende	TAP	3	4	1	4	1	2	1	3	4	4		2	3	3	1	1	4	1	4
2017_2	Studierende	TAP	3	3	4	3	4	3	4	3	3	4	4	3	4	4	4	3	3	3	4
2017_2	Studierende	TAP	3	3	3	3	1	2	4	4	4	4	3	2	3	3	3	4	4	4	4
2017_2	Studierende	TAP	3	3	3	3	3	3	3	4	4	4	3	2	2	3	3	3	4	3	4
2017_2	Studierende	TAP	3	4	4	2	1	4	3	4	3	4	2	1	4	3	2	3	4	3	4
2017_2	Studierende	TAP	3	4	4	3	3	3	4	4	3	4	3	4	4	4	4	4	4	3	4
2017_2	Studierende	TAP	3	3	4	4	4	4	3	4	4	4	4	3	4	3	3	4	3	3	4
2017_2	Studierende	TAP	3	4	3	4	3	2	4	3	4	4	4	2	3	3	4	4	4	3	3
2017_2	Studierende	TAP	3	4	4	4	1	1	4	4	4	4	3	2	3	2	4	4	4	2	4
2017_2	Studierende	TAP	3	3	4	3	1	3	3	3	4	3	2	1	2	3	3	4	4	3	4
2017_2	Studierende	TAP	3	4	4	3	1	4	4	4	4	4	4	4	4	3	3	4	4	2	4
2017_2	Studierende	TAP	3	4	4	4	2	4	4	4	4	3	2	2	4	3	3	4	4	3	4
2017_2	Studierende	TAP	3	4	4	3	1	4	2	4	4	4	1	3	4	3	4	4	4	1	4
2017_2	Studierende	TAP	3	3	3	2	2	3	3	4	4	3	3	2	3	4	2	4	4	4	3
2017_2	Studierende	TAP	3	3	3	2	4	4	3	4	2	2	2	3	4	4	3	3	4	3	2
2017_2	Studierende	TAP	3	3	4	4	3	4	3	3	4	3	3	2	3	3	3	4	3	2	3
2017_2	Studierende	TAP	3	3	4	4	4	4	4	3	4	4	4	1	3	3	3	3	4	2	4
2017_2	Studierende	TAP	3	3	3	4	1	3	4	3	4	4	3	2	3	3	3	3	4	2	4
2017_2	Studierende	TAP	3	3	2	4	3	3	3	3	4	4	3	4	4	3	3	3	4	4	4
2017_2	Studierende	TAP	3	3	3	4	1	3	2	3	3	4	2	1	2	1	1	4	4	2	4
2017_2	Studierende	TAP	3	3	4	2	1	3	4	2	2	4	3	3	2	4	3	2	4	4	4
2017_2	Studierende	TAP	3	3	3	3	1	4	3	3	4	4	2	2	2	3	3	3	3	3	4
2017_2	Studierende	PW	3	3	3	3	2	3	3	4	3	4	3	3	4	4	4	3	3	3	4
2017_2	Studierende	PW	3	4	4	4	2	1	4	2	4	4	3	1	3	4	2	4	3	2	4
2017_2	Studierende	PW	3	3	3	3	3	2	4	4	4	4	3	2	4	4	3	4	3	3	4
2017_2	Studierende	PW	3	4	3	4	4	3	4	4	3	4	4	3	4	4	3	4	3	3	4
2017_2	Studierende	PW	3	4	4	4	2	3	4	3	4	4	3	3	2	3	2	4	4	1	4
2017_2	Studierende	PW	3	3	3	4	1	3	4	2	4	3	2	2	3	3	3	3	4	1	3
2017_2	Studierende	PW	3	3	1	4	2	2	3	3	3	4	1	1	2	4	2	2	3	1	1
2017_2	Studierende	PW	3	4	4	4		2	4	4	4	4	3	4	4	4	3	3	4	2	4
2017_2	Studierende	PW	3	2	4	4	1	1	3	3	4	4	2	1	4	4	4	4	4	3	4
2017_2	Studierende	PW	3	3	2	4	1	3	3	4	4	3	1	4	2	3	2	4	4	2	2
2017_2	Studierende	PW	3	4	3	3	2	3	3	3	4	4	2	4	3	4	3	3	4	3	4
2017_2	Studierende	PW	3	3	3	1	1	3	3	4	1	1	2	4	3	4	4	4	3	3	2
2017_2	Studierende	PW	3	1	4	2	2	2	4	4	3	3	4	1	3	3	3	3	4	4	3
2017_2	Studierende	PW	3	3		3	2	2	3	4	4	4	2	1	4		3	2	4	4	4
2017_2	Studierende	PW	3	2	2	3	3	2	2	3	3	4	2	2	1	2	3	3	4	1	3
2017_2	Studierende	PW	3	3	2	3	2	2	3	2	3	4	2	2	3	3	2	3	3	3	4
2017_2	Studierende	PW	3	3	4	3	1	3	3	1	4	4	2	2	3	4	4	3	4	2	4
2017_2	Studierende	PW	3	3	3	3	3	3	3	4	4	3	3	3	4	3	4	4	3	4	3
2017_2	Studierende	PW	3	3	4	4	2	2	4	3	3	3	3	2	3	4	3	3	4	2	3
2017_2	Studierende	PW	3	4	2	4	2	3	4	3	4	4	2	3	3	3	2	3	4	1	4
2017_2	Studierende	PW	3	4	2	3	2	3	3	2	3	3	3	1	3	3	3	3	2	2	4

Appendix - Perception-Based Test - Data Collection

Semester	Rolle	Thema	T1.1	T1.2	T2.1	T3.1	T4.1	C1.1	C2.1	C3.1	C3.2	C3.3	C4.1	C4.2	A1.1	A1.2	A2.1	A2.2	A3.1	A4.1	A4.2
2017_2	Studierende	PW	3	3	1	2	1	1	3	3	4	4	1	2	2	3	1	1	4	1	4
2017_2	Studierende	PW	3	3	3	3	1	2	2	4	4	4	3	3	2	4	2	2	3	2	4
2017_2	Studierende	PW	3	4	3	4	1	2	2	4	4	4	3	3	3	3	2	2	4	2	4
2017_2	Studierende	PW	3	3	1	2	3	4	3	3	4	4	3	3	2	2	3	3	3	1	4
2017_2	Studierende	PW	3	3	2	4	2	3	3	4	4	4	3	2	3	3	3	4	3	2	4
2017_2	Studierende	PW	3	2	3	4	1	3	3	4	4	4	3	1	3	3	3	3	3	3	4
2017_2	Studierende	PW	3	3	3	4	3	2	4	4	3	4	2	2	4	3	3	4	4	3	4
2017_2	Studierende	PW	3	3	4	4	4	2	3	4	4	4	3		4	3	3	3	3	3	4
2017_2	Studierende	PW	3	2	4	4	1	2	4	4	4	4	3	2	2	3	3	4	4	3	4
2017_2-X	Studierende		3	4	4	2	1	2	4	2	4	4	3	2	3	4	3	3	4	2	4
2017_2-X	Studierende		3	3	4	4	3	3	3	3	3	3	3	4	3	3	3	3	3	2	4
2017_2-X	Studierende		3	4	3	4	1	3	2	3	4	4	3	1	3	2	2	3	4	1	4
2017_2	Studierende	VK	3	3	3	3	3	3	4	3	3	3	3	3	3	3	4	3	3	3	4
2017_2	Studierende	VK	3	3	4	3	2	3	4	4	4	3	2	1	4	3	4	3	4	4	3
2017_2	Studierende	VK	3	3	3	4	4	2	3	3	3	4	4	2	4	3	4	3	4	2	4
2017_2	Studierende	VK	3	3	4	3	2	3	4	3	3	4	2	2	4	4	4	3	4	2	3
2017_2	Studierende	VK	3	4	4	3	3	3	4	2	4	4	3	2	3	3	4	3	4	4	4
2017_2	Studierende	VK	3	3	2	1	1	2	4	4	4	4	1	1	4	3	4	3	4	1	4
2017_2	Studierende	VK	2	4	2	2	2	2	2	3	3	3	3		4	3	4	3	2	3	3
2017_2	Studierende	TAP	2	2	3	4	2	2	2	3	3	3	3	2	3	3	2	3	4	2	4
2017_2	Studierende	TAP	2	1	1	2	4	1	1	1	1	1	1	2	1	1	1	1	1	2	1
2017_2	Studierende	TAP	2	2	1	2	3	3	2	2	2	2	2	2	2	3	2	2	2	3	2
2017_2	Studierende	TAP	2	3	3	4	4	3	3	3	4	4	2	4	3	1	3	3	4	1	4
2017_2	Studierende	TAP	2	3	3	2	3	3	3	1	4	4	1	1	4	2	1	2	4	2	4
2017_2	Studierende	TAP	2	2	2	2	1	3	4	4	4	4	1	3	4	2	2	3	4	3	4
2017_2	Studierende	TAP	2	2	2	1	2	2	1	1	1	1	2	2	1	2	1	1	1	3	1
2017_2	Studierende	TAP	2	4	4	4	3	4	3	4	4	4	2	4	3	4	3	4	4	3	4
2017_2	Studierende	TAP	2	3	4	3	1	3	2	4	4	4	3	1	3	4	3	3	4	3	4
2017_2	Studierende	TAP	2	3	2	3	2	3	2	3	4	3	2	2	2	3	2	3	3	3	3
2017_2	Studierende	PW	2	3	2	2	2	2	2	2	3	3	2	2	2	3	2	2	3	1	3
2017_2	Studierende	PW	2	3	4	3	3	2	2	2	4	4	2	2	1	3	2	1	1	2	3
2017_2	Studierende	PW	2	2	2	2	4	3	2	1	1	1	1	3	2	2	1	2	2	1	1
2017_2	Studierende	PW	2	3	2	3	2	2	3	2	4	3	2	3	4	3	3	3	4	4	3
2017_2	Studierende	PW	2	2	2	3	2	2	1	2	1	1	2	3	1	2	1	2	1	2	1
2017_2	Studierende	PW	2	3	1	3	1	2	2	4	4	4	1	3	4	4	4	3	3	3	4
2017_2	Studierende	PW	2	2	3	4	2	2	3	3	2	1	4	3	2	2	2	2	2	2	1
2017_2	Studierende	VK	2	3	3	3	1	3	4	4	4	4	2	1	4	3	4	3	4	2	4
2017_2	Studierende	TAP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2017_2	Studierende	TAP	1	1		1	1	4	4	1	3	4	1	1	1	1	1	1	4	2	4
2017_2	Studierende	TAP	1	2	3	1	1	1	2	3	4	4	2	1	3	3	1	3	4	1	4
2017_2-X	Studierende		1	2	3	1	2	2	1	2	1	1	2	1	2	3	1	2	1	1	1
2017_2	Tutorinnen	PW	4	2	4	4	2	2	4	3	2	4	2	2	4	4	3	3	4	2	4
2017_2	Tutorinnen	TAP	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4
2017_2	Tutorinnen	TAP	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2017_2	Tutorinnen	PW	4	4	2	4	2	1	1	4	4	4	4	1	4	4	3	4	4	3	4
2017_2	Studierende	VK	2	3	2	3	1	4	4	4	4	4	4	1	4	4	4	4	4	1	4
2017_2	Tutorinnen	PW	4	2	4	3	1	1	3	4	4	4	1	2	3	3	1	3	4	2	4
2017_2	Tutorinnen	TAP	4	4	4	4	4	4	3	4	4	4	4	4	4	4	3	4	4	4	4
2017_2	Tutorinnen	TAP	4	4	4	4	4	4	4	4	4	4	3	3	3	3	4	4	4	4	4
2017_2	Studierende	VK	2	3	3	2	2	3	4	4	3	4	1	2	3	2	4	3	4	3	4
2017_2	Studierende	VK	1	3	4	3	1	3	3	2	4	4	2	3	3	2	4	4	4	2	4
2017_2	Tutorinnen	PW	3	3	3	2	2	1	3	3	4	4	2	4	4	2	3	3	4	2	4
2017_2	Tutorinnen	VK	3	3	3	2	1	3	4	4	4	4	2	3	4	3	4	4	4	1	4

Appendix

Perception-Based Test

Data Analysis

Appendix - Perception-Based Test - Data Analysis

Formulas used for the data analysis of the evidence-based test				
Semester	**Rolle**	**Thema**	**Mean**	**T1.1 and for all of the cells to the right of it respectively**
2017_2	Abschluss		=AVERAGE(F5:W5)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B5));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B5))
2017_2	Abschluss		SD	=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A6)*(combined!$B$2:$B=$B6);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A6)*(combined!$B$2:$B=$B6);combined!D$2:D;)))))
2017_2	Studierende		Cronbach	=(COUNT(F5:W5)/(COUNT(F5:W5)-1))*(1-(SUMSQ(F6:W6)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A7)*(combined!$B$2:$B=$B7);combined!BA$2:BA;))))^2))
	Studierende		=AVERAGE(F9:W9)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B9));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B9))
2017_1	Studierende		=AVERAGE(F10:W10)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A10;combined!$B$2:$B;$B10));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A10;combined!$B$2:$B;$B10))
2017_2	Studierende		=AVERAGE(F11:W11)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A11;combined!$B$2:$B;$B11));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A11;combined!$B$2:$B;$B11))
	Tutorinnen		=AVERAGE(F13:W13)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B13));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B13))
2017_1	Tutorinnen		=AVERAGE(F14:W14)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A14;combined!$B$2:$B;$B14));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A14;combined!$B$2:$B;$B14))
2017_2	Tutorinnen		=AVERAGE(F15:W15)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A15;combined!$B$2:$B;$B15));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A15;combined!$B$2:$B;$B15))
	Beobachterin		=AVERAGE(F17:W17)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B17));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B17))
2017_1	Beobachterin		=AVERAGE(F18:W18)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A18;combined!$B$2:$B;$B18));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A18;combined!$B$2:$B;$B18))
2017_2	Beobachterin		=AVERAGE(F19:W19)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A19;combined!$B$2:$B;$B19));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A19;combined!$B$2:$B;$B19))
	Studierende	VK	=AVERAGE(F23:W23)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B23;combined!$C$2:$C;$C23));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B23;combined!$C$2:$C;$C23))
2017_1	Studierende	VK	=AVERAGE(F24:W24)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A24;combined!$B$2:$B;$B24;combined!$C$2:$C;$C24));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A24;combined!$B$2:$B;$B24;combined!$C$2:$C;$C24))
2017_2	Studierende	VK	=AVERAGE(F25:W25)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A25;combined!$B$2:$B;$B25;combined!$C$2:$C;$C25));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A25;combined!$B$2:$B;$B25;combined!$C$2:$C;$C25))
2017_1	Studierende	VK	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A24)*(combined!$B$2:$B=$B24)*(combined!$C$2:C=$C24);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A24)*(combined!$B$2:$B=$B24)*(combined!$C$2:C=$C24); combined!D$2:D;)))))"
2017_2	Studierende	VK	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A25)*(combined!$B$2:$B=$B25)*(combined!$C$2:C=$C25);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A25)*(combined!$B$2:$B=$B25)*(combined!$C$2:C=$C25); combined!D$2:D;)))))"
2017_1	Studierende	VK	Cronbach	=(COUNT(F23:W23)/(COUNT(F23:W23)-1))*(1-(SUMSQ(F26:W26)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A28)*(combined!$B$2:$B=$B28)*(combined!$C$2:C=$C28);combined!BA$2:BA;))))^2))
2017_2	Studierende	VK	Cronbach	=(COUNT(F24:W24)/(COUNT(F24:W24)-1))*(1-(SUMSQ(F27:W27)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A29)*(combined!$B$2:$B=$B29)*(combined!$C$2:C=$C29);combined!BA$2:BA;))))^2))
	Tutorinnen	VK	=AVERAGE(F31:W31)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B31;combined!$C$2:$C;$C31));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B31;combined!$C$2:$C;$C31))
2017_1	Tutorinnen	VK	=AVERAGE(F32:W32)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A32;combined!$B$2:$B;$B32;combined!$C$2:$C;$C32));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A32;combined!$B$2:$B;$B32;combined!$C$2:$C;$C32))
2017_2	Tutorinnen	VK	=AVERAGE(F33:W33)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A33;combined!$B$2:$B;$B33;combined!$C$2:$C;$C33));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A33;combined!$B$2:$B;$B33;combined!$C$2:$C;$C33))
2017_1	Beobachterin	VK	=AVERAGE(F35:W35)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A35;combined!$B$2:$B;$B35;combined!$C$2:$C;$C35));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A35;combined!$B$2:$B;$B35;combined!$C$2:$C;$C35))
	Studierende	TAP	=AVERAGE(F39:W39)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B39;combined!$C$2:$C;$C39));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B39;combined!$C$2:$C;$C39))
2017_1	Studierende	TAP	=AVERAGE(F40:W40)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A40;combined!$B$2:$B;$B40;combined!$C$2:$C;$C40));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A40;combined!$B$2:$B;$B40;combined!$C$2:$C;$C40))
2017_2	Studierende	TAP	=AVERAGE(F41:W41)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A41;combined!$B$2:$B;$B41;combined!$C$2:$C;$C41));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A41;combined!$B$2:$B;$B41;combined!$C$2:$C;$C41))
2017_1	Studierende	TAP	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A40)*(combined!$B$2:$B=$B40)*(combined!$C$2:C=$C40);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A40)*(combined!$B$2:$B=$B40)*(combined!$C$2:C=$C40); combined!D$2:D;)))))"
2017_2	Studierende	TAP	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A41)*(combined!$B$2:$B=$B41)*(combined!$C$2:C=$C41);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A41)*(combined!$B$2:$B=$B41)*(combined!$C$2:C=$C41); combined!D$2:D;)))))"
2017_1	Studierende	TAP	Cronbach	=(COUNT(F39:W39)/(COUNT(F39:W39)-1))*(1-(SUMSQ(F42:W42)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A44)*(combined!$B$2:$B=$B44)*(combined!$C$2:C=$C44);combined!BA$2:BA;))))^2))
2017_2	Studierende	TAP	Cronbach	=(COUNT(F40:W40)/(COUNT(F40:W40)-1))*(1-(SUMSQ(F43:W43)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A45)*(combined!$B$2:$B=$B45)*(combined!$C$2:C=$C45);combined!BA$2:BA;))))^2))
	Tutorinnen	TAP	=AVERAGE(F47:W47)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B47;combined!$C$2:$C;$C47));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B47;combined!$C$2:$C;$C47))
2017_1	Tutorinnen	TAP	=AVERAGE(F48:W48)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A48;combined!$B$2:$B;$B48;combined!$C$2:$C;$C48));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A48;combined!$B$2:$B;$B48;combined!$C$2:$C;$C48))
2017_2	Tutorinnen	TAP	=AVERAGE(F49:W49)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A49;combined!$B$2:$B;$B49;combined!$C$2:$C;$C49));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A49;combined!$B$2:$B;$B49;combined!$C$2:$C;$C49))
	Beobachterin	TAP	=AVERAGE(F51:W51)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B51;combined!$C$2:$C;$C51));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B51;combined!$C$2:$C;$C51))
2017_1	Beobachterin	TAP	=AVERAGE(F52:W52)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A52;combined!$B$2:$B;$B52;combined!$C$2:$C;$C52));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A52;combined!$B$2:$B;$B52;combined!$C$2:$C;$C52))
2017_2	Beobachterin	TAP	=AVERAGE(F53:W53)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A53;combined!$B$2:$B;$B53;combined!$C$2:$C;$C53));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A53;combined!$B$2:$B;$B53;combined!$C$2:$C;$C53))
	Studierende	PW	=AVERAGE(F56:W56)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B56;combined!$C$2:$C;$C56));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B56;combined!$C$2:$C;$C56))
2017_1	Studierende	PW	=AVERAGE(F57:W57)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A57;combined!$B$2:$B;$B57;combined!$C$2:$C;$C57));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A57;combined!$B$2:$B;$B57;combined!$C$2:$C;$C57))
2017_2	Studierende	PW	=AVERAGE(F58:W58)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A58;combined!$B$2:$B;$B58;combined!$C$2:$C;$C58));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A58;combined!$B$2:$B;$B58;combined!$C$2:$C;$C58))
2017_1	Studierende	PW	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A57)*(combined!$B$2:$B=$B57)*(combined!$C$2:C=$C57);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A57)*(combined!$B$2:$B=$B57)*(combined!$C$2:C=$C57); combined!D$2:D;)))))"
2017_2	Studierende	PW	SD	"=IF(ISERROR(ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A58)*(combined!$B$2:$B=$B58)*(combined!$C$2:C=$C58);combined!D$2:D;))))));;ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A58)*(combined!$B$2:$B=$B58)*(combined!$C$2:C=$C58); combined!D$2:D;)))))"
2017_1	Studierende	PW	Cronbach	=(COUNT(F56:W56)/(COUNT(F56:W56)-1))*(1-(SUMSQ(F59:W59)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A61)*(combined!$B$2:$B=$B61)*(combined!$C$2:C=$C61);combined!BA$2:BA;))))^2))
2017_2	Studierende	PW	Cronbach	=(COUNT(F57:W57)/(COUNT(F57:W57)-1))*(1-(SUMSQ(F60:W60)/ARRAYFORMULA(STDEV((IF((combined!$A$2:$A=$A62)*(combined!$B$2:$B=$B62)*(combined!$C$2:C=$C62);combined!BA$2:BA;))))^2))
	Tutorinnen	PW	=AVERAGE(F64:W64)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B64;combined!$C$2:$C;$C64));;AVERAGEIFS(combined!D$2:D;combined!$B$2:$B;$B64;combined!$C$2:$C;$C64))
2017_1	Tutorinnen	PW	=AVERAGE(F65:W65)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A65;combined!$B$2:$B;$B65;combined!$C$2:$C;$C65));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A65;combined!$B$2:$B;$B65;combined!$C$2:$C;$C65))
2017_2	Tutorinnen	PW	=AVERAGE(F66:W66)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A66;combined!$B$2:$B;$B66;combined!$C$2:$C;$C66));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A66;combined!$B$2:$B;$B66;combined!$C$2:$C;$C66))
2017_1	Beobachterin	PW	=AVERAGE(F68:W68)	=IF(ISERR(AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A68;combined!$B$2:$B;$B68;combined!$C$2:$C;$C68));;AVERAGEIFS(combined!D$2:D;combined!$A$2:$A;$A68;combined!$B$2:$B;$B68;combined!$C$2:$C;$C68))
2017_1	Studierende			=COUNTIFS(combined!$A$2:$A;$A72;combined!$B$2:$B;$B72)
2017_1	Studierende	VK		=COUNTIFS(combined!$A$2:$A;$A73;combined!$B$2:$B;$B73;combined!$C$2:$C;$C73)
2017_1	Studierende	TAP		=COUNTIFS(combined!$A$2:$A;$A74;combined!$B$2:$B;$B74;combined!$C$2:$C;$C74)
2017_1	Studierende	PW		=COUNTIFS(combined!$A$2:$A;$A75;combined!$B$2:$B;$B75;combined!$C$2:$C;$C75)
2017_1	Tutorinnen			=COUNTIFS(combined!$A$2:$A;$A77;combined!$B$2:$B;$B77)
2017_1	Tutorinnen	VK		=COUNTIFS(combined!$A$2:$A;$A78;combined!$B$2:$B;$B78;combined!$C$2:$C;$C78)
2017_1	Tutorinnen	TAP		=COUNTIFS(combined!$A$2:$A;$A79;combined!$B$2:$B;$B79;combined!$C$2:$C;$C79)
2017_1	Tutorinnen	PW		=COUNTIFS(combined!$A$2:$A;$A80;combined!$B$2:$B;$B80;combined!$C$2:$C;$C80)
2017_1	Beobachterin			=COUNTIFS(combined!$A$2:$A;$A82;combined!$B$2:$B;$B82)
2017_1	Beobachterin	VK		=COUNTIFS(combined!$A$2:$A;$A83;combined!$B$2:$B;$B83;combined!$C$2:$C;$C83)
2017_1	Beobachterin	TAP		=COUNTIFS(combined!$A$2:$A;$A84;combined!$B$2:$B;$B84;combined!$C$2:$C;$C84)
2017_1	Beobachterin	PW		=COUNTIFS(combined!$A$2:$A;$A85;combined!$B$2:$B;$B85;combined!$C$2:$C;$C85)
2017_2	Studierende			=COUNTIFS(combined!$A$2:$A;$A89;combined!$B$2:$B;$B89)
2017_2	Studierende	VK		=COUNTIFS(combined!$A$2:$A;$A90;combined!$B$2:$B;$B90;combined!$C$2:$C;$C90)
2017_2	Studierende	TAP		=COUNTIFS(combined!$A$2:$A;$A91;combined!$B$2:$B;$B91;combined!$C$2:$C;$C91)
2017_2	Studierende	PW		=COUNTIFS(combined!$A$2:$A;$A92;combined!$B$2:$B;$B92;combined!$C$2:$C;$C92)
2017_2	Tutorinnen			=COUNTIFS(combined!$A$2:$A;$A94;combined!$B$2:$B;$B94)
2017_2	Tutorinnen	VK		=COUNTIFS(combined!$A$2:$A;$A95;combined!$B$2:$B;$B95;combined!$C$2:$C;$C95)
2017_2	Tutorinnen	TAP		=COUNTIFS(combined!$A$2:$A;$A96;combined!$B$2:$B;$B96;combined!$C$2:$C;$C96)
2017_2	Tutorinnen	PW		=COUNTIFS(combined!$A$2:$A;$A97;combined!$B$2:$B;$B97;combined!$C$2:$C;$C97)
2017_2	Beobachterin			=COUNTIFS(combined!$A$2:$A;$A99;combined!$B$2:$B;$B99)
2017_2	Beobachterin	VK		=COUNTIFS(combined!$A$2:$A;$A100;combined!$B$2:$B;$B100;combined!$C$2:$C;$C100)
2017_2	Beobachterin	TAP		=COUNTIFS(combined!$A$2:$A;$A101;combined!$B$2:$B;$B101;combined!$C$2:$C;$C101)
2017_2	Beobachterin	PW		=COUNTIFS(combined!$A$2:$A;$A102;combined!$B$2:$B;$B102;combined!$C$2:$C;$C102)
2017_2	Abschluss			=COUNTIFS(combined!$A$2:$A;$A105;combined!$B$2:$B;$B105)

Appendix

Comparative Self-Assessment Test

Questionnaires

Technische Universität Berlin
André Baier, Sabine Pongratz
Blue Engineering

Markieren Sie so: ☐ ☒ ☐ ☐ ☐ Bitte verwenden Sie einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.

Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Ihre Fähigkeiten

In welchen Maße verfügen Sie zum jetzigen Zeitpunkt über folgende Fähigkeiten?

		in sehr geringem Maße					in sehr hohem Maße
1.1	den Einfluss von Technik auf Natur und Gesellschaft beschreiben	☐	☐	☐	☐	☐	☐
1.2	anderen Studierenden Wissen vermitteln	☐	☐	☐	☐	☐	☐
1.3	fächerübergreifend denken	☐	☐	☐	☐	☐	☐
1.4	lösen von vorgegebenen Problemen	☐	☐	☐	☐	☐	☐
1.5	mit Fakten argumentieren	☐	☐	☐	☐	☐	☐
1.6	gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken	☐	☐	☐	☐	☐	☐
1.7	Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe	☐	☐	☐	☐	☐	☐
1.8	gemeinsame Entscheidungen in einer Gruppe koordinieren und treffen	☐	☐	☐	☐	☐	☐
1.9	meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen	☐	☐	☐	☐	☐	☐
1.10	Kritik anderer umsetzen	☐	☐	☐	☐	☐	☐
1.11	die lokalen und globalen Auswirkungen von Technik darstellen	☐	☐	☐	☐	☐	☐
1.12	Machtstrukturen innerhalb einer Gruppe erkennen	☐	☐	☐	☐	☐	☐
1.13	mit Emotionen argumentieren	☐	☐	☐	☐	☐	☐
1.14	unterschiedliche Ansichten innerhalb einer Gruppe freilegen	☐	☐	☐	☐	☐	☐
1.15	Wert- und Zielkonflikte mit anderen Menschen aushandeln	☐	☐	☐	☐	☐	☐
1.16	Wissen ausserhalb meiner Disziplin finden und erschließen	☐	☐	☐	☐	☐	☐
1.17	orientiert an meinen eigenen Einstellungen und Werten handeln	☐	☐	☐	☐	☐	☐
1.18	aus Sicht verschiedener Perspektiven zu argumentieren	☐	☐	☐	☐	☐	☐
1.19	komplexe Sachverhalte didaktisch aufbereiten	☐	☐	☐	☐	☐	☐
1.20	mit eigenen Werten zu argumentieren	☐	☐	☐	☐	☐	☐
1.21	unterschiedliche Ansichten über Technik nachvollziehen	☐	☐	☐	☐	☐	☐
1.22	die Grenzen meines Wissens kennen	☐	☐	☐	☐	☐	☐
1.23	Risiken und Gefahren nicht nachhaltigen Handelns erkennen und beurteilen	☐	☐	☐	☐	☐	☐
1.24	einen Gruppenprozess im Nachhinein in Hinsicht auf Ergebnis und Prozess reflektieren	☐	☐	☐	☐	☐	☐
1.25	in andere hineinversetzen und ihre Beweggründe verstehen	☐	☐	☐	☐	☐	☐
1.26	Kritik anderer Menschen annehmen	☐	☐	☐	☐	☐	☐
1.27	dazu beitragen, dass alle Mitglieder einer Gruppe sich gleichberechtigt einbringen	☐	☐	☐	☐	☐	☐
1.28	mir eine eigene Problemstellung erarbeiten	☐	☐	☐	☐	☐	☐
1.29	mit anderen kooperieren um ein gemeinsames Ziel zu erreichen	☐	☐	☐	☐	☐	☐
1.30	anderen Menschen eine konstruktive Rückmeldung geben	☐	☐	☐	☐	☐	☐
1.31	eigene Einstellungen und Werte in Bezug auf Technik kennen	☐	☐	☐	☐	☐	☐

2. Ihre Einstellungen

		stimmt genau	stimmt weitgehend	stimmt ein wenig	stimmt eher nicht	stimmt weitgehend nicht	stimmt überhaupt nicht
2.1	Ich bin der Meinung, dass auch ein/e Einzelne/r im Unternehmen viel bewirken kann.	☐	☐	☐	☐	☐	☐
2.2	Wenn etwas technisch machbar ist, möchte ich auch dass es umgesetzt wird.	☐	☐	☐	☐	☐	☐
2.3	Ich finde, dass sich meine Kommiliton*Innen zu wenig mit den Auswirkungen von Technik auseinandersetzen.	☐	☐	☐	☐	☐	☐
2.4	Ich finde es problematisch, dass ich sehr abhängig von Technik bin.	☐	☐	☐	☐	☐	☐
2.5	Ich denke oft darüber nach, was meine Handlungen für die Natur bedeuten.	☐	☐	☐	☐	☐	☐
2.6	Ich denke oft darüber nach, welche Auswirkungen meine Handlungen auf andere Menschen haben.	☐	☐	☐	☐	☐	☐
2.7	Ich denke, dass Technik durch gesellschaftliche und politische Entscheidungsprozesse beschränkt werden darf.	☐	☐	☐	☐	☐	☐
2.8	Ich finde den hohen Stellenwert von Technik in unserer Gesellschaft bedenklich.	☐	☐	☐	☐	☐	☐
2.9	Ich bevorzuge technische Lösungen für gesellschaftliche Problemstellungen.	☐	☐	☐	☐	☐	☐
2.10	Ich bin der Ansicht, dass technische Innovationen immer auch ein gesellschaftlicher Fortschritt sind.	☐	☐	☐	☐	☐	☐
2.11	In meiner privaten Lebensweise berücksichtige ich immer die Auswirkungen von Technik.	☐	☐	☐	☐	☐	☐
2.12	Ich bin der Meinung, dass manche Probleme nur bearbeitet werden können, wenn sich Menschen zusammenschließen und kollektiv handeln.	☐	☐	☐	☐	☐	☐

3. Zur Person

3.1 Geschlecht: ☐ männlich ☐ weiblich ☐ keine Angabe

3.2 Nächster angestrebter Studienabschluss: ☐ Bachelor ☐ Master ☐ Diplom ☐ anderes

3.3 Studienfeld:

☐ Ingenieurswissenschaften ☐ Mathematik und Naturwissenschaften (auch Informatik) ☐ Geistes- und Gesellschaftswissenschaften

☐ Planungswissenschaften ☐ Wirtschaftswissenschaften/ Wirtschaftsingenieurwesen

4. Matchingcode

Sie werden diesen Fragebogen am Ende des Moduls noch einmal vorgelegt bekommen.
Um eine mögliche Veränderung der Werte dokumentieren zu können, ist es notwendig die Fragebögen einer Person eineindeutig zuzuordenen (Matching).
Bitte tragen Sie nachfolgend den beschriebenen Code ein, um eine Zuordnung zu ermöglichen.

4.1
1. Den ersten beiden Buchstaben des Vornamens Ihrer Mutter (Bsp. Anna = **An**)
2. Ihrem Geburts**tag** ohne Angabe von Monat und Jahr (Bsp. 1.4.1990 = **01)**
3. Die ersten beiden Buchstaben Ihrer Geburtsstadt (Bsp. Berlin = **Be**)

Technische Universität Berlin André Baier, Sabine Pongratz

Blue Engineering

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1.3	fächerübergreifend denken	☐	☐	☐	☐	☐	☐
1.4	lösen von vorgegebenen Problemen	☐	☐	☐	☐	☐	☐
1.5	mit Fakten argumentieren	☐	☐	☐	☐	☐	☐
1.6	gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken	☐	☐	☐	☐	☐	☐
1.7	Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe	☐	☐	☐	☐	☐	☐
1.8	gemeinsame Entscheidungen in einer Gruppe koordinieren und treffen	☐	☐	☐	☐	☐	☐
1.9	meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen	☐	☐	☐	☐	☐	☐
1.10	Kritik anderer umsetzen	☐	☐	☐	☐	☐	☐
1.11	die lokalen und globalen Auswirkungen von Technik darstellen	☐	☐	☐	☐	☐	☐
1.12	Machtstrukturen innerhalb einer Gruppe erkennen	☐	☐	☐	☐	☐	☐
1.13	mit Emotionen argumentieren	☐	☐	☐	☐	☐	☐
1.14	unterschiedliche Ansichten innerhalb einer Gruppe freilegen	☐	☐	☐	☐	☐	☐
1.15	Wert- und Zielkonflikte mit anderen Menschen aushandeln	☐	☐	☐	☐	☐	☐
1.16	Wissen ausserhalb meiner Disziplin finden und erschließen	☐	☐	☐	☐	☐	☐
1.17	orientiert an meinen eigenen Einstellungen und Werten handeln	☐	☐	☐	☐	☐	☐
1.18	aus Sicht verschiedener Perspektiven zu argumentieren	☐	☐	☐	☐	☐	☐
1.19	komplexe Sachverhalte didaktisch aufbereiten	☐	☐	☐	☐	☐	☐
1.20	mit eigenen Werten zu argumentieren	☐	☐	☐	☐	☐	☐
1.21	unterschiedliche Ansichten über Technik nachvollziehen	☐	☐	☐	☐	☐	☐
1.22	die Grenzen meines Wissens kennen	☐	☐	☐	☐	☐	☐
1.23	Risiken und Gefahren nicht nachhaltigen Handelns erkennen und beurteilen	☐	☐	☐	☐	☐	☐
1.24	einen Gruppenprozess im Nachhinein in Hinsicht auf Ergebnis und Prozess reflektieren	☐	☐	☐	☐	☐	☐
1.25	in andere hineinversetzen und ihre Beweggründe verstehen	☐	☐	☐	☐	☐	☐
1.26	Kritik anderer Menschen annehmen	☐	☐	☐	☐	☐	☐
1.27	dazu beitragen, dass alle Mitglieder einer Gruppe sich gleichberechtigt einbringen	☐	☐	☐	☐	☐	☐
1.28	mir eine eigene Problemstellung erarbeiten	☐	☐	☐	☐	☐	☐
1.29	mit anderen kooperieren um ein gemeinsames Ziel zu erreichen	☐	☐	☐	☐	☐	☐
1.30	anderen Menschen eine konstruktive Rückmeldung geben	☐	☐	☐	☐	☐	☐
1.31	eigene Einstellungen und Werte in Bezug auf Technik kennen	☐	☐	☐	☐	☐	☐

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2.4	Ich finde es problematisch, dass ich sehr abhängig von Technik bin.	☐	☐	☐	☐	☐	☐
2.5	Ich denke oft darüber nach, was meine Handlungen für die Natur bedeuten.	☐	☐	☐	☐	☐	☐
2.6	Ich denke oft darüber nach, welche Auswirkungen meine Handlungen auf andere Menschen haben.	☐	☐	☐	☐	☐	☐
2.7	Ich denke, dass Technik durch gesellschaftliche und politische Entscheidungsprozesse beschränkt werden darf.	☐	☐	☐	☐	☐	☐
2.8	Ich finde den hohen Stellenwert von Technik in unserer Gesellschaft bedenklich.	☐	☐	☐	☐	☐	☐
2.9	Ich bevorzuge technische Lösungen für gesellschaftliche Problemstellungen.	☐	☐	☐	☐	☐	☐
2.10	Ich bin der Ansicht, dass technische Innovationen immer auch ein gesellschaftlicher Fortschritt sind.	☐	☐	☐	☐	☐	☐
2.11	In meiner privaten Lebensweise berücksichtige ich immer die Auswirkungen von Technik.	☐	☐	☐	☐	☐	☐
2.12	Ich bin der Meinung, dass manche Probleme nur bearbeitet werden können, wenn sich Menschen zusammenschließen und kollektiv handeln.	☐	☐	☐	☐	☐	☐

3. Zur Person

3.1 Geschlecht: ☐ männlich ☐ weiblich ☐ keine Angabe

3.2 Nächster angestrebter Studienabschluss: ☐ Bachelor ☐ Master ☐ Diplom ☐ anderes

3.3 Studienfeld:
- ☐ Ingenieurswissenschaften
- ☐ Mathematik und Naturwissenschaften (auch Informatik)
- ☐ Geistes- und Gesellschaftswissenschaften
- ☐ Planungswissenschaften
- ☐ Wirtschaftswissenschaften/ Wirtschaftsingenieurwesen

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4.1
1. Den ersten beiden Buchstaben des Vornamens Ihrer Mutter (Bsp. Anna = **An**)
2. Ihrem Geburts**tag** ohne Angabe von Monat und Jahr (Bsp. 1.4.1990 = **01)**
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EvaSys	Abschlussbefragung Blue Engineering 2014	Electric Paper

Technische Universität Berlin — André Baier, Sabine Pongratz

Blue Engineering

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Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachten Sie im Interesse einer optimalen Datenerfassung die links gegebenen Hinweise beim Ausfüllen.

1. Ihre Fähigkeiten

In welchen Maße verfügen Sie zum jetzigen Zeitpunkt über folgende Fähigkeiten?

		in sehr geringem Maße					in sehr hohem Maße
1.1	den Einfluss von Technik auf Natur und Gesellschaft beschreiben	☐	☐	☐	☐	☐	☐
1.2	anderen Studierenden Wissen vermitteln	☐	☐	☐	☐	☐	☐
1.3	fächerübergreifend denken	☐	☐	☐	☐	☐	☐
1.4	lösen von vorgegebenen Problemen	☐	☐	☐	☐	☐	☐
1.5	mit Fakten argumentieren	☐	☐	☐	☐	☐	☐
1.6	gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken	☐	☐	☐	☐	☐	☐
1.7	Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe	☐	☐	☐	☐	☐	☐
1.8	gemeinsame Entscheidungen in einer Gruppe koordinieren und treffen	☐	☐	☐	☐	☐	☐
1.9	meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen	☐	☐	☐	☐	☐	☐
1.10	Kritik anderer umsetzen	☐	☐	☐	☐	☐	☐
1.11	die lokalen und globalen Auswirkungen von Technik darstellen	☐	☐	☐	☐	☐	☐
1.12	Machtstrukturen innerhalb einer Gruppe erkennen	☐	☐	☐	☐	☐	☐
1.13	mit Emotionen argumentieren	☐	☐	☐	☐	☐	☐
1.14	unterschiedliche Ansichten innerhalb einer Gruppe freilegen	☐	☐	☐	☐	☐	☐
1.15	Wert- und Zielkonflikte mit anderen Menschen aushandeln	☐	☐	☐	☐	☐	☐
1.16	Wissen ausserhalb meiner Disziplin finden und erschließen	☐	☐	☐	☐	☐	☐
1.17	orientiert an meinen eigenen Einstellungen und Werten handeln	☐	☐	☐	☐	☐	☐
1.18	aus Sicht verschiedener Perspektiven zu argumentieren	☐	☐	☐	☐	☐	☐
1.19	komplexe Sachverhalte didaktisch aufbereiten	☐	☐	☐	☐	☐	☐
1.20	mit eigenen Werten zu argumentieren	☐	☐	☐	☐	☐	☐
1.21	unterschiedliche Ansichten über Technik nachvollziehen	☐	☐	☐	☐	☐	☐
1.22	die Grenzen meines Wissens kennen	☐	☐	☐	☐	☐	☐
1.23	Risiken und Gefahren nicht nachhaltigen Handelns erkennen und beurteilen	☐	☐	☐	☐	☐	☐
1.24	einen Gruppenprozess im Nachhinein in Hinsicht auf Ergebnis und Prozess reflektieren	☐	☐	☐	☐	☐	☐
1.25	in andere hineinversetzen und ihre Beweggründe verstehen	☐	☐	☐	☐	☐	☐
1.26	Kritik anderer Menschen annehmen	☐	☐	☐	☐	☐	☐
1.27	dazu beitragen, dass alle Mitglieder einer Gruppe sich gleichberechtigt einbringen	☐	☐	☐	☐	☐	☐
1.28	mir eine eigene Problemstellung erarbeiten	☐	☐	☐	☐	☐	☐
1.29	mit anderen kooperieren um ein gemeinsames Ziel zu erreichen	☐	☐	☐	☐	☐	☐
1.30	anderen Menschen eine konstruktive Rückmeldung geben	☐	☐	☐	☐	☐	☐
1.31	eigene Einstellungen und Werte in Bezug auf Technik kennen	☐	☐	☐	☐	☐	☐

2. Ihre Einstellungen

		stimmt genau	stimmt weitgehend	stimmt ein wenig	stimmt eher nicht	stimmt weitgehend nicht	stimmt überhaupt nicht
2.1	Ich bin der Meinung, dass auch ein/e Einzelne/r im Unternehmen viel bewirken kann.	☐	☐	☐	☐	☐	☐
2.2	Wenn etwas technisch machbar ist, möchte ich auch dass es umgesetzt wird.	☐	☐	☐	☐	☐	☐
2.3	Ich finde, dass sich meine Kommiliton*Innen zu wenig mit den Auswirkungen von Technik auseinandersetzen.	☐	☐	☐	☐	☐	☐
2.4	Ich finde es problematisch, dass ich sehr abhängig von Technik bin.	☐	☐	☐	☐	☐	☐
2.5	Ich denke oft darüber nach, was meine Handlungen für die Natur bedeuten.	☐	☐	☐	☐	☐	☐
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2.13	Ich denke, dass die Welt in Ordnung ist, wie sie ist.	☐	☐	☐	☐	☐	☐

3. Zur Person

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Blue Engineering 2015

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1. Ihre Fähigkeiten

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		in sehr hohe Maße					in sehr geringem Maße
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1.2	einen Gruppenprozess im Nachhinein in Hinsicht auf Ergebnis und Prozess reflektieren	☐	☐	☐	☐	☐	☐
1.3	aus Sicht verschiedener Perspektiven argumentieren	☐	☐	☐	☐	☐	☐
1.4	orientiert an meinen eigenen Einstellungen und Werten handeln	☐	☐	☐	☐	☐	☐
1.5	Wert- und Zielkonflikte mit anderen Menschen aushandeln	☐	☐	☐	☐	☐	☐
1.6	gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken	☐	☐	☐	☐	☐	☐
1.7	komplexe Sachverhalte didaktisch aufbereiten	☐	☐	☐	☐	☐	☐
1.8	lösen von vorgegebenen Problemen	☐	☐	☐	☐	☐	☐
1.9	mit Fakten argumentieren	☐	☐	☐	☐	☐	☐
1.10	Wissen ausserhalb meiner Disziplin finden und erschließen	☐	☐	☐	☐	☐	☐
1.11	im eigenen Handeln die Folgen für zukünftige Generationen berücksichtigen	☐	☐	☐	☐	☐	☐
1.12	anderen Studierenden Wissen vermitteln	☐	☐	☐	☐	☐	☐
1.13	Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe	☐	☐	☐	☐	☐	☐
1.14	in andere hineinversetzen und ihre Beweggründe verstehen	☐	☐	☐	☐	☐	☐
1.15	mit Emotionen argumentieren	☐	☐	☐	☐	☐	☐
1.16	eine Entscheidung trotz widersprüchlicher Zielvorgaben treffen	☐	☐	☐	☐	☐	☐
1.17	die zukünftigen lokalen und globalen Auswirkungen von Technik bedenken	☐	☐	☐	☐	☐	☐
1.18	anderen Menschen eine konstruktive Rückmeldung geben	☐	☐	☐	☐	☐	☐
1.19	mir eigenständig eine Problemstellung erarbeiten	☐	☐	☐	☐	☐	☐
1.20	meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen	☐	☐	☐	☐	☐	☐
1.21	den Einfluss von Technik auf Natur und Menschen beschreiben	☐	☐	☐	☐	☐	☐
1.22	mit Werten argumentieren	☐	☐	☐	☐	☐	☐
1.23	Kritik anderer Menschen annehmen und berücksichtigen	☐	☐	☐	☐	☐	☐
1.24	dazu beitragen, dass alle Mitglieder einer Gruppe sich gleichberechtigt einbringen	☐	☐	☐	☐	☐	☐
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1.27	die Grenzen meines Wissens kennen	☐	☐	☐	☐	☐	☐
1.28	die Natur nach meinem Willen formen	☐	☐	☐	☐	☐	☐

2. Ihre Einstellungen

		stimmt genau					stimmt überhaupt nicht
2.1	Die Menschen werden irgendwann einmal genug über die Funktionsweise der Natur lernen, sodass sie diese kontrollieren können.	☐	☐	☐	☐	☐	☐
2.2	Ich bin der Meinung, dass auch ein/e Einzelne/r im Unternehmen viel bewirken kann.	☐	☐	☐	☐	☐	☐
2.3	Trotz seiner speziellen Fähigkeiten ist der Mensch immer noch den Gesetzen der Natur unterworfen.	☐	☐	☐	☐	☐	☐
2.4	Wenn etwas technisch machbar ist, möchte ich auch, dass es umgesetzt wird.	☐	☐	☐	☐	☐	☐
2.5	Eine industrialisierte, hoch technologisierte Gesellschaft bietet die beste Gewähr dafür, dass die Armut erfolgreich bekämpft werden kann.	☐	☐	☐	☐	☐	☐
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2.7	Ich denke, dass Technik durch gesellschaftliche und politische Entscheidungsprozesse beschränkt werden darf.	☐	☐	☐	☐	☐	☐
2.8	Menschlicher Einfallsreichtum und Innovationspotential werden dafür sorgen, dass wir die Erde nicht unbewohnbar machen.	☐	☐	☐	☐	☐	☐
2.9	Ich bin der Ansicht, dass technische Innovationen immer auch ein gesellschaftlicher Fortschritt sind.	☐	☐	☐	☐	☐	☐
2.10	In unserer Gesellschaft sollten Entscheidungsfindungen so demokratisch wie möglich sein.	☐	☐	☐	☐	☐	☐
2.11	Ich bin der Meinung, dass manche Probleme nur bearbeitet werden können, wenn sich Menschen zusammenschließen und kollektiv handeln.	☐	☐	☐	☐	☐	☐
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3. Zur Person

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Technische Universität Berlin André Baier, Sabine Pongratz

Blue Engineering WS 15/16

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Zur Person

Geschlecht: ☐ männlich ☐ weiblich ☐ keine Angabe

Nächster angestrebter Studienabschluss: ☐ Bachelor ☐ Master ☐ anderes

Studienfeld:

☐ Ingenieurswissenschaften ☐ Mathematik, Naturwissenschaften, Informatik ☐ Geistes- und Gesellschaftswissenschaften

☐ Planungswissenschaften ☐ Wirtschaftswissenschaften/ Wirtschaftsingenieurwesen

Ihre Fähigkeiten

In welchen Maße verfügen Sie zum jetzigen Zeitpunkt über folgende Fähigkeiten?

	in sehr hohem Maße					in sehr geringem Maße
eigene Einstellungen und Werte in Bezug auf Technik kennen	☐	☐	☐	☐	☐	☐
einen Gruppenprozess im Nachhinein in Hinsicht auf Ergebnis und Prozess reflektieren	☐	☐	☐	☐	☐	☐
aus Sicht verschiedener Perspektiven argumentieren	☐	☐	☐	☐	☐	☐
orientiert an meinen eigenen Einstellungen und Werten handeln	☐	☐	☐	☐	☐	☐
Wert- und Zielkonflikte mit anderen Menschen aushandeln	☐	☐	☐	☐	☐	☐
gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken	☐	☐	☐	☐	☐	☐
komplexe Sachverhalte didaktisch aufbereiten	☐	☐	☐	☐	☐	☐
Wissen ausserhalb meiner Disziplin finden und erschließen	☐	☐	☐	☐	☐	☐
anderen Studierenden Wissen vermitteln	☐	☐	☐	☐	☐	☐
Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe	☐	☐	☐	☐	☐	☐
in andere hineinversetzen und ihre Beweggründe verstehen	☐	☐	☐	☐	☐	☐
eine Entscheidung trotz widersprüchlicher Zielvorgaben treffen	☐	☐	☐	☐	☐	☐
die zukünftigen lokalen und globalen Auswirkungen von Technik bedenken	☐	☐	☐	☐	☐	☐
mir eigenständig eine Problemstellung erarbeiten	☐	☐	☐	☐	☐	☐
meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen	☐	☐	☐	☐	☐	☐
den Einfluss von Technik auf Natur und Menschen beschreiben	☐	☐	☐	☐	☐	☐
die Natur nach meinem Willen formen	☐	☐	☐	☐	☐	☐
Ursachen von sozialer Ungleichheit identifizieren	☐	☐	☐	☐	☐	☐

Ihre Einstellungen

	stimmt genau					stimmt überhaupt nicht
Die Menschen werden irgendwann einmal genug über die Funktionsweise der Natur lernen, sodass sie diese kontrollieren können.	☐	☐	☐	☐	☐	☐
Ich bin der Meinung, dass auch ein/e Einzelne/r im Unternehmen viel bewirken kann.	☐	☐	☐	☐	☐	☐
Trotz seiner speziellen Fähigkeiten ist der Mensch immer noch den Gesetzen der Natur unterworfen.	☐	☐	☐	☐	☐	☐

Ihre Einstellungen [Fortsetzung]

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Wenn etwas technisch machbar ist, möchte ich auch, dass es umgesetzt wird.	☐	☐	☐	☐	☐	☐
Eine industrialisierte, hoch technologisierte Gesellschaft bietet die beste Gewähr dafür, dass die Armut erfolgreich bekämpft werden kann.	☐	☐	☐	☐	☐	☐
Die Natur ist empfindlich und sehr leicht aus dem Gleichgewicht zu bringen.	☐	☐	☐	☐	☐	☐
Ich denke, dass Technik durch gesellschaftliche und politische Entscheidungsprozesse beschränkt werden darf.	☐	☐	☐	☐	☐	☐
Menschlicher Einfallsreichtum und Innovationspotential werden dafür sorgen, dass wir die Erde nicht unbewohnbar machen.	☐	☐	☐	☐	☐	☐
Ich bin der Ansicht, dass technische Innovationen immer auch ein gesellschaftlicher Fortschritt sind.	☐	☐	☐	☐	☐	☐
In unserer Gesellschaft sollten Entscheidungsfindungen so demokratisch wie möglich sein.	☐	☐	☐	☐	☐	☐
Ich bin der Meinung, dass manche Probleme nur bearbeitet werden können, wenn sich Menschen zusammenschließen und kollektiv handeln.	☐	☐	☐	☐	☐	☐
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Das Gleichgewicht der Natur ist stark genug, um die negativen Einwirkungen der modernen Industrienationen zu verkraften.	☐	☐	☐	☐	☐	☐

Studium der Ingenieurswissenschaften

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Das Ingenieursstudium sollte die Rolle von Technik in der Gesellschaft thematisieren.	☐	☐	☐	☐	☐	☐

Matchingcode

Sie werden diesen Fragebogen am Ende des Moduls noch einmal vorgelegt bekommen.
Um eine mögliche Veränderung der Werte dokumentieren zu können, ist es notwendig die Fragebögen einer Person eineindeutig zuzuordenen (Matching).
Bitte tragen Sie nachfolgend den beschriebenen Code ein, um eine Zuordnung zu ermöglichen.

1. Den ersten beiden Buchstaben des Vornamens Ihrer Mutter (Bsp. Anna = **AN**)
2. Ihrem Geburts**tag** ohne Angabe von Monat und Jahr (Bsp. 1.4.1990 = **01)**
3. Die ersten beiden Buchstaben Ihrer Geburtsstadt (Bsp. Berlin = **BE**)

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eigene Einstellungen und Werte in Bezug auf Technik kennen - aktuelle Selbsteinschätzung		☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung		☐	☐	☐	☐	☐	☐
einen Gruppenprozess mit Blick auf Ergebnis und Prozess reflektieren - aktuelle Selbsteinschätzung		☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung		☐	☐	☐	☐	☐	☐
aus Sicht verschiedener Perspektiven argumentieren - aktuelle Selbsteinschätzung		☐	☐	☐	☐	☐	☐
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Wert- und Zielkonflikte mit anderen Menschen aushandeln - aktuelle Selbsteinschätzung		☐	☐	☐	☐	☐	☐
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komplexe Sachverhalte didaktisch aufbereiten - aktuelle Selbsteinschätzung		☐	☐	☐	☐	☐	☐
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Ihre Fähigkeiten [Fortsetzung]

die zukünftigen lokalen/globalen Auswirkungen von Technik bedenken
- aktuelle Selbsteinschätzung ☐ ☐ ☐ ☐ ☐ ☐
- rückblickende Selbsteinschätzung ☐ ☐ ☐ ☐ ☐ ☐

mir eigenständig eine Problemstellung erarbeiten
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meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen
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die Natur nach meinem Willen formen
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Studienfeld:

☐ Ingenieurswissenschaften ☐ Mathematik, Naturwissenschaften, Informatik ☐ Geistes- und Gesellschaftswissenschaften

☐ Planungswissenschaften/Architektur ☐ Wirtschaftswissenschaften Wirtschaftsingenieurwesen

Ihre Fähigkeiten

	in sehr hohem Maße					in sehr geringem Maße
eigene Einstellungen und Werte in Bezug auf Technik kennen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
einen Gruppenprozess mit Blick auf Ergebnis und Prozess reflektieren - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
aus Sicht verschiedener Perspektiven argumentieren - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
orientiert an meinen eigenen Einstellungen und Werten handeln - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
Wert- und Zielkonflikte mit anderen Menschen aushandeln - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
gegenwärtige und zukünftige Folgen des eigenen Handelns bedenken - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
komplexe Sachverhalte didaktisch aufbereiten - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
Wissen ausserhalb meiner Disziplin finden und erschließen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
anderen Studierenden Wissen vermitteln - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
Handlungsoptionen auswählen, auch wenn ich nicht alle Informationen über mögliche Folgen habe - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
in andere hineinversetzen und ihre Beweggründe verstehen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
eine Entscheidung trotz widersprüchlicher Zielvorgaben treffen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐

Ihre Fähigkeiten [Fortsetzung]

die zukünftigen lokalen/globalen Auswirkungen von Technik bedenken - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
mir eigenständig eine Problemstellung erarbeiten - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
meinen Standpunkt konstruktiv in eine Gruppendiskussion einbringen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
den Einfluss von Technik auf Natur und Menschen beschreiben - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
die Natur nach meinem Willen formen - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐
Ursachen von sozialer Ungleichheit identifizieren - aktuelle Selbsteinschätzung	☐	☐	☐	☐	☐	☐
- rückblickende Selbsteinschätzung	☐	☐	☐	☐	☐	☐

Ihre Einstellungen

	stimmt genau					stimmt überhaupt nicht
Die Menschen werden irgendwann einmal genug über die Funktionsweise der Natur lernen, sodass sie diese kontrollieren können.	☐	☐	☐	☐	☐	☐
Ich bin der Meinung, dass auch ein/e Einzelne/r im Unternehmen viel bewirken kann.	☐	☐	☐	☐	☐	☐
Trotz seiner speziellen Fähigkeiten ist der Mensch immer noch den Gesetzen der Natur unterworfen.	☐	☐	☐	☐	☐	☐
Wenn etwas technisch machbar ist, möchte ich auch, dass es umgesetzt wird.	☐	☐	☐	☐	☐	☐
Eine industrialisierte, hoch technologisierte Gesellschaft bietet die beste Gewähr dafür, dass die Armut erfolgreich bekämpft werden kann.	☐	☐	☐	☐	☐	☐
Die Natur ist empfindlich und sehr leicht aus dem Gleichgewicht zu bringen.	☐	☐	☐	☐	☐	☐
Ich denke, dass Technik durch gesellschaftliche und politische Entscheidungsprozesse beschränkt werden darf.	☐	☐	☐	☐	☐	☐
Menschlicher Einfallsreichtum und Innovationspotential werden dafür sorgen, dass wir die Erde nicht unbewohnbar machen.	☐	☐	☐	☐	☐	☐
Ich bin der Ansicht, dass technische Innovationen immer auch ein gesellschaftlicher Fortschritt sind.	☐	☐	☐	☐	☐	☐
In unserer Gesellschaft sollten Entscheidungsfindungen so demokratisch wie möglich sein.	☐	☐	☐	☐	☐	☐
Ich bin der Meinung, dass manche Probleme nur bearbeitet werden können, wenn sich Menschen zusammenschließen und kollektiv handeln.	☐	☐	☐	☐	☐	☐
Die Menschen sind dazu bestimmt über die Natur zu herrschen.	☐	☐	☐	☐	☐	☐
Ich denke, dass die Welt in Ordnung ist, wie sie ist.	☐	☐	☐	☐	☐	☐
Das Gleichgewicht der Natur ist stark genug, um die negativen Einwirkungen der modernen Industrienationen zu verkraften.	☐	☐	☐	☐	☐	☐

Befragung zu den Werkzeugen

	stimmt genau					stimmt überhaupt nicht
Ich habe das Konzept der Werkzeuge verstanden.	☐	☐	☐	☐	☐	☐
Die TING-D Konstellation hilft mir gesellschaftliche Prozesse zu analysieren.	☐	☐	☐	☐	☐	☐
Ich nutze Werkzeuge in meinem Alltag, z.B. bei Diskussionen mit Freund_innen	☐	☐	☐	☐	☐	☐
Einzelne Werkzeuge helfen mir gesellschaftliche Prozesse besser zu verstehen.	☐	☐	☐	☐	☐	☐
Die Menge der Werkzeuge hat mich überfordert.	☐	☐	☐	☐	☐	☐
Die TING-D Konstellation berücksichtigt alle wesentlichen Komponenten, um komplexe Verhältnisse zu beschreiben.	☐	☐	☐	☐	☐	☐

Appendix

Comparative Self-Assessment Test

Data Collection

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
2	2017_1	2017_1-2	postthen	2017_1_E	1	2	5	3	2	5	5	4	3	4	5	3	2	4	3	4	5	5	4	5
2	2017_1	2017_1-2	then	2017_1_B	1	2	5	3	2	4	3	3	3	4	4	3	2	4	2	4	5	5	4	3
3	2017_1	2017_1-3	postthen	2017_1_E	1	2	1	5	5	6	6	5	5	5	6	6	6	5	5	5	5	6	5	5
3	2017_1	2017_1-3	then	2017_1_B	1	2	1	5	4	5	5	5	5	4	4	5	5	5	5	4	4	4	4	4
4	2017_1	2017_1-4	postthen	2017_1_E	3			6	5	6	6	5	5	5	6	6	5	5	5	6	6	6	6	5
4	2017_1	2017_1-4	then	2017_1_B	3			4	3	5	4	4	4	4	5	4	4	4	4	5	4	5	4	3
5	2017_1	2017_1-5	postthen	2017_1_E				4	5	6	6	6	6	6	4	6	4	6	6	6	5	5	6	6
5	2017_1	2017_1-5	then	2017_1_B				5	5	5	6	6	6	6	5	6	4	6	5	5	4	5	6	4
6	2017_1	2017_1-6	postthen	2017_1_E	1	1	1	5	5	5	4	4	4	3	5	4	4	4	5	5	4	4	4	4
6	2017_1	2017_1-6	then	2017_1_B	1	1	1	3	4	4	3	4	3	3	3	4	3	4	5	4	3	3	3	3
7	2017_1	2017_1-7	postthen	2017_1_E	1		1	4	5	5	6	3	4	5	4	4	3	5	5	5	4	3	4	3
7	2017_1	2017_1-7	then	2017_1_B	1		1	4	3	3	3	3	4	4	2	4	4	4	4	4	4	3	4	2
8	2017_1	2017_1-8	postthen	2017_1_E	2	1	1	5	5	3	5	5	3	3	5	3	5	4	4	3	2	4	5	4
8	2017_1	2017_1-8	then	2017_1_B	2	1	1	5	4	4	5	5	3	3	5	2	5	3	4	4	2	5	5	3
9	2017_1	2017_1-9	postthen	2017_1_E	1	1	1	4	4	4	4	4	4	6	5	6	5	5	4	3	5	5	5	4
9	2017_1	2017_1-9	then	2017_1_B	1	1	1	4	4	4	4	3	4	6	4	6	5	4	3	4	5	5	4	4
10	2017_1	2017_1-10	postthen	2017_1_E	1	1	3	4	5	6	5	5	5	5	5	5	4	5	5	5	5	5	5	5
10	2017_1	2017_1-10	then	2017_1_B	1	1	3	3	4	6	4	4	4	3	4	4	4	4	4	4	5	5	4	5
11	2017_1	2017_1-11	postthen	2017_1_E	1	2	1	4	4	5	5	4	4	4	5	5	4	4	4	4	4	4	5	2
11	2017_1	2017_1-11	then	2017_1_B	1	2	1	5	5	6	6	5	5	4	5	5	5	4	4	5	5	5	5	5
12	2017_1	2017_1-12	postthen	2017_1_E		1	3	5	5	5	5	5	4	4	5	4	5	4	4	4	5	5	4	5
12	2017_1	2017_1-12	then	2017_1_B		1	3	4	4	4	3	3	4	4	4	3	4	4	3	2	5	5	4	5
13	2017_1	2017_1-13	postthen	2017_1_E	1		1	6	6	5	5	6	5	5	5	6	6	5	6	6	6	6	6	6
13	2017_1	2017_1-13	then	2017_1_B	1		1	5	4	3	4	5	4	4	5	4	6	4	6	5	4	5	6	4
14	2017_1	2017_1-14	postthen	2017_1_E	1	2	5	5	5	4	5	5	6	5	4	5	5	4	5	5	5	4	4	4
14	2017_1	2017_1-14	then	2017_1_B	1	2	5	4	4	4	3	5	5	4	4	4	4	4	5	4	4	4	4	4
15	2017_1	2017_1-15	postthen	2017_1_E	2	1	5	4	5	4	5	5	4	4	6	5	5	5	6	4	6	5	5	5
15	2017_1	2017_1-15	then	2017_1_B	2	1	5	5	4	5	3	5	4	4	6	5	4	4	4	2	6	5	5	4
16	2017_1	2017_1-16	postthen	2017_1_E	2	1	5	5	5	5	4	5	4	3	4	4	5	5	5	4	5	5	4	4
16	2017_1	2017_1-16	then	2017_1_B	2	1	5	4	4	5	3	4	3	3	3	3	4	4	4	3	5	4	4	3
17	2017_1	2017_1-17	postthen	2017_1_E	1	2	1	5	5	6	6	5	5	4	6	5	5	6	5	6	6	5	6	5
17	2017_1	2017_1-17	then	2017_1_B	1	2	1	4	4	5	5	4	4	4	4	5	3	4	5	5	5	5	6	5
18	2017_1	2017_1-18	postthen	2017_1_E	1	2	5	5	4	5	6	5	4	4	5	5	6	5	5	5	5	4	5	5
18	2017_1	2017_1-18	then	2017_1_B	1	2	5	3	3	4	4	5	4	4	4	5	5	4	5	4	4	5	5	3
19	2017_1	2017_1-19	postthen	2017_1_E	1	1	1	4	5	5	5	6	6	4	4	6	6	5	4	5	5	6	4	4
19	2017_1	2017_1-19	then	2017_1_B	1	1	1	3	4	3	3	6	6	2	4	6	6	4	4	6	4	6	4	3
20	2017_1	2017_1-20	postthen	2017_1_E	1		1	5	5	5	6	5	5	4	5	4	6	5	6	5	5	4	5	5
20	2017_1	2017_1-20	then	2017_1_B	1		1	5	5	5	5	5	4	4	4	4	6	5	5	5	5	4	5	5
21	2017_1	2017_1-21	postthen	2017_1_E	3	1	4	5		6	5	5	5	5	6	5		2	4	3	6	6		5
21	2017_1	2017_1-21	then	2017_1_B	3	1	4	4		5	4	4	4	5	6	5		2	5	3	5	6		5
22	2017_1	2017_1-22	postthen	2017_1_E	1	2	1	5	6	5	6	6	4	6	4	5	6	5	5	5	6	5	5	6
22	2017_1	2017_1-22	then	2017_1_B	1	2	1	4	4	5	4	4	4	5	4	4	4	5	5	4	4	5	5	4
23	2017_1	2017_1-23	postthen	2017_1_E	1	2	5	5	5	5	5	5	4	4	5	4	5	3	4	5	5	5	4	4
23	2017_1	2017_1-23	then	2017_1_B	1	2	5	3	4	3	3	4	4	4	5	3	3	3	4	4	4	4	4	4
24	2017_1	2017_1-24	postthen	2017_1_E	1	1	1	4	5	5	5	5		5	4	5	5	6	6	5	5	5	5	5
24	2017_1	2017_1-24	then	2017_1_B	1	1	1	4	4	4	4	5		3	3	5	3	6	6	4	5	4	3	3
25	2017_1	2017_1-25	postthen	2017_1_E	2	2	5	5	6	6	6	5	5	4	5	5	5	5	5	5	5	5	4	5
25	2017_1	2017_1-25	then	2017_1_B	2	2	5	5	3	4	4	4	5	3	4	5	3	2	3	3	3	4	3	5
26	2017_1	2017_1-26	postthen	2017_1_E	2	2	5	5	4	5	5	4	4	4	4	4	3	5	4	5	6	5	4	3
26	2017_1	2017_1-26	then	2017_1_B	2	2	5	3	2	4	3	2	4	4	3	2	1	3	3	3	6	5	2	1
27	2017_1	2017_1-27	postthen	2017_1_E	1	2	5	4	5	5	5	4	5	5	4	5	5	5	5	4	5	5	5	4
27	2017_1	2017_1-27	then	2017_1_B	1	2	5	4	5	5	5	4	5	5	4	5	5	5	5	4	5	5	5	4
28	2017_1	2017_1-28	postthen	2017_1_E	1	2	5	5	5	6	6	5	4	4	5	5	6	5	4	5	6	5	5	6
28	2017_1	2017_1-28	then	2017_1_B	1	2	5	3	5	4	5	4	4	4	4	5	5	5	4	4	5	4	5	5
29	2017_1	2017_1-29	postthen	2017_1_E	1	2	2	3	5	5	5	2	1	2	4	5	5	4	2	4	5	5	5	2
29	2017_1	2017_1-29	then	2017_1_B	1	2	2	3	4	3	3	2	1	2	4	4	5	2	2	3	4	5	5	2
30	2017_1	2017_1-30	postthen	2017_1_E	1	2	5	5	4	6	5	5	5	4	5	4	3	5	4	6	5	5	6	5
30	2017_1	2017_1-30	then	2017_1_B	1	2	5	4	3	4	4	5	4	4	4	3	2	4	4	5	5	5	6	4
31	2017_1	2017_1-31	postthen	2017_1_E	1	2	5	5	5	6	5	5	5	5	5	5	6	4	5	5	5	5	5	6
31	2017_1	2017_1-31	then	2017_1_B	1	2	5	3	4	3	4	4	4	4	5	4	4	4	5	4	5	4	4	5
32	2017_1	2017_1-32	postthen	2017_1_E	2	1	3	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6
32	2017_1	2017_1-32	then	2017_1_B	2	1	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
33	2017_1	2017_1-33	postthen	2017_1_E	1	1	1	5	5	4	5	4	5	4	4	3	5	4	4	5	3	5	4	5
33	2017_1	2017_1-33	then	2017_1_B	1	1	1	5	4	3	4	3	4	4	4	3	5	4	4	4	3	5	4	5
34	2017_1	2017_1-34	postthen	2017_1_E	1	2	1	5	5	5	5	6	5	3	5	5	6	6	5	5	5	6	6	5
34	2017_1	2017_1-34	then	2017_1_B	1	2	1	5	4	4	3	6	4	3	5	5	5	6	5	3	5	6	6	4
35	2017_1	2017_1-35	postthen	2017_1_E	2	2	5	6	5	6	4	6	4	4	5	6	4	6	5	5	6	5	6	4
35	2017_1	2017_1-35	then	2017_1_B	2	2	5	4	3	4	3	6	5	3	4	4	4	6	5	4	6	4	6	5
36	2017_1	2017_1-36	postthen	2017_1_E	2	2	5	6	5	5	5	5	5	5	5	5	5	5	5	3	6	5	5	4
36	2017_1	2017_1-36	then	2017_1_B	2	2	5	6	4	4	5	4	4	4	4	5	5	4	4	3	6	5	5	3
37	2017_1	2017_1-37	postthen	2017_1_E	2	2	1	5	6	5	5	4	5	5	4	5	5	6	5	3	5	5	6	5
37	2017_1	2017_1-37	then	2017_1_B	2	2	1	4	5	5	5	4	4	4	4	5	5	6	5	4	5	5	6	4
38	2017_1	2017_1-38	postthen	2017_1_E	2	2	5	6	5	5	5	4	5	5	4	5	6	6	5	5	5	6	5	5
38	2017_1	2017_1-38	then	2017_1_B	2	2	5	6	3	4	3	4	4	5	4	5	6	6	5	4	5	6	5	3
39	2017_1	2017_1-39	postthen	2017_1_E	2	2	5	4	5	5	5	4	4	4	4	5	3	5	4	4	5	5	4	4
39	2017_1	2017_1-39	then	2017_1_B	2	2	5	4	5	4	3	3	4	4	4	4	3	4	3	4	5	5	4	5
40	2017_1	2017_1-40	postthen	2017_1_E	1	1		6	5	6	5	5	5	4	5	5	6	5	5	6	6	2	5	5

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
40	2017_1	2017_1-40	then	2017_1_B	1	1		6	3	5	3	4	2	3	5	5	6	5	4	3	6	2	4	3
41	2017_1	2017_1-41	postthen	2017_1_E	2	2	5	5	6	5	5	5	4	5	4	4	5	6	4	5	5	6	5	5
41	2017_1	2017_1-41	then	2017_1_B	2	2	5	4	4	4	4	4	4	4	4	4	3	3	4	3	5	4	3	4
42	2017_1	2017_1-42	postthen	2017_1_E	1	2	5	5	4	4	4	5	2	5	5	5	4	5	6	4	6	5	5	5
42	2017_1	2017_1-42	then	2017_1_B	1	2	5	5	4	5	4	5	2	5	5	5	6	5	6	4	6	5	5	4
43	2017_1	2017_1-43	postthen	2017_1_E	1	2	5	5	4	5	4	5	4	4	5	5	5	5	5	6	5	5	5	4
43	2017_1	2017_1-43	then	2017_1_B	1	2	5	4	3	4	3	4	3	4	4	4	4	5	5	6	3	5	5	3
44	2017_1	2017_1-44	postthen	2017_1_E	1	2	5	5	5	5	5	4	4	4	5	5	5	5	5	5	5	4	4	5
44	2017_1	2017_1-44	then	2017_1_B	1	2	5	3	3	5	3	4	4	4	4	3	4	5	4	5	5	4	4	4
45	2017_1	2017_1-45	postthen	2017_1_E	1	1	1	5	5	5	5	5	4	4	5	5	5	5	4	5	5	5	5	5
45	2017_1	2017_1-45	then	2017_1_B	1	1	1		3	4	3	4	4	4	5	5	4	4	4	3	5	5	5	4
46	2017_1	2017_1-46	postthen	2017_1_E	1	2	5	4	3	4	5	3	5	3	5	4	4	5	5	5	5	4	5	5
46	2017_1	2017_1-46	then	2017_1_B	1	2	5	3	3	4	4	3	5	3	3	4	4	5	4	4	4	4	5	4
47	2017_1	2017_1-47	postthen	2017_1_E	1	2	5	6	5	6	6	6	5	4	5	6	5	6	5	5	6	5	5	6
47	2017_1	2017_1-47	then	2017_1_B	1	2	5	3	4	5	4	4	3	3	4	5	4	4	5	4	6	5	5	4
48	2017_1	2017_1-48	postthen	2017_1_E	2	2	1	6	6	5	5	5	4	5	6	5	5	5	6	5	5	5	4	5
48	2017_1	2017_1-48	then	2017_1_B	2	2	1	5	3	4	4	4	4	4	5	4	5	4	6	4	4	4	4	4
49	2017_1	2017_1-49	postthen	2017_1_E	1	2	1	5	6	4	5	5	5	5	5	5	5	5	5	4	4	4	5	4
49	2017_1	2017_1-49	then	2017_1_B	1	2	1	5	2	4	4	4	5	5	4	5	4	4	5	3	4	4	5	4
50	2017_1	2017_1-50	postthen	2017_1_E	2	2	5	6	6	5	5	5	5	4	5	5	6	5	6	5	5	4	6	4
50	2017_1	2017_1-50	then	2017_1_B	2	2	5	6	4	4	3	4	5	4	5	4	6	4	6	4	5	4	6	3
51	2017_1	2017_1-51	postthen	2017_1_E	2	1	5	5	6	6	6	6	6	5	6	5	4	4	5	6	6	6	5	3
51	2017_1	2017_1-51	then	2017_1_B	2	1	5	4	5	5	6	6	5	5	5	5	4	3	4	5	5	6	4	3
52	2017_1	2017_1-52	postthen	2017_1_E	1	2	5	5	5	5	5	6	5	4	5	5	5	5	5	5	5	4	5	5
52	2017_1	2017_1-52	then	2017_1_B	1	2	5	5	4	2	3	6	3	3	4	4	5	5	4	4	5	3	5	4
53	2017_1	2017_1-53	postthen	2017_1_E	1		1	6	6	5	5	5	5	5	6	6	6	5	5	6	6	5	6	5
53	2017_1	2017_1-53	then	2017_1_B	1		1	6	5	5	4	5	4	5	6	6	6	4	4	6	6	5	6	4
54	2017_1	2017_1-54	postthen	2017_1_E	1	2	1	3	4	3	3	3	4	3	3	3	4	4	4	4	4	4	3	4
54	2017_1	2017_1-54	then	2017_1_B	1	2	1	5	6	5	6	5	5	4	5	4	4	5	5	5	5	5	4	6
55	2017_1	2017_1-55	postthen	2017_1_E	2	1	1	4	6	5	4	4	4	5	6	5	4	6	6	2	6	6	4	4
55	2017_1	2017_1-55	then	2017_1_B	2	1	1	5	6	4	4	4	4	5	6	5	5	6	6	5	6	5	5	4
56	2017_1	2017_1-56	postthen	2017_1_E	1		5	5	6	5	6	5	5	6	5	5	5	4	5	4	5	6	5	5
56	2017_1	2017_1-56	then	2017_1_B	1		5	4	4	5	4	3	4	4	4	5	4	4	4	5	5	4	4	4
57	2017_1	2017_1-57	postthen	2017_1_E	1	2	1	4	4	5	6	6	5	5	6	4	4	6	5	5	6	5	6	4
57	2017_1	2017_1-57	then	2017_1_B	1	2	1	2	4	4	5	6	5	4	6	4	3	6	5	3	6	4	6	3
58	2017_1	2017_1-58	postthen	2017_1_E	1		5	5	5	6	6	6	5	5	6	6	6	6	5	5	5	6	6	6
58	2017_1	2017_1-58	then	2017_1_B	1		5	5	5	6	5	5	5	5	5	6	6	5	4	4	4	6	6	5
59	2017_1	2017_1-59	postthen	2017_1_E	3	2	1	6	6	6	5	5	5	4	6	6	4	4	4	6	5	5	5	5
59	2017_1	2017_1-59	then	2017_1_B	3	2	1	4	5	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4
60	2017_1	2017_1-60	postthen	2017_1_E	1	2	5	5	5	5	4	6	5	5	5	5	4	4	6	6	5	6	5	4
60	2017_1	2017_1-60	then	2017_1_B	1	2	5	5	5	3	3	6	5	5	5	4	4	2	6	4	4	6	5	4
61	2017_1	2017_1-61	postthen	2017_1_E	1	2	1	5	4	5	4	5	5	5	6	5	4	5	4	5	5	5	5	4
61	2017_1	2017_1-61	then	2017_1_B	1	2	1	5	3	4	3	4	5	5	5	5	4	5	4	4	5	5	5	4
62	2017_1	2017_1-62	postthen	2017_1_E	1	2	1	6	5	5	5	6	4	4	5	5	5	5	5	6	5	5	4	5
62	2017_1	2017_1-62	then	2017_1_B	1	2	1	6	5	5	3	6	4	2	5	5	4	4	5	5	4	4	4	5
63	2017_1	2017_1-63	postthen	2017_1_E	1	2	1	6	5	5	5	5	4	3	5	3	4	4	4	5	5	5	5	5
63	2017_1	2017_1-63	then	2017_1_B	1	2	1	4	3	3	3	5	4	3	4	3	2	4	4	5	4	4	5	5
64	2017_1	2017_1-64	postthen	2017_1_E	1	2	1	6	6	6	5	5	5	5	5	6	4	6	5	6	6	6	5	5
64	2017_1	2017_1-64	then	2017_1_B	1	2	1	3	6	5	4	4	5	5	4	6	4	6	3	4	4	5	4	5
2	2016_2	2016_2-2	postthen	2016_2_E	1	1	1	3	6	6	5	5	4	4	5	6	5	6	5	6	5	5	5	5
2	2016_2	2016_2-2	then	2016_2_B	1	1	1	6	5	5	4	5	3	4	5	5	5	5	5	6	5	5	5	4
3	2016_2	2016_2-3	postthen	2016_2_E		2	1	5	6	6	5	5	4	5	5	5	5	5	5	5	5	6	5	5
3	2016_2	2016_2-3	then	2016_2_B		2	1	3	3	4	3	5	3	4	4	4	4	4	4	4	4	4	5	3
4	2016_2	2016_2-4	postthen	2016_2_E	1	1	1	4	5	5	5	5	4	4	4	4	4	4	4	5	4	5	3	5
4	2016_2	2016_2-4	then	2016_2_B	1	1	1	3	3	5	2	3	3	3	4	4	3	3	4	3	4	4	3	2
5	2016_2	2016_2-5	postthen	2016_2_E	2	2	5	5	5	4	5	5	4	4	5	5	4	5	5	4	4	4	4	4
5	2016_2	2016_2-5	then	2016_2_B	2	2	5	3	4	2	3	4	3	3	4	4	2	5	4	2	5	4	4	2
6	2016_2	2016_2-6	postthen	2016_2_E	2	2	1	3	3	4	3	4	5	5	4	5	3	4	5	3	4	4	4	
6	2016_2	2016_2-6	then	2016_2_B	2	2	1	4	4	4	4	5	4	5	4	4	4	5	5	4		4	4	4
7	2016_2	2016_2-7	postthen	2016_2_E	2	2	1	6	6	5	6	6	4	5	6	6	4	4	4	4	4	4	6	5
8	2016_2	2016_2-8	postthen	2016_2_E	1	2	1	4	5	5	5	5	3	4	5	4	5	5	5	5	5	5	5	5
8	2016_2	2016_2-8	then	2016_2_B	1	2	1	3	4	4	4	4	4	5	5	3	5	5	3	4	5	5	4	5
9	2016_2	2016_2-9	postthen	2016_2_E	2	2	5	4	4	5	4	4	4	3	5	4	3	3	3	5	5	5	4	5
9	2016_2	2016_2-9	then	2016_2_B	2	2	5	4	5	5	5	4	4		3	5	4	4	5	4	5	5	5	5
10	2016_2	2016_2-10	postthen	2016_2_E	1	2	5	6	6	5	5	6	6	6	5	5	6	6	4	5	5	5	4	6
10	2016_2	2016_2-10	then	2016_2_B	1	2	5	6	5	5	4	6	6	6	3	5	6	6	3	4	5	4	4	6
11	2016_2	2016_2-11	postthen	2016_2_E	2	2	5	5	5	6	5	5	4	4	5	6	5	4	5	4	5	6	4	5
11	2016_2	2016_2-11	then	2016_2_B	2	2	5	4	5	5	4	3	4	4	4	4	4	4	5	4	6	6	4	5
12	2016_2	2016_2-12	postthen	2016_2_E	1	1	5	6	5	5	5	5	5	4	5	5	5	5	5	5	6	4	4	5
12	2016_2	2016_2-12	then	2016_2_B	1	1	5	6	4	3	4	5	3	4	5	5	4	4	5	4		4	4	5
14	2016_2	2016_2-14	postthen	2016_2_E	1	1	5	3	6	5	5	4	5	2	6	5	5	6	4	5	4	4	5	3
14	2016_2	2016_2-14	then	2016_2_B	1	1	5	2	4	4	4	4	5	2	4	5	3	4	4	5	6	3	4	2
15	2016_2	2016_2-15	postthen	2016_2_E	2	1	5	5	5	4	5	5	4	5	5	5	5	5	6	4	6	5	4	4
15	2016_2	2016_2-15	then	2016_2_B	2	1	5	5	4	4	4	4	4			4	4	5	5	4	4	5	4	3
16	2016_2	2016_2-16	postthen	2016_2_E	1	2	1	4	5	5	4	4	5	5	4	4	5	4	4	5	4	4	4	5
16	2016_2	2016_2-16	then	2016_2_B	1	2	1	2	3	3	3	4	4	4	4	3	2	4	3	4	4	3	3	3
17	2016_2	2016_2-17	postthen	2016_2_E	1	2	1	4	3	4	2	4	3	4	4	4	4	4	4	5	5	4	3	4

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
17	2016_2	2016_2-17	then	2016_2_B	1	2	1	4	3	3	1	2	3	4	5	3	3	2	3	3	6	4	2	4
18	2016_2	2016_2-18	postthen	2016_2_E	1	2	1	5	4	6	5	6	2	4		5	5	6	5	6	6	4	4	6
18	2016_2	2016_2-18	then	2016_2_B	1	2	1	4	3	5	5	6	2	4	5	5	4	5	4	6	5	4	4	6
19	2016_2	2016_2-19	postthen	2016_2_E	1	1	1	5	3	5	5	4	4	5	5	5	5	5	3	5	6	5	4	5
19	2016_2	2016_2-19	then	2016_2_B	1	1	1	4	3	3	3	4	4	4	2	4	4	5	2	4	4	4	4	4
20	2016_2	2016_2-20	postthen	2016_2_E	2	2	1	4	4	3	3	5	2	4	3	4	4	4	4	5	4	4	4	5
20	2016_2	2016_2-20	then	2016_2_B	2	2	1	4	6	5	5	5	3	6	5	5	5	5	5	5	5	4	4	6
21	2016_2	2016_2-21	postthen	2016_2_E	1	1	1	5	5	5	2	5	4	4	5	5	4	5	5	3	5	6	5	4
21	2016_2	2016_2-21	then	2016_2_B	1	1	1	5	2	3	3	5	3	3	3	4	4	2	2	2	4	6	2	4
22	2016_2	2016_2-22	postthen	2016_2_E	1	2	5	5	5	6	5	5	5	5	5	3	4	4	4	6	5	4	4	5
22	2016_2	2016_2-22	then	2016_2_B	1	2	5	4	4	5	4	4	4	3	4	3	3	3	3	5	5	3	4	4
23	2016_2	2016_2-23	postthen	2016_2_E	2	1	1	5	4	5	5	5	4	5	5	5	5	5		4	5	4	4	5
23	2016_2	2016_2-23	then	2016_2_B	2	1	1	3	4	2	5	5	4		5	5	4	4	4	3	4	3	3	4
24	2016_2	2016_2-24	postthen	2016_2_E	1	1	5	4	2	4	5	4	4	4	4	3	3	4	4	5	4	3	4	3
24	2016_2	2016_2-24	then	2016_2_B	1	1	5	4	3	4	5	4	4	4	4		3	4	4	5	5	3	4	2
25	2016_2	2016_2-25	postthen	2016_2_E	1	1	2	6	5	6	6	4	4	3	6	4	3	5	5	5	5	4	5	5
25	2016_2	2016_2-25	then	2016_2_B	1	1	2	5	3	4	4	4	3	3	4	4	2	5	5	4	5	3	5	3
26	2016_2	2016_2-26	postthen	2016_2_E	1	2	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5
26	2016_2	2016_2-26	then	2016_2_B	1	2	1	5	4	5	4	5	5	5	4	5	5	5	5	5	3	4	5	4
27	2016_2	2016_2-27	postthen	2016_2_E	1	2	5	6	2	6	5	4	6	5	6	4	6	4	6	5	4	5	6	5
27	2016_2	2016_2-27	then	2016_2_B	1	2	5	6	4	1	3	3	1	2	6	3	2	3	6			4	4	6
29	2016_2	2016_2-29	postthen	2016_2_E	2	1	1	6	6	6	6	4	4		6	5	5	6	6	5	6	5	5	
29	2016_2	2016_2-29	then	2016_2_B	2	1	1	6	5	5	4	4	3		3	3	4	4	4	2	5	3	3	
30	2016_2	2016_2-30	postthen	2016_2_E	1	2	1	3	5	6	5	5	2	3	5	4	3	3	3	5	5	4	4	4
30	2016_2	2016_2-30	then	2016_2_B	1	2	1	3	3	4	3	3	2	3	4	3	2	3	3	4	4	4	4	3
31	2016_2	2016_2-31	postthen	2016_2_E	1	1	2	6	6	6	6	5	5	5	5	5	6	4	5	6	6	5	5	5
31	2016_2	2016_2-31	then	2016_2_B	1	1	2	6	4	6	4	5	3	2	5	4	5	4	4	5	5	4	3	5
32	2016_2	2016_2-32	postthen	2016_2_E	1		1	3	1	6	4	4	1	1	5	4	1	4	5	5	3	4	3	4
32	2016_2	2016_2-32	then	2016_2_B	1		1	5	6	4	5	3	4	6	4		1	6		5	2		6	3
33	2016_2	2016_2-33	postthen	2016_2_E	3	2	1	5	4	5	4	4	4	4	5	5	4	4	5	5	4	5	5	5
33	2016_2	2016_2-33	then	2016_2_B	3	2	1	3	2	3	3	3	3	2	3	3	2	2	4	3	3	4	4	3
34	2016_2	2016_2-34	postthen	2016_2_E	1	1		5	6	5	6	5	5	4	5	5	5	5	5	6	4	6	4	5
34	2016_2	2016_2-34	then	2016_2_B	1	1		3	6	4	4	3	5	3	5	3	5	4		4	4	6	3	6
35	2016_2	2016_2-35	postthen	2016_2_E	1	2	5	6	6	5	6	5	4	5	6	5	5	6	5	6	5	5	5	4
35	2016_2	2016_2-35	then	2016_2_B	1	2	5	5	4	4	4	5	4	4	4	5	5	6	5	5	3	4	5	3
36	2016_2	2016_2-36	postthen	2016_2_E	1	2	5	5	5	5	6	5	4	4	5	4	3	3	4	5	5	5	5	5
36	2016_2	2016_2-36	then	2016_2_B	1	2	5	5	3	4	5	5	5	4	4	4	2	3	4	3	5	4	5	2
37	2016_2	2016_2-37	postthen	2016_2_E	1	2	2	3	4	6	5	5	2	1	5	4	5	4	6	6	5	6	6	4
37	2016_2	2016_2-37	then	2016_2_B	1	2	2	4	3	6	4	4	2	1	5	3	4	3	6	6	6	6	6	3
38	2016_2	2016_2-38	postthen	2016_2_E	1	2	1	5	5	3	5	5	5	4	2	5	5	5	6	3	6	2	5	2
38	2016_2	2016_2-38	then	2016_2_B	1	2	1	4	3	3	2	5	5	4	2	5	3	5	6	2	2	2	5	2
39	2016_2	2016_2-39	postthen	2016_2_E	1		1	6	5	5	5	5	4	5	6	5	5	5	5	5	4	5	5	6
39	2016_2	2016_2-39	then	2016_2_B	1		1	6	3	4	4	5	2	5	4	3	2	2	3	5		5	4	5
40	2016_2	2016_2-40	postthen	2016_2_E	1	2	5	4	5	5	5	5	4	4	6	4	5	5	4	5	3	5	5	5
40	2016_2	2016_2-40	then	2016_2_B	1	2	5	4	4	4	4		4	4	4	4	4	3	4	5	4	5	5	5
2	2016_1	2016_1-2	postthen	2016_1_E	2	1	3	5	5	5	5	5	4	4	5	6	5	5	6	5	4	5	4	6
2	2016_1	2016_1-2	then	2016_1_B	2	1	3	5	2	3	2	5	3	4	5	5	5	5	5	2	5	4	4	4
3	2016_1	2016_1-3	postthen	2016_1_E	2	1	1	5	5	4	5	3	5	5	6	6	6	4	5	6	6	5	6	6
3	2016_1	2016_1-3	then	2016_1_B	2	1	1	4	2	4	3	2	3	3	2	6	6	3	4	2	3	4	4	6
4	2016_1	2016_1-4	postthen	2016_1_E	1	2	1	6	6	6	6	6	5	6	5	4	5	5	4	5	6	6	5	5
4	2016_1	2016_1-4	then	2016_1_B	1	2	1	5	4	5	6	6	4	6	4	4	2	4	4	4	5	6	3	3
5	2016_1	2016_1-5	postthen	2016_1_E	2	2	1	6	5	5	4	5	3	5	5	5	5	5	5	5	6	4	6	3
5	2016_1	2016_1-5	then	2016_1_B	2	2	1	6	5	4	3	2	3	4	5	4	5	4	3	4	6	4	5	2
6	2016_1	2016_1-6	postthen	2016_1_E	2	1		5	4	5	4	4	5	4	6	4	5	6	5	4	6	5	4	5
6	2016_1	2016_1-6	then	2016_1_B	2	1		4	1	5	1	3	4	4	6	3	3	6	4	2	6	5	3	2
7	2016_1	2016_1-7	postthen	2016_1_E	1	1	5	5	2	4	5	6	6	6	5	4	4	4	4	5	4	4	3	4
7	2016_1	2016_1-7	then	2016_1_B	1	1	5	4	2	4	5	6	5	6	5	4	4	4	5	5	4	5	3	4
8	2016_1	2016_1-8	postthen	2016_1_E	2	1	1	6	6	6	6	4	4	5	5	4	5	5	5	6	4	5	4	5
8	2016_1	2016_1-8	then	2016_1_B	2	1	1	5	2	4	2	4	3	2	5	4	4	3	3	4	4	5	3	3
9	2016_1	2016_1-9	postthen	2016_1_E	1	1		6	5	5	6	4	4	4	5	3	2	4	5	4	5	5	5	5
9	2016_1	2016_1-9	then	2016_1_B	1	1		4	3	2	3	4	4	4		2	2	4	3	4	5	3	4	3
10	2016_1	2016_1-10	postthen	2016_1_E	1	1	1	6	5	6	5	5	4	4	5	5	5	6	6	4	5	5	5	5
10	2016_1	2016_1-10	then	2016_1_B	1	1	1	5	3	4	4	5	3	4	4	4	3	6	5	3	5	5	4	5
11	2016_1	2016_1-11	postthen	2016_1_E	1	1	2	4	5	4	5	4	4	4	5	4	4	4	4	4	5	5	3	3
11	2016_1	2016_1-11	then	2016_1_B	1	1	2	3	3	3	3	3	3	3	3	3	2	3	3	3	4	4	2	3
12	2016_1	2016_1-12	postthen	2016_1_E	1	2	5	5	6	6	6	5	4	5	5	5	5	5	5	5	6	4	5	6
12	2016_1	2016_1-12	then	2016_1_B	1	2	5	3	5	4	4	4	4	5	4	4	4	5	5	4	5	3	4	5
13	2016_1	2016_1-13	postthen	2016_1_E	1	2	1	6	6	6	6	5	5	3	4	4	2	3	4	5	6	6	4	4
13	2016_1	2016_1-13	then	2016_1_B	1	2	1	4	3	4	2	5	3	3	3	3	2	3	4	2	2	2	4	2
14	2016_1	2016_1-14	postthen	2016_1_E	2	2	1	5	5	5	5	4	4	5	4	4	5	5	5	5	5	4	5	5
14	2016_1	2016_1-14	then	2016_1_B	2	2	1	5	3	5	3	3	4	5	3	4	5	4	4	3	5	4	5	4
15	2016_1	2016_1-15	postthen	2016_1_E	2	1	1	5	6	5	6	5	4	4	5	4	4	4	3	4	5	5	5	5
15	2016_1	2016_1-15	then	2016_1_B	2	1	1	5	3	3	3	5	4	4	4	4	4	4	3	2	5	3	4	4
16	2016_1	2016_1-16	postthen	2016_1_E	1	2	5	3	5	5	5	5	5	4	4	5	4	5	5	4	6	5	4	5
16	2016_1	2016_1-16	then	2016_1_B	1	2	5	3	4	4	4	5	5	4	4	4	4	5	5	5	6	4	4	4
17	2016_1	2016_1-17	postthen	2016_1_E	2	2	1	4	5	4	5	5	4	4	3	5	4	5	4	4	4	4	4	5
17	2016_1	2016_1-17	then	2016_1_B	2	2	1	4	5	4	4	4	3	3	3	4	4	4	4	3	3	4	4	4

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
18	2016_1	2016_1-18	postthen	2016_1_E	1	1	1	6	4	5	4	5	4	5	6	6	6	6	6	5	4	6	6	5
18	2016_1	2016_1-18	then	2016_1_B	1	1	1	6	3	5	3	5	4	5	6	6	6	6	6	4	4	6	6	5
19	2016_1	2016_1-19	postthen	2016_1_E	1	1	1	5	5	5	6	5	5	5	4	5	6	4	4	5	5	5	5	5
19	2016_1	2016_1-19	then	2016_1_B	1	1	1	5	5	5	6	5	5	5	4	5	6	4	4	5	5	5	5	5
20	2016_1	2016_1-20	postthen	2016_1_E	1	2	1	6	4	5	5	5	5	4	2	5	4	4	4	5	6	6	6	6
20	2016_1	2016_1-20	then	2016_1_B	1	2	1	5		4	3	3	3	2	4	2	2	2	3	4	4	5	5	5
21	2016_1	2016_1-21	postthen	2016_1_E	2		5	5	4	3	4	5	4	4	4	3	3	3	5	4	4	5	4	5
21	2016_1	2016_1-21	then	2016_1_B	2		5	3	3	3	3	3	3	3	4	3	3	2	3	3	3	3	4	3
22	2016_1	2016_1-22	postthen	2016_1_E	1			5	4	6	5		5	4	5	4	4	4	4	6	5	5	5	4
22	2016_1	2016_1-22	then	2016_1_B	1			4	4	3	4	4	4	3	4	3	5	3	4		4	4	4	2
23	2016_1	2016_1-23	postthen	2016_1_E	1	2	1	4	5	5	5	3	6	5	5	4	5	6	4	4	6	4	5	5
23	2016_1	2016_1-23	then	2016_1_B	1	2	1	4	5	3	5	4	5	5	4	3	5	6	5	4	5	3	5	5
24	2016_1	2016_1-24	postthen	2016_1_E	2	2	1	5	4	5	5	5	4	5	5	5	4	6	4	5	5	5	5	4
24	2016_1	2016_1-24	then	2016_1_B	2	2	1	5	5	5	5	5	4	5	5	5	5	6	5	5	5	5	5	5
25	2016_1	2016_1-25	postthen	2016_1_E	1	2	2	5	5	5	5	5	4	3	5	4	5	5	5	4	5	5	5	5
25	2016_1	2016_1-25	then	2016_1_B	1	2	2	5	4	5	5	5	4	3	4	4	4	4	4	4	5	5	5	5
26	2016_1	2016_1-26	postthen	2016_1_E	1	2	1	4	3	3	5	5	4	4	5	4	4	2	2	5	3	6	5	3
26	2016_1	2016_1-26	then	2016_1_B	1	2	1	4	3	3	4	5	4	4	5	4	4	2	2	5	3	6	5	3
27	2016_1	2016_1-27	postthen	2016_1_E	1	2	2	4	5	5	6	5	4	4	5	4	4	4	5	5	5	5	5	5
27	2016_1	2016_1-27	then	2016_1_B	1	2	2	4	4	4	4	5	3	4	4	4	4	4	5	3	4	3	5	4
28	2016_1	2016_1-28	postthen	2016_1_E	1	2	5	3	6	5	5	5	5	4	6	4	5	6	5	5	4	5	5	
28	2016_1	2016_1-28	then	2016_1_B	1	2	5	3	4	4	4	5	5	4	4	4	4	4	5	4	3	5	4	4
29	2016_1	2016_1-29	postthen	2016_1_E	1	2	5	5		5	5	5	5	5	5	5	5	5	6	5	5	6	5	5
29	2016_1	2016_1-29	then	2016_1_B	1	2	5	5		3	3	3	3	4	5	4	5	4	2	3	5	6	5	5
30	2016_1	2016_1-30	postthen	2016_1_E	1	1	1	4	5	5	5	4	5	4	5	4	5	4	3	5	5	5	4	4
30	2016_1	2016_1-30	then	2016_1_B	1	1	1	4	3	4	4	4	5	3	5	3	3	4	2	3	5	5	4	3
31	2016_1	2016_1-31	postthen	2016_1_E	1	2	1	4	3	5	5	3	5	5	4	4	5	4	4	5	4	5	4	4
31	2016_1	2016_1-31	then	2016_1_B	1	2	1	4	3	2	3	3	4	3	3	4	4	3	3	4	4	4	4	4
32	2016_1	2016_1-32	postthen	2016_1_E	3	2	3	5	4	4	4	5	4	5	5	4	4	3	3	5	5	5	5	5
32	2016_1	2016_1-32	then	2016_1_B	3	2	3	5	4	4	4	5	4	5	5	4	4	3	3	5	5	5	5	5
33	2016_1	2016_1-33	postthen	2016_1_E	1	2	5	6	6	6	6	6	5	4	6	6	6	6	6	6	6	6	6	5
33	2016_1	2016_1-33	then	2016_1_B	1	2	5	6	6	6	6	6	4	4	6	6	6	4	4	6	6	6	6	5
34	2016_1	2016_1-34	postthen	2016_1_E	2	2	5	5	6	5	5	5	5	5	5	5	4	5	5	5	6	5	5	5
34	2016_1	2016_1-34	then	2016_1_B	2	2	5	4	5	4	4	4	4	5	5	5	4	5	5	5	5	5	5	5
35	2016_1	2016_1-35	postthen	2016_1_E	1	2	1	5	1	4	4	6	1	6	1	5	1	1	3	4	6	6	6	1
35	2016_1	2016_1-35	then	2016_1_B	1	2	1	5	1	4	5	6	1	6	1	5	1	1	5	3	6	6	6	1
36	2016_1	2016_1-36	postthen	2016_1_E	1	2	5	5	5	5	5	6	4	5	5	5	6	5	6	5	5	5	5	5
36	2016_1	2016_1-36	then	2016_1_B	1	2	5	4	3	4	4	6	4	4	4	4	5	4	4	4	5	4	4	4
37	2016_1	2016_1-37	postthen	2016_1_E	2	2	1	5	6	5	5	5	5	5	5	4	5	5	5	5	5	4	5	5
37	2016_1	2016_1-37	then	2016_1_B	2	2	1	4	5	4	5	5	3	4	4	4	3	4	5	5	4	4	4	5
38	2016_1	2016_1-38	postthen	2016_1_E	3	2	1	6	6	6	6	6	3	5	5	6	6	6	6	6	6	6	6	6
38	2016_1	2016_1-38	then	2016_1_B	3	2	1	4	3	4	4	5	5	5	3	4	3	4	4	5	4	5	5	4
39	2016_1	2016_1-39	postthen	2016_1_E	1		1	5	4	6	5	5	3	4	5	5	4	5	4	4	5	4	4	4
39	2016_1	2016_1-39	then	2016_1_B	1		1	3	4	5	2	4	3	4	3	4	3	5	4	4	5	4	4	4
40	2016_1	2016_1-40	postthen	2016_1_E	2	2	3	5	5		3	4	5	4	5		5	5	4	2	6	5	5	4
40	2016_1	2016_1-40	then	2016_1_B	2	2	3	5	4	4	2	3	5	4	5	4	4	5	4	2	6	5	4	4
41	2016_1	2016_1-41	postthen	2016_1_E	1	2	1	2	5	5	5	4	4	4	4	5	6	6	6	5	3	6	6	5
41	2016_1	2016_1-41	then	2016_1_B	1	2	1	2	5	3	5	3	2	3	5	5	6	6	6	5	2	6	6	4
42	2016_1	2016_1-42	postthen	2016_1_E	1	2	5	5	6	5	5	3	3	4	4	5	5	4	3	5	3	5	4	4
42	2016_1	2016_1-42	then	2016_1_B	1	2	5	4	3	4	4	3	3	4	4	4	4		3	4	3	5	4	4
43	2016_1	2016_1-43	postthen	2016_1_E	2	1	5	4	5	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4
43	2016_1	2016_1-43	then	2016_1_B	2	1	5	4	3	4	3	4	4	4	4	4	4		4	4	4	4	4	4
44	2016_1	2016_1-44	postthen	2016_1_E	2		5	5	5	5	5	4	4	5	4	4	5	4	4	5	4	5	4	4
44	2016_1	2016_1-44	then	2016_1_B	2		5	2	4	3	3	2	4	3	2	3	4	3	3	2	2	4	3	2
45	2016_1	2016_1-45	postthen	2016_1_E	2	1	1	4	4	5	6	4	4	3	5	5	5	5	4	3	6	6	5	4
45	2016_1	2016_1-45	then	2016_1_B	2	1	1	4	3	4	4	4	4	3	4	5	4	5	4	3	5	6	5	3
AG29PR	2015_2	2015_2-AG29PR	pre	2015_2_B	2	1	1	6	5	4	5	5	3	3	5	5	5	4	4	6	3	6	4	5
AN01BE	2015_2	2015_2-AN01BE	pre	2015_2_B	2	2	5	5	3	5	3	5	4	4	5	5	4	4	5	4	5	6	5	4
AN01BE	2015_2	2015_2-AN01BE	post	2015_2_E	2	2	1	5	5	5	4	5	5	4	5	4	4	5	6	4	6	5	5	5
AN03GL	2015_2	2015_2-AN03GL	pre	2015_2_B	1	1	1	6	3	5	4	6	5	5	5	4	2	4	5	5	6	3	4	4
AN05ME	2015_2	2015_2-AN05ME	pre	2015_2_B	1	1	1	5	4	5	5	2	4	4	3	3	3	2	2	5	4	5	3	5
AN09PI	2015_2	2015_2-AN09PI	pre	2015_2_B	1	2	1	4	3	6	3	4	4	5	4	3	4	5	3	4	5	5	6	3
AN14DO	2015_2	2015_2-AN14DC	pre	2015_2_B	1	2	5	6	4	4	4	3	3	3	4	5	6	5	4	5	5	5	3	5
AN14DO	2015_2	2015_2-AN14DC	post	2015_2_E	1	2	5	6	6	4	5	4	3	3	5	5	5	6	5	6	5	5	3	4
AN18PI	2015_2	2015_2-AN18PI	post	2015_2_E	1	2	1	4	4	5	4	4	5	6	5	6	4	4	5	5	5	5	6	6
AN23BE	2015_2	2015_2-AN23BE	pre	2015_2_B	1	2	1	5	3	5	4	3	2	4	3	4	4	3	4	4	5	5	3	3
AN23BE	2015_2	2015_2-AN23BE	post	2015_2_E	3	2	1	5	2	5	4	4	5	3	5	4	5	4	4	4	3	4	5	3
AN26BE	2015_2	2015_2-AN26BE	pre	2015_2_B	2	2	1	5	4	4	3	3	2	3	5	4	3	3	3	6	4	5	4	4
AN29BE	2015_2	2015_2-AN29BE	pre	2015_2_B	2	2	5	4	5	6	5	5	4	4	5	4	4	3	5	5	4	5	5	4
AN29HA	2015_2	2015_2-AN29HA	pre	2015_2_B	1	2	5	3	5	5	5	3	4	4	4	4	4	3	4	4	5	5	3	3
AN29HA	2015_2	2015_2-AN29HA	post	2015_2_E	1	2	5	5	4	5	4	5	4	3	5	3	4	4	4	4	5	4	3	5
AS15BE	2015_2	2015_2-AS15BE	pre	2015_2_B	1	2	5	5	5	6	4	4	4	4	5	5	5	4	5	4	3	6	5	3
AY27BE	2015_2	2015_2-AY27BE	pre	2015_2_B	2	2	5	5	5	4	3	5	4	3	3	4	3	3	5	2	3	1	2	4
BE14BE	2015_2	2015_2-BE14BE	pre	2015_2_B	1	1	1	6	3	4	2	5	5	6	4	3	6	2	1	4	2	6	6	4
BE14BE	2015_2	2015_2-BE14BE	post	2015_2_E	1	1	1	4	4	6	3	3	5	2	5	3	5	3	3	4	2	2	5	3
BI28LE	2015_2	2015_2-BI28LE	pre	2015_2_B	1	2	1	5	4	5	4	5	4	4	5	4	5	5	2	5	5	4	3	6
CH10BE	2015_2	2015_2-CH10BE	pre	2015_2_B	1	2	5	5	5	4	4	4	4	4	4	3	5	2	2	4	5	4	5	4

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
CH10BE	2015_2	2015_2-CH10BE	post	2015_2_E	1		5	6	5	6	5	5	5	4	4	5	5	4	3	5	5	4	5	4
CH27BE	2015_2	2015_2-CH27BE	pre	2015_2_B	1	1	1	4	5	5	5	5	4	4	5	5	5	5	5	5	4	6	5	2
CH30BE	2015_2	2015_2-CH30BE	pre	2015_2_B	1	2	5	5	5	4	5	5	5	5	5	5	5	3	3	5	4	6	6	4
CO25BE	2015_2	2015_2-CO25BE	pre	2015_2_B	1	2	1	4	3	5	5	4	3	4	4	4	3	4	6	6	4	5	5	2
CO25BE	2015_2	2015_2-CO25BE	post	2015_2_E	1	2	1	6	6	5	4	5	5	5	4	4	5	5	4	5	4	6	5	2
DA01BE	2015_2	2015_2-DA01BE	pre	2015_2_B	1	1	5	5	3	6	6	5	3	3	4	3	4	3	3	4	5	5	2	5
DA01BE	2015_2	2015_2-DA01BE	post	2015_2_E	1	1	5	5	4	4	4	5	3	4	5	3	5	4	4	4	5	5	4	6
EL10BE	2015_2	2015_2-EL10BE	pre	2015_2_B	1		1	5	3	4	3	4	4	4	5	5	5	5	4	5	4	4	5	4
EL15FR	2015_2	2015_2-EL15FR	post	2015_2_E	1	2	1	6	5	5	5	5	4	4	6	6	6	5	5	6	3	6	5	6
EL18VI	2015_2	2015_2-EL18VI	pre	2015_2_B	1	2	1	5	5	5	5	4	5	3	4	4	5	4	4	5	5	6	5	4
EL18VI	2015_2	2015_2-EL18VI	post	2015_2_E	1	2	1	6	5		5	5	5	5	6	5	5	5	5	5	5		4	5
EL28ST	2015_2	2015_2-EL28ST	pre	2015_2_B	1	2	1	5	4	4	5	4	4	4	5	4	6	4	4	5	3	5	5	6
FI03BE	2015_2	2015_2-FI03BE	pre	2015_2_B	1	2	5	5	5		5	5	5	5	5	5	5	5	5	5	5	5	5	5
GI07BO	2015_2	2015_2-GI07BO	pre	2015_2_B	1		5	5	3	4	3	3	5	4	4	4	5	3	4	4	3	4	5	3
GI07BO	2015_2	2015_2-GI07BO	post	2015_2_E	1	2	5	5	4	5	4	5	5	4	5	5	5	5	4	5	5	5	6	3
GI11BE	2015_2	2015_2-GI11BE	pre	2015_2_B	1	2	1	5	3	2	3	4	5	5	4	2	4	2	3	3	5	4	5	2
GI11BE	2015_2	2015_2-GI11BE	post	2015_2_E	1	1	1	5	3	4	5	5	4	4	5	4	5	5	4	4	4	5	5	3
GU16KL	2015_2	2015_2-GU16KL	pre	2015_2_B	1	2	5	5	5	4	3	5	5	4	5	4	6	5	4	5	4	4	4	4
GU16KL	2015_2	2015_2-GU16KL	post	2015_2_E	1	2	5	4	5	5	5	4	4	5	5	4	5	5	4	5	4	5	5	4
HA11KO	2015_2	2015_2-HA11KO	post	2015_2_E	1	2	5	5	4	5	6	4	5	5	5	6	5	5	4	5	4	6	5	4
HE16GE	2015_2	2015_2-HE16GE	pre	2015_2_B	1	2	5	3	5	5	5	3	2	4	5	4	5	3	3	5	5	6	4	4
HE26BE	2015_2	2015_2-HE26BE	pre	2015_2_B	1	2	1	4	4	5	4	4	4	5	5	4	5	4	5	5	5	5	4	4
HE26BE	2015_2	2015_2-HE26BE	post	2015_2_E	1	2	1	5	5	5	5	4	5	5	5	5	4	4	5	5	5	5	5	5
HE29FR	2015_2	2015_2-HE29FR	pre	2015_2_B	2	2	1	5		5	5	5	4	4	4	4	5	4	4	5	5	6	4	
HE29FR	2015_2	2015_2-HE29FR	post	2015_2_E	2	2	1	5	5	5	5	5	5	5	5	5	6	5	5	5	6	6	5	5
HI29PR	2015_2	2015_2-HI29PR	post	2015_2_E	2	1	1	6	6	5	6	6	5	4	6	4	6	5	5	6	4	6	6	6
IL11KI	2015_2	2015_2-IL11KI	pre	2015_2_B	1	2	5	6	5	4		6	4		4	5	5	6	5	5	4	5	4	5
IN14GR	2015_2	2015_2-IN14GR	pre	2015_2_B	2	2	5	3	4	5	3	5	5	4	4	4	5	4	4	4	4	5	5	4
IR17BE	2015_2	2015_2-IR17BE	pre	2015_2_B	1	2	5	2	4	4	3	4	4	4	4	5	5		5	5	5	5	5	4
IR17BE	2015_2	2015_2-IR17BE	post	2015_2_E	1	2	5	4	5	5	4	6	5	4	5	5	4	4	5	5	5	6	5	5
IR20BE	2015_2	2015_2-IR20BE	pre	2015_2_B	1	2	5	5	4	5	4	4	5	5	6	3	4		4	4	5	4	4	4
KA25LA	2015_2	2015_2-KA25LA	pre	2015_2_B	1	2	1	3	5	5	5	4	4	4	4	4	6	4	5	4	5	5	5	5
KA25LA	2015_2	2015_2-KA25LA	post	2015_2_E	1	2	1	4	5	3	3	6	4	4	5	4	4	5	5	5	4	5	5	5
KE05ME	2015_2	2015_2-KE05ME	pre	2015_2_B	1	2	1	5	4	4	3	4	4	3	5	4	4	3	5	4	5	5	4	4
KE05ME	2015_2	2015_2-KE05ME	post	2015_2_E	1	2	1	5	5	5	5	4	4	4	4	4	4	5	5	6	3	5	4	5
KO07BE	2015_2	2015_2-KO07BE	pre	2015_2_B	2	1	5	6	5	4	4	6	2	3	4	5	3	4	4	6	4	5	4	5
KO07BE	2015_2	2015_2-KO07BE	post	2015_2_E	2	1	5	5	5	3	4	6	4	4	5	5	5		6	5	5	4	5	4
LI30AM	2015_2	2015_2-LI30AM	pre	2015_2_B	3	2	1	5	3	5	2	4	4	5	3	5	5	6	5	5	5	5	5	5
LI30AM	2015_2	2015_2-LI30AM	post	2015_2_E	3	2	1	5	5	5	5	6	4	3	5	5	5	6	6	6	4	6	5	5
MA01BE	2015_2	2015_2-MA01BE	pre	2015_2_B	1		1	5	5	5	5	4	4	5	4	5	5	5	4	5	6	5	4	4
MA24MA	2015_2	2015_2-MA24MA	pre	2015_2_B			5	5	2	6	4	4	5	4	3	6	4	5	6	5	2	6	6	3
MA25ER	2015_2	2015_2-MA25ER	pre	2015_2_B	2		5	5	3	4	3	4	3	3	4	5	5	6	3	4	5	6	3	3
MA25ER	2015_2	2015_2-MA25ER	post	2015_2_E	2		5	6	5	5	4	4	3	4	6	5	5	4	5	5	6	6	4	4
MA27GE	2015_2	2015_2-MA27GE	pre	2015_2_B	1	2	1	5	5	5	4	4	5	5	5	6	6	5	4	6	6	5	6	5
MA27GE	2015_2	2015_2-MA27GE	post	2015_2_E	1	2	1	6	5	5	5	5	6	5	6	6	6	5	5	6	6	4	5	6
MA30WA	2015_2	2015_2-MA30WA	pre	2015_2_B	1	2	5	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	4	5
MI01BE	2015_2	2015_2-MI01BE	pre	2015_2_B	1	2	5	5	5	5	5	5	4	4	5	4	5	5	4	4	5	4	5	4
MI15BE	2015_2	2015_2-MI15BE	post	2015_2_E	1	2	5	5	6	6	6	5	5	5	6	5	5	5	5	6	6	5	5	5
MI16BE	2015_2	2015_2-MI16BE	pre	2015_2_B	2	1	1	4	3	2	5	6	6	5	5	5	6	6	4	5	5	3	4	3
MO14MU	2015_2	2015_2-MO14MU	pre	2015_2_B	2		5	2	4	3	3	4	3	2	3	4	3	4	2	4	4	3	3	4
NI08RE	2015_2	2015_2-NI08RE	pre	2015_2_B	1	2	1	3	3	3	4	3	5	5	3	5	2	2	1	5	4	4	3	5
NI08RE	2015_2	2015_2-NI08RE	post	2015_2_E	1	2	1	4	4	5	5	5	5	4	4	6	4	5	2	5	5	6	5	3
PE08BE	2015_2	2015_2-PE08BE	pre	2015_2_B	1	1	1	4	2	5	3	5	2	2	4	4	4	4	4	4	3	5	3	3
PE08BE	2015_2	2015_2-PE08BE	post	2015_2_E	1	2	1	5	4	5	4	4	5	5	4	4	5	5	3	5	5	5	3	4
PE21BE	2015_2	2015_2-PE21BE	pre	2015_2_B	1	2	1	5	4	5	3	5	5	4	5	4	4	4	4	5	2	5	5	4
PE24BE	2015_2	2015_2-PE24BE	post	2015_2_E	1	2	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
PE29EI	2015_2	2015_2-PE29EI	pre	2015_2_B		2	1	5	5	6	6	5	5	4	5	5	4	5	6	5	6	6	6	6
SA04BE	2015_2	2015_2-SA04BE	pre	2015_2_B	2	2	5	5	5	3	3	5		3	3	3	5	2	5	5	3	1	2	4
SA04BE	2015_2	2015_2-SA04BE	post	2015_2_E	2		5	6	5	5	4	6	5	4	5	5	4	6	5	5	6	4	5	5
SA08BE	2015_2	2015_2-SA08BE	pre	2015_2_B	2	2	5	5	5	6	5	5	5	5	6	6	5	5	5	5	5	6	4	4
SA21BE	2015_2	2015_2-SA21BE	pre	2015_2_B	1	1	1	5	4	5	4	6	5	5	3	4	4	3	3	5	3	4	5	4
SA21BE	2015_2	2015_2-SA21BE	post	2015_2_E	1	1	1	5	4	4	4	5	5	5	3	3	3	2	3	4	4	5	3	3
SA21HA	2015_2	2015_2-SA21HA	pre	2015_2_B	1	2	1	5	4	6	4	4	4	4	4	6	4	3	5	4	6	5	4	5
SA21HA	2015_2	2015_2-SA21HA	post	2015_2_E	1	2	1	6	5	5	5	6	5	5	5	6	5	6	4	5	5	5	6	5
SE28BE	2015_2	2015_2-SE28BE	pre	2015_2_B	2	1	1	6	5	5	6	3	5	5	5	4	5	5	4	5	6	4	5	6
SE28BE	2015_2	2015_2-SE28BE	post	2015_2_E	2	1	1	6	5	5	5	5	4	5	5	4	4	5	4	5	6	5	5	6
SI06BE	2015_2	2015_2-SI06BE	pre	2015_2_B	2	1	5	5	3	4	2	4	4	5	3	6	5	3	3	2	5	6	4	4
SI15BE	2015_2	2015_2-SI15BE	pre	2015_2_B	1	2	1	3	5	5	5	6	5	4	4	2	6	5	5	5	3	5	5	4
SI15BE	2015_2	2015_2-SI15BE	post	2015_2_E	1	2	1	5	5	6	5	6	5	5	5	5	6	5	5	5	5	4	6	5
SI19HA	2015_2	2015_2-SI19HA	pre	2015_2_B	1	1	1	3	3	5	4	3	2	4	5	4	5	4	5	5	5	4	2	3
SI22BE	2015_2	2015_2-SI22BE	pre	2015_2_B	1	1	5	4	2	4	2	3	4	4	5	4	4	3	2	3	4	5	3	4
SI22BE	2015_2	2015_2-SI22BE	post	2015_2_E	1	2	5	5	4	5	4	3	5	5	5	4	5	4	4	4	5	5	4	5
SI22DR	2015_2	2015_2-SI22DR	pre	2015_2_B	1	2	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	6	5	5
SI22DR	2015_2	2015_2-SI22DR	post	2015_2_E	1	2	5	4	4	4	5	6	6	6	5	4	4	4	4	5	5	4	5	
SU20BE1	2015_2	2015_2-SU20BE	pre	2015_2_B	1	2	5	5	4	5	5	5	5	4	4	4	5	5	4	6	4	6	6	5
SU20BE	2015_2	2015_2-SU20BE	pre	2015_2_B	2	1	5	4	3	5	5	4	3	4	5	4	4	3	4	4	5	3	4	4
SU27MU	2015_2	2015_2-SU27MU	pre	2015_2_B	1	1	5	5	5	4		5	4		5	4			5	5	6	5	6	4

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
SY13BE	2015_2	2015_2-SY13BE	pre	2015_2_B	1	2	1	5	4	4	3	5	3	4	5	4	4	2	4	4	5	4	4	3
SY13BE	2015_2	2015_2-SY13BE	post	2015_2_E	1	2	1	6	5	5	5	4	5	5	5	4	4	5	4	5	5	5	5	5
SY21BA	2015_2	2015_2-SY21BA	pre	2015_2_B	1	2	5	4	4	3	3	4	4	4	4	5	2	4	2	5	3	4	2	4
TA30MO	2015_2	2015_2-TA30MC	pre	2015_2_B	1	2	5	3	4	4	5	3	3	3	2	4	4	5	3	2	4	4	3	6
UF07BE	2015_2	2015_2-UF07BE	post	2015_2_E	2	2	1	6	6	5	5	6	6	5	6	6	5	6	6	6	6	6	6	5
UN04OS	2015_2	2015_2-UN04OS	pre	2015_2_B	1	2	1	5	5	5	5	4	5	5	3	5	5	4	5	4	5	4	4	4
UN30BI	2015_2	2015_2-UN30BI	post	2015_2_E	1	2	1	5	5	5	5	4	4	4	5	4	4	4	4	5	5	5	4	4
UT07BE	2015_2	2015_2-UT07BE	pre	2015_2_B	2	2	5	6	5	6	5	5		4	5	5	5	5	5	4	6	5	5	5
UT21KA	2015_2	2015_2-UT21KA	pre	2015_2_B	1	2	5	4	3	6	6	4	3	4	5	4	3	2	4	4	5	5	5	5
UT21KA	2015_2	2015_2-UT21KA	post	2015_2_E	1	2	5	5	5	6	5	4	4	4	5	5	4	5	5	6	5	5	5	5
VE28ER	2015_2	2015_2-VE28ER	pre	2015_2_B	1	2	5	3	3	5	4	3	3	3	5	5	5	5	5	4	3	4	5	3
CA02SC	2015_1	2015_1-CA02SC	pre	2015_1_B	1	2	1	4	4	4	4	4	3	4	3	4	5	2	4	5	4	5	4	
BE12ST	2015_1	2015_1-BE12ST	pre	2015_1_B	1	1	1	4	3	4	3	4	4	4	3	4	4	5	5	5	2	4	3	
BR11PO	2015_1	2015_1-BR11PC	pre	2015_1_B	1	1	1	3	3	4	3	4	4	3	5	5	5	4	5	4	4	5	4	
CA01BE	2015_1	2015_1-CA01BE	pre	2015_1_B	1	2	1	4	5	2	2	2	4	2	3	4	4	3	3	4	4	5	2	
CH14MA	2015_1	2015_1-CH14M/	pre	2015_1_B		2	5	4	5	4	4	5	5	4	4	4	5	4	5	5	4	4	4	
OL23EK	2015_1	2015_1-OL23EK	pre	2015_1_B	1	2	1	4	5	5	5	5	4	4	4	4	4	6	5	4	5	4	4	
MA15BE	2015_1	2015_1-MA15BE	pre	2015_1_B	1	2	5	5	5	4	4	5	5	4	4	4	5	5	4	4	5	5	4	
MI14BE	2015_1	2015_1-MI14BE	pre	2015_1_B	1	2	1	4	5	4	4	4	4	4	5	4	5	4	5	4	4	5	4	
SH04BE	2015_1	2015_1-SH04BE	pre	2015_1_B	1	2	1	3	3	1	3	2	2	4	2	2	5	4	1	4	4	4	4	
SI30HI	2015_1	2015_1-SI30HI	pre	2015_1_B	2	2	1	4	4	4	4	4	4	4	3	4	5	4	4	4	5	4	5	
TH20OB	2015_1	2015_1-TH20OB	pre	2015_1_B	1	2	5	5	4	3	4	4	2	3	4	4	4	2	2	4	4	5	2	
UR02BA	2015_1	2015_1-UR02BA	pre	2015_1_B	1	2	1	4	4	5	5	5	4	5	4	4	4	3	3	5	5	4	4	
XI09SH	2015_1	2015_1-XI09SH	pre	2015_1_B	1	2	1	5	4	4	4	4	3	5	3	3	5	3	2	4	4	4	4	
YA27BE	2015_1	2015_1-YA27BE	pre	2015_1_B	1	2	1	4	4	4	4	3	4	3	3	2	4	2	4	3	2	2	5	
AL02BE	2015_1	2015_1-AL02BE	pre	2015_1_B	1	2	1	4	4	5	4	5	4	4	4	5	5	4	5	4	5	3	5	
AN01LO	2015_1	2015_1-AN01LO	pre	2015_1_B	1	1	1	4	4	5	4	4	3	3	4	4	4	4	3	5	3	5	4	
AN07BI	2015_1	2015_1-AN07BI	pre	2015_1_B	1	2	1	5	4	3	3	3	2	3	5	4	5	4	3	4	4	4	3	
AN19NÜ	2015_1	2015_1-AN19NÜ	pre	2015_1_B	1	1	1	5	4	5	4	5	5	4	3	3	4	3	4	5	4	5	5	
CH05LÜ	2015_1	2015_1-CH05LÜ	pre	2015_1_B	1	2	5	3	3	5	3	4	2	4	4	3	4	2	2	3	6	5	4	
CL17HI	2015_1	2015_1-CL17HI	pre	2015_1_B	1	2	1	5	4	4	5	4	3	3	6	3	4	5	3	5	4	3	5	
EL29DR	2015_1	2015_1-EL29DR	pre	2015_1_B	2	2	5	4	5	4	4	4	4	3	5	3	4	5	3	3	5	3	5	
GU06BE	2015_1	2015_1-GU06BE	pre	2015_1_B	1	2	1	4	2	2	5	3	2	4	3	2	3	2	3	4	2	4	4	
HA17HA	2015_1	2015_1-HA17HA	pre	2015_1_B	1	1	5	2	4	4	4	4	3	2	2	1	2	3	2	4	3	3	4	
HE28SD	2015_1	2015_1-HE28SD	pre	2015_1_B	1	3	5	5	3	6	3	5	4	4	4	5	4	3	3	4	5	5	4	
HO11ZI	2015_1	2015_1-HO11ZI	pre	2015_1_B	1	1	1	5	3	3	3	3	3	5	3	4	4	4	3	3		4	3	
KA09BI	2015_1	2015_1-KA09BI	pre	2015_1_B	1	1	1	4	5	4	4	3	4	4	3	4	5	2	3	5	5	4	4	
KE09NE	2015_1	2015_1-KE09NE	pre	2015_1_B	1	2	5	5	5	5	5	6	4	4	5	5	6	5	5	6	3	6	4	
MA06BE	2015_1	2015_1-MA06BE	pre	2015_1_B	1	2	1	5	2	4	2	3	3	3	4	3	3	3	2	4	4	4	3	
MA07FR	2015_1	2015_1-MA07FR	pre	2015_1_B	1	2	1	4	1	3	2	2	2	2	4	2	4	1	2	3	3	4	2	
MA10BE	2015_1	2015_1-MA10BE	pre	2015_1_B	2	1	1	5	4	4	5	4	4	4	5	5	3	5	4	4	6	6	4	
MA30BE	2015_1	2015_1-MA30BE	pre	2015_1_B	2	2	1	3	3	5	3	6	4	2	4	3	4	2	2	2	2	5	2	
MI05FA	2015_1	2015_1-MI05FA	pre	2015_1_B	2	2	1	4	4	4	3	4	5	5	5	4	4	4	4	4	5	3	4	
MI24FR	2015_1	2015_1-MI24FR	pre	2015_1_B	1	1	5	4	3	5	3	5	5	4	4	5	5	5	4	5	6	4	4	
PE02BR	2015_1	2015_1-PE02BR	pre	2015_1_B	1	1	1	4	3	4	4	5	4	5	5	3	5	2	3	5	4	3	3	
SI15BE	2015_1	2015_1-SI15BE	pre	2015_1_B	2	2	1	5	4	5	4	4	3	4	4	3	3	3	4	4	5	4	3	
SR30TR	2015_1	2015_1-SR30TR	pre	2015_1_B	2	2	1	5	4	4	4	4	4	4	5	4	3	4	5	5	4	4	3	
UL02HI	2015_1	2015_1-UL02HI	pre	2015_1_B	1	2	1	2	2	3		4	3	4	4	4	3	4	5	4	3	5	5	
AL01WO	2015_1	2015_1-AL01WC	pre	2015_1_B	1	2	2	5	4	4	4	5	4	3	4	4	4	5	3	5	5	5	4	
AM12BO	2015_1	2015_1-AM12BC	pre	2015_1_B	1	1	5	6	6	6	6	4	3	6	6	5	6	6	5	6	6	4	4	
AN07BE	2015_1	2015_1-AN07BE	pre	2015_1_B	1	1	5	3	2	5	5	3	3		3	4	3	4	2	3	5		3	
AN11WE	2015_1	2015_1-AN11WE	pre	2015_1_B	2	1	1	5	4	5	4	4	2	2	4	5	2	2	3	4	4	5	2	
AN13BE	2015_1	2015_1-AN13BE	pre	2015_1_B	2	1	1	4	4	3	4	4	2	2	4	4	3	3	4	4	4	5	4	
AN22BT	2015_1	2015_1-AN22BT	pre	2015_1_B	1	2	5	4	4	4	5	5	4	4	4	4	5	4	4	4	4	5	5	
BE16BE	2015_1	2015_1-BE16BE	pre	2015_1_B	2	2	1	3	4	4	4	4	3	3	3	3	4	5	3	5	4	5	3	
BI14RO	2015_1	2015_1-BI14RO	pre	2015_1_B	2	2	1	2	5	5	5	5	6	5	5	5	4	6	4	5	6	4	6	
BI24BE	2015_1	2015_1-BI24BE	pre	2015_1_B	1	2	1	5	2	3	2	4	2	2	4	3	3	3	3	4	3	3	1	
BI25BE	2015_1	2015_1-BI25BE	pre	2015_1_B	1	2	1	4	3	4	3	4	3	3	4	4	3	4	3	4	4	4	3	
BO27JO	2015_1	2015_1-BO27JO	pre	2015_1_B	1	2	1	5	3	5	3	3	2	4	4	5	5	3	4	5	4	4	4	
CA15ES	2015_1	2015_1-CA15ES	pre	2015_1_B	1	1	1	3	4	5	3	5	3	2	5	4	4	4	3	4	4	4	4	
CH04SA	2015_1	2015_1-CH04SA	pre	2015_1_B	1	2	5	5	4	4	4	5	2	3	5	3	3	4	4	5	2	3	5	
CH09BE	2015_1	2015_1-CH09BE	pre	2015_1_B	1	1	1	4	4	5	4	4	2	2	5	3	5	1	2	6	6	5	2	
CH30BR	2015_1	2015_1-CH30BR	pre	2015_1_B	3		1	3	5	4	4	4	5	5	5	2	5	3	4	6	5	5	4	
CO24BE	2015_1	2015_1-CO24BE	pre	2015_1_B	1	1	1	5	4	5	4	5	4	3	3	5	5	3	1	2	4	3	2	
DO08SP	2015_1	2015_1-DO08SP	pre	2015_1_B	2	2	1	3	2	5	3	4	5	4	2	4	3	1	1	5	5	6	1	
FI16BE	2015_1	2015_1-FI16BE	pre	2015_1_B	1	2	1	4	5	3	5	3	4	4	4	4	4	5	6	5	4	4	4	
GA06CE	2015_1	2015_1-GA06CE	pre	2015_1_B	1	2	5	4	4	4	3	3	3	2	2	4	5	3	3	4	4	3	4	
HE03AA	2015_1	2015_1-HE03AA	pre	2015_1_B	1	1	1	3	3	5	5	5	4	4	2	3	5	2	1	4	5	4	4	
HE27AL	2015_1	2015_1-HE27AL	pre	2015_1_B	1	1	1	4	3	3	4	3	3	3	2	4	4	3	2	3	4	4	3	
JA17IZ	2015_1	2015_1-JA17IZ	pre	2015_1_B	1	1	1	5	3	4	4	5	4	5	3	6	3	3	3	4	5	6	3	
JR19BE	2015_1	2015_1-JR19BE	pre	2015_1_B	1	1	1	4	3	3	3	2	1	1	2	2	4	3	2	2	4	3	2	
KA04ME	2015_1	2015_1-KA04ME	pre	2015_1_B	1	2	1	5	5	5	5	5	4	2	4	5	4	4	3	4	5	5	5	
KA08BE	2015_1	2015_1-KA08BE	pre	2015_1_B	1	2	1	5	4	5	5	5	4	4	4	4	4	5	4	5	6	5	5	
KE17BE	2015_1	2015_1-KE17BE	pre	2015_1_B	1	2	1	4	4	4	3	4	4	4	3	4	3	4	3	5	4	3	2	
MA09AL	2015_1	2015_1-MA09AL	pre	2015_1_B	1	2	1	5	4	4	4	4	3	3	4	5	4	4	4	5	6	5	3	
MA10BR	2015_1	2015_1-MA10BR	pre	2015_1_B	1	1	1	3	2	5	4	3	5	4	3	5	2	3	4	4	5	4	3	
ME14BE	2015_1	2015_1-ME14BE	pre	2015_1_B	1	2	2	5	4	5	5	4	4	4	4	4	5	3	3	5	5	5	5	

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
PI04BE	2015_1	2015_1-PI04BE	pre	2015_1_B	2	2	5	4	5	5	5	5	5	5	5	4	5	5	5	3	5	5	5	
RO22NA	2015_1	2015_1-RO22NA	pre	2015_1_B	1	2	1	4	4	5	3	5	4	4	4	4	4	5	4	3	3	4	3	
SA22BE	2015_1	2015_1-SA22BE	pre	2015_1_B	1	2	1	4	1	3	2	3	3	5	5	3	5	4	4	4	2	5	5	
SA26BE	2015_1	2015_1-SA26BE	pre	2015_1_B	1	2	5	4	4	3	4	5	4	4	4	4	5	5	4	4	5	5	4	
SI18HA	2015_1	2015_1-SI18HA	pre	2015_1_B	2	2	1	4	4	5	4	5	4	3	2	3	4	4	1	3	3	5	3	
SV30MO	2015_1	2015_1-SV30MC	pre	2015_1_B	1	2	1	2	2	2	2	3	5	1	5	2	5	5	3	4	3	5	4	
SY14RO	2015_1	2015_1-SY14RC	pre	2015_1_B	1	2	5	5	4	4	5	4	4	4	4	3	4	4	3	5	5	3	5	
TH26BE	2015_1	2015_1-TH26BE	pre	2015_1_B	1	1	1	5	4	4	4	5	3	3	4	4	4	3	3	4	5	4	3	
WA14SI	2015_1	2015_1-WA14SI	pre	2015_1_B	1	2	1	4	4	4	4	4	5	5	4	4	5	4	3	5	4	4	5	
WA31BE	2015_1	2015_1-WA31BE	pre	2015_1_B	2	3	2	4	3		4	4	2	4	2	5	5	4	3	4	4	5	3	
YA27BE	2015_1	2015_1-YA27BE	pre	2015_1_B	2	1	1	2	4	3	2	4	6	6	2	5	5	1	2	2	3	6	2	
ZA27NE	2015_1	2015_1-ZA27NE	pre	2015_1_B	2	1	3	5	3	3	3	4	4	5	5	5	5	3	3	3	5	4	3	
AL01WO	2015_1	2015_1-AL01WC	post	2015_1_E	1	2	2	5		5	5	5	5		4	4		5	4	5		5		
AL03RU	2015_1	2015_1-AL03RU	post	2015_1_E	1	2	1	4	3	5	1	5	5	4	5	5	5	5	4	5	5	4	5	
AM12BO	2015_1	2015_1-AM12BC	post	2015_1_E	1	1	5	6	6	6	5	6	4	6	6	5	6	6	6	6	6	4	6	
AN13BE	2015_1	2015_1-AN13BE	post	2015_1_E	2	1	1	5	5	4	4	5	5	6	5	5	4	6	4	6	4	6	5	
BE16BE	2015_1	2015_1-BE16BE	post	2015_1_E	2	2	1	6	5	6	5	6	5	5	6	5	6	6	5	5	5	6	5	
BE18BE	2015_1	2015_1-BE18BE	post	2015_1_E	2	2	5	5	6	4	4	4	5	5	5	4	5	5	4	5	5	5	5	
BI14RÖ	2015_1	2015_1-BI14RÖ	post	2015_1_E	2	2	1	5	5	5	5	4	5	3	3	5	4	6	5	3	6	5	6	
BI24BE	2015_1	2015_1-BI24BE	post	2015_1_E	1	2	1	3	5	4	2	4	5	5	5	5	4	3	3	4	4	5	3	
BI25BE	2015_1	2015_1-BI25BE	post	2015_1_E	1	2	1	4	4	5	5	4	4	5	4	5	4	4	4	4	5	5	4	
BO27JO	2015_1	2015_1-BO27JO	post	2015_1_E	1	2	1	5	4	4	4	4	4	4	5	5	4	4	4	5	5	5	4	
CA01BE	2015_1	2015_1-CA01BE	post	2015_1_E	1	2	1	4	5	5	4	4	5	5	4	5	5	5	3	2	5	4	5	
CA15ES	2015_1	2015_1-CA15ES	post	2015_1_E	1	1	1	5	5	5	5	6	4	4	4	5	5	5	4	5	5	5	4	
CH04SA	2015_1	2015_1-CH04SA	post	2015_1_E	1	2	5	6	4	4	2	5	3	3	5	4	4	5	4	5	4	5	4	
CH05LÜ	2015_1	2015_1-CH05LÜ	post	2015_1_E	1	2	5	5	4	4	4	4	3		5	5	3	4	4		6		4	
CH09BE	2015_1	2015_1-CH09BE	post	2015_1_E	1	1	1	5	5	5	5	6	5	4	5	4	6	4	4	6	6	6	4	
CL17HI	2015_1	2015_1-CL17HI	post	2015_1_E	1	2	1	6	5	6	6	5	5	6	6	4	6	5	5	5	6	5	6	
CO24BE	2015_1	2015_1-CO24BE	post	2015_1_E	1	1	1	5	5	5	6	4	5	2	3	5	5	5	3	4	5	3	5	
DO08SP	2015_1	2015_1-DO08SP	post	2015_1_E	2	2	1	5	4	4	6	5	5	5	2	4	4	4	3	5	5	6	6	
EL29DR	2015_1	2015_1-EL29DR	post	2015_1_E	2	2	5	5	5	4	5	6	5	5	6	4	5	5	4	5	6	5	6	
FI16BE	2015_1	2015_1-FI16BE	post	2015_1_E	1	2	1	6	5	5	4	5	5	4	5	6	5	6	5	5	4	6	4	
GA06CE	2015_1	2015_1-GA06CE	post	2015_1_E	1	2	5	5	4	4	4	5	4	3	5	5	5	5	5	5	5	5	4	
GR30TR	2015_1	2015_1-GR30TR	post	2015_1_E	2	2	1	6	5	6	5	5	6	4	6	5	5	6	6		5	6	6	
GU20BE	2015_1	2015_1-GU20BE	post	2015_1_E	1	2	1	5	5	5	5	5	4	4	4	5	5	5	4	5	4	5	4	
HA17HA	2015_1	2015_1-HA17HA	post	2015_1_E	1	1	5	6	6	6	6	5	6	6	5	6	6	6	5	5	6	5	6	
HE28ST	2015_1	2015_1-HE28ST	post	2015_1_E	1	3	5	5	4	4	4		5	5	5	4	5	4	4	5	6	5	4	
JA27NE	2015_1	2015_1-JA27NE	post	2015_1_E	2	1	3	5	5	5	4	4	5	5	5	5	5	5	4	5	5	5	5	
JR19BE	2015_1	2015_1-JR19BE	post	2015_1_E	1	1	1	5	5	5	6	5	4	4	4	4	5	6	4	5	3	4	3	
KA04ME	2015_1	2015_1-KA04ME	post	2015_1_E	1	2	1	5	4	5	4	5	4	3	5	5	4	4	4	5	4	6	5	
KA08BE	2015_1	2015_1-KA08BE	post	2015_1_E	1	2	1	6	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	
KE09NE	2015_1	2015_1-KE09NE	post	2015_1_E	1	2	5	5	5	4	4	5	4	4	5	5	5	4	5	5	4	5	5	
MA09AL	2015_1	2015_1-MA09AL	post	2015_1_E	1	2	1	5	6	5	6	6	5	5	5	5	4	5	4	5	6	6	5	
MA10BE	2015_1	2015_1-MA10BE	post	2015_1_E	2	1	1	5	5	5	6	5	5	5	5	4	5	5	4	5	5	5	5	
MA10BR	2015_1	2015_1-MA10BR	post	2015_1_E	1	1	5	5	4	5	4	4	5	5	4	5	4	4	4	4	6	5	3	
MA30BE	2015_1	2015_1-MA30BE	post	2015_1_E	2	2	1	5	4	4	4	6	5	4	5	5	5	6	6	5	3	5	5	
ME14BE	2015_1	2015_1-ME14BE	post	2015_1_E	1	2	2	5	4	5	5	4	3	4	4	5	5	5	5	5	5	5	5	
MI05FA	2015_1	2015_1-MI05FA	post	2015_1_E	2	2	1	4	5	5	5	5	4	6	5	5	5	4	4	5	6	4	5	
MI14BE	2015_1	2015_1-MI14BE	post	2015_1_E	1	2	1	4	5	5	5	4	5	5	4	5	5	5	5	5	6	4	6	
MI24HO	2015_1	2015_1-MI24HO	post	2015_1_E	1	1	5	5	5	6	4	5	6	5	5	4	5	4	4	5	6	4	4	
NA30HI	2015_1	2015_1-NA30HI	post	2015_1_E	2	2	1	5	5	4	4	4	4	5	5	5	5	5	5	5	5	5	5	
PI04BE	2015_1	2015_1-PI04BE	post	2015_1_E	2		5	6	5	4	4	3	5	4	5	4	5	3	3	5	5	6	4	
RO22NA	2015_1	2015_1-RO22NA	post	2015_1_E	1	2	1	5	6	5	5	5	5	5	4	4	5	5	5	4	5	5	5	
SH04BE	2015_1	2015_1-SH04BE	post	2015_1_E	1	2	1		5	6	5	3	5	4	5	6	4	4	4	5	5	5	4	
SI15BE	2015_1	2015_1-SI15BE	post	2015_1_E	2	2	1	3	4	5	4	5	4	4	5	4	5	4	5	5	5	4	4	
SO10DR	2015_1	2015_1-SO10DR	pre	2015_1_B	1	2	1	5	5	5	5	5	3		4	4	4	3	4	5	5	5	5	
TH20OB	2015_1	2015_1-TH20OB	post	2015_1_E	1	2	5	6	6	6	6	5	5	5	6	6	6	6	6	5	5	6	5	
UL28SP	2015_1	2015_1-UL28SP	post	2015_1_E	1	2	1	5	5	5	4	3	4	3	4	4	5	4	4	4	6	5	3	
WA14SI	2015_1	2015_1-WA14SI	post	2015_1_E	1	2	1	4	5	5	5	5	4	5	5	5	5	4	4	5	5	5	5	
YA27BE	2015_1	2015_1-YA27BE	post	2015_1_E	1	2	1	6	5	6	6	5	6	5	5	4	5	5	6	6	5	5	5	
YA27BE	2015_1	2015_1-YA27BE	post	2015_1_E	2	1	1	5	6	5	5	5	4	5	6	4	6	5	5	5	3	6	5	
EMPTY1	2015_1	2015_1-EMPTY1	post	2015_1_E	1		2	5	4	6	5	5	4	4	5	5	5	5	4	6	6	5	5	
EMPTY2	2015_1	2015_1-EMPTY2	post	2015_1_E	1	2	1	4	5	4	5	5	4	5	4	3	4	5	5	4	4	5	5	
260.390	2014_2	2014_2-260.390	pre	2014_2_B	1	2	1	4	2	4		5	4		3	3	5	5	4	4	4	4	4	
AD06BO	2014_2	2014_2-AD06BC	pre	2014_2_B	1	2	4	1	3	2		1	2		2	2	1	3	4	2	1	2	3	
AI03BE	2014_2	2014_2-AI03BE	pre	2014_2_B	1	2	1	3	3	4		3	3		3	3	3	6	3	4	6	3	6	
AL18WI	2014_2	2014_2-AL18WI	post	2014_2_E	1	2	1	5	4	4		5	4		4	4	5	5	3	5	4	5	4	
AN07BE	2014_2	2014_2-AN07BE	pre	2014_2_B	1	2	1	2	2	6		6	6		5	3	6	4	3	6	6	6	6	
AN12BE	2014_2	2014_2-AN12BE	pre	2014_2_B	1	1	1	3	3	4		4	3		3	4	5	4	3	4	5	3	4	
AN13HA	2014_2	2014_2-AN13HA	pre	2014_2_B	2	1		5	3	5		4	4		4	4	5	5	5	4	5	6	5	
AN20BE	2014_2	2014_2-AN20BE	pre	2014_2_B	1	1	1	4	2	4		4	5		4	4	4	3	4	4	5	5	4	
AN21BE	2014_2	2014_2-AN21BE	post	2014_2_E	2	2		5	6	6		6	4		4	4	5	5	5	5	5	4	6	
AN30WI	2014_2	2014_2-AN30WI	pre	2014_2_B	2	2	1	5	3	5		5	5		5	5	5	5	5	3	5	5	5	
AS12BE	2014_2	2014_2-AS12BE	post	2014_2_E	1	2	1	5	4	4		5	5		3	4	4	5	4	4	3	5	2	
AS12BE	2014_2	2014_2-AS12BE	pre	2014_2_B	1	2	1	4	2	3		3	4		4	5	5	3	3	4	4	5	3	
BE11DR	2014_2	2014_2-BE11DR	post	2014_2_E	1	1	1	5	4	4		5	4		4	4	4	5	5	4	4	5	3	
BE11DR	2014_2	2014_2-BE11DR	pre	2014_2_B	1	1	1	4	3	4		5	2		3	4	2	2	3	4	3	4	4	

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
BI21MA	2014_2	2014_2-BI21MA	post	2014_2_E	1	2	5	6	4	5		6	4		5	4	6	4	5	4	4	5	5	
BI21MA	2014_2	2014_2-BI21MA	pre	2014_2_B	1	2	5	4	4	4		4	3		5	4	5	5	5	4	3	5	4	
CA01MA	2014_2	2014_2-CA01MA	pre	2014_2_B	2	2		5	2	5		5	4		3	5	5	3	2	4	4	4	4	
CA05BE	2014_2	2014_2-CA05BE	pre	2014_2_B	1	2	5	2	2	3		4	2		2	2	4	3	3	2	3	3	4	
CA18PO	2014_2	2014_2-CA18PO	post	2014_2_E	1	2	1	2	5	5		5	2		4	3	3	3	3	5	5	6	4	
CA18PO	2014_2	2014_2-CA18PO	pre	2014_2_B	1	2	1	1	2	2		4	4		2	3	2	1	2	3	2	3	2	
CL20FL	2014_2	2014_2-CL20FL	post	2014_2_E	1	2	1	6	5	4			5		6	5	6	6	6	5	6	5	6	
CL20FL	2014_2	2014_2-CL20FL	pre	2014_2_B	1	2	1	5	4	4		4	5		5	4	5	5	4	5	4	5	5	
CL26HE	2014_2	2014_2-CL26HE	post	2014_2_E	2	2	5	5	5	6		5	5		6	5	5	5	5	4	5	6	4	
CL26HE	2014_2	2014_2-CL26HE	pre	2014_2_B	2	2	5	5	4	6		4	5		6	4	6	3	3	5	4	4	3	
DI22WI	2014_2	2014_2-DI22WI	pre	2014_2_B	1	1	5	3	3	3		3	2		3	2	2	2	2	3	3	3	3	
DO27FR	2014_2	2014_2-DO27FR	pre	2014_2_B	1	2	1	4	5	4		4	4		5	5	5	4	4	4	5	5	3	
DO28LA	2014_2	2014_2-DO28LA	pre	2014_2_B	1	1	5	4	3	4		4	2		3	4	3	4	3	4	4	5	3	
DO29GE	2014_2	2014_2-DO29GE	post	2014_2_E	1	2	1	5	5	5		5	5		5	5	5	4	5	5	5	5	4	
DO29GE	2014_2	2014_2-DO29GE	pre	2014_2_B	1	2	1	5	3	4		4	3		3	4	4	4	3	4	5	4	4	
EL01OS	2014_2	2014_2-EL01OS	pre	2014_2_B	1	2	1	5	2	3		3	4		4	4	5	6	5	3	5	5	3	
EL06BO	2014_2	2014_2-EL06BO	post	2014_2_E	1	1	1	5	5	5		5	4		4	4	5	5	5	4	5	4	5	
EL06BO	2014_2	2014_2-EL06BO	pre	2014_2_B	1	1	1	5	4	4		5	4		3	4	5	5	4	4	5	4	3	
FL06BE	2014_2	2014_2-FL06BE	pre	2014_2_B	1	1	1	4	5	3		6	4		2	4	4	1	6	3	5	4	3	
FL13BA	2014_2	2014_2-FL13BA	pre	2014_2_B	1	2	2	4	2	4		4	4		2	3	4	3	2	3	4	4	3	
GA14LD	2014_2	2014_2-GA14LD	post	2014_2_E	1	2	1	5	5	5		5	4		4	4	3	5	3	3	4	4	5	
GA14LD	2014_2	2014_2-GA14LD	pre	2014_2_B	1	2	1	4	3	6		5	5		4	5	5	5	3	4	4	4	5	
GI27SE	2014_2	2014_2-GI27SE	pre	2014_2_B	2	2	3	4	3	5		4	3		3	3	5	3	4	4	5	4	4	
GR05ME	2014_2	2014_2-GR05ME	pre	2014_2_B	3	2	4	3	4	4		4	3		3	2	4	3	2	3	3	3	3	
GR09NA	2014_2	2014_2-GR09NA	post	2014_2_E	1	2	1	5	5	5		3	5		5	4	6	5	5	6	5	4	5	
GR09NA	2014_2	2014_2-GR09NA	pre	2014_2_B	1		1	5	2	3		4	5		5	3	6	6	6	5	5	4	5	
GR22AL	2014_2	2014_2-GR22AL	post	2014_2_E	1	2	1	3	5	5		4	3		4	3	4	4	4	5	6	4	4	
GR22AL	2014_2	2014_2-GR22AL	pre	2014_2_B	1	2	1	4	5	5		5	4		5	4	4	3	5	5	5	6	3	
HE13HA	2014_2	2014_2-HE13HA	post	2014_2_E	1	2	1	4	6	5		5	4		5	5	4	4	3	5	6	6	5	
HE13HA	2014_2	2014_2-HE13HA	pre	2014_2_B	1	2	1	4	5	5		5	4		4	3	3	2	2	5	6	4	4	
HI07SC	2014_2	2014_2-HI07SC	pre	2014_2_B	1	2		5	4	3		4	4		5	4	6	4	4	5	4	4	4	
HÜ22BE	2014_2	2014_2-HÜ22BE	pre	2014_2_B	1	2	1	5	4	3		5	4		5	4	5	3	4	4	4	4	4	
IM12PI	2014_2	2014_2-IM12PI	post	2014_2_E	1		5	6	4	5		5	4		5	4	5	4	4	5	6	5	5	
IM12PI	2014_2	2014_2-IM12PI	pre	2014_2_B	1	2	5	5	3	4		4	3		5	4	5	2	3	4	5	5	3	
IN25LI	2014_2	2014_2-IN25LI	post	2014_2_E	1	2	1		4	4		5	5		4	3	5	4	4	4	4	5	3	
IN25LI	2014_2	2014_2-IN25LI	pre	2014_2_B	1	2	1	4	3	4		5	6		3	2	3	3	3	3	3	3	2	
IN31FI	2014_2	2014_2-IN31FI	post	2014_2_E	1	2	4	5	5	5		5	5		5	5	6	5	5	5	5	6	5	
IN31FI	2014_2	2014_2-IN31FI	pre	2014_2_B	1	2	4	6	5	6		6	5		5	5	5	5		5	6	5	5	
IR05DI	2014_2	2014_2-IR05DI	pre	2014_2_B	1	2	1	4	4	5		5	3		2	5	5	4	2	5	4	6	2	
IR25WE	2014_2	2014_2-IR25WE	pre	2014_2_B	2	1	5	3	1	4		4	3		4	3	4	3	5	2	4	4	3	
IR26KI	2014_2	2014_2-IR26KI	pre	2014_2_B	1	1	2	4	4	4		4	4		2	3	3	2	3	4	4	3	4	
IR29HE	2014_2	2014_2-IR29HE	post	2014_2_E	1	2	1	4	6	6		4	6		5	5	5	6	6	5	4	6	6	
JL25ER	2014_2	2014_2-JL25ER	post	2014_2_E	1	2	1	6	6	6		5	5		5	4	6	6	6	5	5	5	5	
JL25ER	2014_2	2014_2-JL25ER	pre	2014_2_B	1	2	1	5	5	5		4	5		2	3	4	4	5	4	5	5	5	
JR05DI	2014_2	2014_2-JR05DI	post	2014_2_E	1	2	1	5	5	4		5	4		5	5	5	5	5	6	5	6	3	
JU14BE	2014_2	2014_2-JU14BE	post	2014_2_E	1	2	5	4	5	5		5	4		4	5	5	5	5	5	5	5	5	
JU14BE	2014_2	2014_2-JU14BE	pre	2014_2_B	1	2	5	5	4	5		4	4		4	5	5	4	4	5	4	5	5	
KA02RÖ	2014_2	2014_2-KA02RÖ	post	2014_2_E	2	1	4	4	4	5		5	4		5	4	3	3	4	4	5	5	4	
KA02RÖ	2014_2	2014_2-KA02RÖ	pre	2014_2_B	2	1	4		4	4		3	4		3	3	3	3	3	3	4	4	3	
KA11BA	2014_2	2014_2-KA11BA	post	2014_2_E	1	2	1	4	4	5		5	5		5	4	4	3	5	4	5	5	4	
KA11BA	2014_2	2014_2-KA11BA	pre	2014_2_B	3	2	1	4	3			3	3		6	5		3	3	4	5	5	3	
KE10WI	2014_2	2014_2-KE10WI	pre	2014_2_B	2	2	1	5	4	4		5	4		4	6	5	4	5	5	4	5	5	
MA01ER	2014_2	2014_2-MA01ER	post	2014_2_E	1	2	1	3	5	4		4	3		4	3	4	4	4	3	5	5	3	
MA01ER	2014_2	2014_2-MA01ER	pre	2014_2_B	1	2	1	4	2	3		2	3		2	3	3	2	2	3	4	3	3	
MA03MU	2014_2	2014_2-MA03MU	post	2014_2_E	3	1	1	4	4	5		4	2		5	6	5	4	4	4	5	5	4	
MA07LE	2014_2	2014_2-MA07LE	pre	2014_2_B	1	2	2	5	4	4		5	2		4	3	3	2	4	4	5	5	2	
MA09NO	2014_2	2014_2-MA09NO	pre	2014_2_B	1	2	1	5	4	4		6	3		4	5	5	3	4	5	6	4	5	
MA10BE	2014_2	2014_2-MA10BE	post	2014_2_E	1		1	5	5	6		6	6		5	5	6	5	5	5	6	6	5	
MA10BE	2014_2	2014_2-MA10BE	pre	2014_2_B	1	1	1	4	3	4		5	4		3	4	5	3	3	3	5	5	3	
MA11BE	2014_2	2014_2-MA11BE	pre	2014_2_B	2	2	1	3	4	6		4	4		3	5	5	6	3	4	4	5	5	
MA15AL	2014_2	2014_2-MA15AL	post	2014_2_E	1	2	1	4	6	5		4	4		4	3	5	5	3	4	3	4	3	
MA15AL	2014_2	2014_2-MA15AL	pre	2014_2_B	1	2	1	1	6			3	4		5	3	5	4	2	4	3	1	3	
MA19BE	2014_2	2014_2-MA19BE	post	2014_2_E	2	1	1	6	5	4		4	3		6	5	5	6	4	4	6	5	3	
MA19BE	2014_2	2014_2-MA19BE	pre	2014_2_B	2	1	1	4	3	3		3	2		5	4	3	2	3	3	5	4	3	
MA30RA	2014_2	2014_2-MA30RA	post	2014_2_E	1	1	5	5	5	5		6	4		4	6	6	4	5	4	6	6	5	
MA30RA	2014_2	2014_2-MA30RA	pre	2014_2_B	1	1	5	4	4	6		4	3		4	4	5	4	3	3	6	5	4	
MO30HE	2014_2	2014_2-MO30HE	pre	2014_2_B	1	2	1	4	4	4		5	4		5	4	5	6	4	5	5	5	5	
NU05BE	2014_2	2014_2-NU05BE	pre	2014_2_B	2	1	5	4	2	3		3	4		4	3	5	4	3	3	6	5	3	
OL29OD	2014_2	2014_2-OL29OD	post	2014_2_E	1	2	1	4	4	3		5	5		3	2	3	5	5	5	3	6	5	
OL29OD	2014_2	2014_2-OL29OD	pre	2014_2_B	1	2	1	5	4	4		5	3		4	4	5	5	4	4	3	6	2	
PE09WA	2014_2	2014_2-PE09WA	post	2014_2_E	2	2	1	5	5	5		5	4			5	5	5	5	5	5	6	5	
PE09WA	2014_2	2014_2-PE09WA	pre	2014_2_B	2	2	1	4	2	4		5	5		3	4	3	5	5	5	5	5	4	
PE13BE	2014_2	2014_2-PE13BE	pre	2014_2_B	1	2	1	4	6	5		6	6		4	4	4	5	4	6	3	5	5	
RE076E	2014_2	2014_2-RE076E	post	2014_2_E	1		1	4	5	5		5	5		4	3	6	4	4	4	5	5	5	
RE11BE	2014_2	2014_2-RE11BE	pre	2014_2_B	1		1	3	4	5		3	4		4	4	4	4	4	4	2	5	3	
RE13BA	2014_2	2014_2-RE13BA	post	2014_2_E	1	2	2	5	5	4		5	4		4	5	5	5	5	5	4	5	4	
RE16BE	2014_2	2014_2-RE16BE	post	2014_2_E	1	2	1	4	5	5		5	4		5	5	5	5	4	5	4	5	4	

Appendix - Comparative Self-Assessment - Data Collection

Code	Semester	Unique	prepostthen	Zeitpunkt	Geschlecht	Abschluss	Studienfeld	T1.1	T1.2	T2.1	T2.2	T3.1	T4.1	T4.2	C1.1	C2.1	C3.1	C4.1	C4.2	A1.1	A1.2	A2.1	A3.1	A4.1
RE16BE	2014_2	2014_2-RE16BE	pre	2014_2_B	1	2	1	3	5	4		4	5			4	5	5	4	4	5	5		
SA13BE	2014_2	2014_2-SA13BE	pre	2014_2_B	1	2		3	5	3		4	4		3	4	4	3	3	5	2	4	4	
SA29KA	2014_2	2014_2-SA29KA	post	2014_2_E	1	2	1	5	6	4		4	4		4	3	5	5	5	4	5	4	5	
SA29KA	2014_2	2014_2-SA29KA	pre	2014_2_B	1	2	1	5	6	4		5	4		5	5	5	4	4	5	4	5	6	
SA30RI	2014_2	2014_2-SA30RI	pre	2014_2_B	1	1		6	6	5		5	5		6	4	5	5	6	6	6	6	4	
SE18WI	2014_2	2014_2-SE18WI	pre	2014_2_B	1	2	1	4	2	4		4	5		3	4	4	4	3	4	4	4	4	
SI20ST	2014_2	2014_2-SI20ST	post	2014_2_E	1	2	1	4	5	4		5	4		4	4	4	5	4	4	3	4	4	
SI20ST	2014_2	2014_2-SI20ST	pre	2014_2_B	1	2	1	3	4	4		4	4		4	4	2	5	4	5	3	3	5	
SI24SO	2014_2	2014_2-SI24SO	post	2014_2_E	2	1	5	5	5	4		5	5		4	5	4	4	5	5	5	4	5	
SI24SO	2014_2	2014_2-SI24SO	pre	2014_2_B	2	1	5	4	4	4		5	3		4	5	4	4	3	3	5	4	5	
SO04LÜ	2014_2	2014_2-SO04LÜ	post	2014_2_E	1	2	1	6	6	5		5	6		5	6	5	5	6	6	6	6	6	
SO04LÜ	2014_2	2014_2-SO04LÜ	pre	2014_2_B	1	2	1	5	4	5		3	4		3	4	4	3	2		5	4	4	
SO12HE	2014_2	2014_2-SO12HE	post	2014_2_E	2	1	4	4	3	4		5	2		5	3	5	4	3	5	6	6	4	
SO12OB	2014_2	2014_2-SO12OE	pre	2014_2_B	2	1	4	2	3	4		2	2		4	3	3	3	2	3	5	5	2	
SU05RO	2014_2	2014_2-SU05RC	post	2014_2_E	1	2	5	5	5	5		4	5		5	6	6	4	4	6	6	5	5	
SU05RO	2014_2	2014_2-SU05RC	pre	2014_2_B	1	2	1	4	2	5		4	4		3	5	5	2	4	4	5	4	4	
SU24BI	2014_2	2014_2-SU24BI	post	2014_2_E	2	2	1	5	4	5		4	4		4	5	6	3	4	5	6	5	5	
SU24BI	2014_2	2014_2-SU24BI	pre	2014_2_B	2	2	1	4	4	3		5	4		5	5	5	5	4	4	5	5	5	
TE09BE	2014_2	2014_2-TE09BE	post	2014_2_E	1	2	5	5	6	6		5	5		5	6	6	6	4	6	6	6	6	
TE09BE	2014_2	2014_2-TE09BE	pre	2014_2_B	1	2	5	5	4	5		4	4		4	5	5	5	3	5	5	5	3	
UR31HE	2014_2	2014_2-UR31HE	post	2014_2_E	2	2	1	4	4	6		4	5		6	6	6	6	6	6	6	6	5	
UR31HE	2014_2	2014_2-UR31HE	pre	2014_2_B	2	2	1	3		6		6	5		5	3	6	5	6	5	5	4	5	
UT04NO	2014_2	2014_2-UT04NC	pre	2014_2_B	3	1	1	5	5	4		5	4		4	3	5	2		4	5	4	2	
UT10BO	2014_2	2014_2-UT10BO	post	2014_2_E	1	2	1	5	5	5		4	5		5	4	5	4	4	6	5	5	4	
UT10BO	2014_2	2014_2-UT10BO	pre	2014_2_B	1	2	1	4	4	6		5	5		4	4	5	3	4	4	4	6	3	
UT26BE	2014_2	2014_2-UT26BE	post	2014_2_E	1	1	1	6	5	5		5	5		4	5	6	5	5	5	5	6	5	
UT26BE	2014_2	2014_2-UT26BE	pre	2014_2_B	1	1	1	5	4	5		3	5		5	2	4	4	3	4	5	4	4	
XU12BE	2014_2	2014_2-XU12BE	post	2014_2_E	1	2	1	4	5	5		5	5		5	4	4	4	5	5	5	5	6	
XU20BE	2014_2	2014_2-XU20BE	pre	2014_2_B	1	2	2	2	5	5		3	2		4	2	4	2	3	4	4	4	2	
XX01BE	2014_2	2014_2-XX01BE	pre	2014_2_B	1	2	1	5	3	4		3	3		3	4	5	4	3	5	4	5	5	
YV04SU	2014_2	2014_2-YV04SU	pre	2014_2_B	1	2	1	2	5	3		5	2		3	3	5	4	3	5	2	2	2	
EMPTY3	2014_2	2014_2-EMPTY3	post	2014_2_E	1	1	2	4	4	3		3	4		3	3	4	3	4	4	3	3	4	

Appendix

Comparative Self-Assessment Test

Data Analysis

Appendix - Comparative Self-Assessment - Data Analysis

Formulas used for the Data Analysis		
		T1.1 and all the cells to right respectively
beginn mean	=AVERAGE(C3:S3)	=AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_B")
1	=SUM(C4:S4)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A4)
2	=SUM(C5:S5)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A5)
3	=SUM(C6:S6)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A6)
4	=SUM(C7:S7)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A7)
5	=SUM(C8:S8)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A8)
6	=SUM(C9:S9)	=COUNTIFS(combined!$E$2:$E;"*_B";combined!I$2:I;$A9)
finish Mean	=AVERAGE(C11:S11)	=AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_E")
1	=SUM(C12:S12)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A12)
2	=SUM(C13:S13)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A13)
3	=SUM(C14:S14)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A14)
4	=SUM(C15:S15)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A15)
5	=SUM(C16:S16)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A16)
6	=SUM(C17:S17)	=COUNTIFS(combined!$E$2:$E;"*_E";combined!I$2:I;$A17)
CSA	=IF(B3>0;(((B3-7)*-1)-((B11-7)*-1))/(((B3-7)*-1)-1)*100;)	
pre	=AVERAGE(C21:S21)	=AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;"pre")
1	=SUM(C22:S22)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A22)
2	=SUM(C23:S23)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A23)
3	=SUM(C24:S24)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A24)
4	=SUM(C25:S25)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A25)
5	=SUM(C26:S26)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A26)
6	=SUM(C27:S27)	=COUNTIFS(combined!$D$2:$D;"pre";combined!I$2:I;$A27)
post	=AVERAGE(C29:S29)	=AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;"post")
1	=SUM(C30:S30)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A30)
2	=SUM(C31:S31)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A31)
3	=SUM(C32:S32)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A32)
4	=SUM(C33:S33)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A33)
5	=SUM(C34:S34)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A34)
6	=SUM(C35:S35)	=COUNTIFS(combined!$D$2:$D;"post";combined!I$2:I;$A35)
then	=AVERAGE(C39:S39)	=AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;"then")
1	=SUM(C40:S40)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A40)
2	=SUM(C41:S41)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A41)
3	=SUM(C42:S42)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A42)
4	=SUM(C43:S43)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A43)
5	=SUM(C44:S44)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A44)
6	=SUM(C45:S45)	=COUNTIFS(combined!$D$2:$D;"then";combined!I$2:I;$A45)
postthen	=AVERAGE(C47:S47)	=AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;"postthen")
1	=SUM(C48:S48)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A48)
2	=SUM(C49:S49)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A49)
3	=SUM(C50:S50)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A50)
4	=SUM(C51:S51)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A51)
5	=SUM(C52:S52)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A52)
6	=SUM(C53:S53)	=COUNTIFS(combined!$D$2:$D;"postthen";combined!I$2:I;$A53)
	Participants N	439,00
	Cronbach's Alpha	=(COUNT(C59:S59)/(COUNT(C59:S59)-1))*(1-(SUMSQ(C61:S61)/ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_B";combined!$E$2:$E));combined!Z$2:Z;))))^2))
Beginn	Pre N Survey	=IF(COUNTIFS(combined!I$2:I;">0";combined!$E$2:$E;"*_B")=0;;COUNTIFS(combined!I$2:I;">0";combined!$E$2:$E;"*_B"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_B";combined!I$2:I;">0"));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_B";combined!I$2:I;">0"))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_B";combined!$E$2:$E));combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_B";combined!$E$2:$E));combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C61;C59));;CONFIDENCE(0,05;C61;C59))
	Participation Rate	=C66/C57
	Cronbach's Alpha	=(COUNT(C66:S66)/(COUNT(C66:S66)-1))*(1-(SUMSQ(C68:S68)/ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_E";combined!$E$2:$E));combined!Z$2:Z;))))^2))
Finish	Post N Survey	=IF(COUNTIFS(combined!I$2:I;">0";combined!$E$2:$E;"*_E")=0;;COUNTIFS(combined!I$2:I;">0";combined!$E$2:$E;"*_E"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_E";combined!I$2:I;">0"));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;"*_E";combined!I$2:I;">0"))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_E";combined!$E$2:$E));combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(ISNUMBER(SEARCH("_E";combined!$E$2:$E));combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C68;C66));;CONFIDENCE(0,05;C68;C66))
	Diff Abs	=IF(C67>0;C67-C60;)
	Diff Rel	=IF(ISERROR((C67/C60)-1)*100;;((C67/C60)-1)*100)
	Raupach CSA	=IF(C60>0;(((C60-7)*-1)-((C67-7)*-1))/(((C60-7)*-1)-1)*100;)
	Participants N	218,00
	Cronbach's Alpha	=(COUNT(C79:S79)/(COUNT(C79:S79)-1))*(1-(SUMSQ(C81:S81)/ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A79;combined!Z$2:Z;))))^2))
pre	Pre N Survey	=IF(COUNTIFS(combined!$D$2:$D;$A79;combined!I$2:I;">0")=0;;COUNTIFS(combined!$D$2:$D;$A79;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A79));;AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A79))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A79;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A79;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C81;C79));;CONFIDENCE(0,05;C81;C79))
	Participation Rate	=C86/C77
	Cronbach's Alpha	=(COUNT(C86:S86)/(COUNT(C86:S86)-1))*(1-(SUMSQ(C88:S88)/ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A86;combined!Z$2:Z;))))^2))
post	Post N Survey	=IF(COUNTIFS(combined!$D$2:$D;$A86;combined!I$2:I;">0")=0;;COUNTIFS(combined!$D$2:$D;$A86;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A86));;AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A86))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A86;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A86;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C88;C86));;CONFIDENCE(0,05;C88;C86))
	Diff Abs	=IF(C87>0;C87-C80;)
	Diff Rel	=IF(ISERROR((C87/C80)-1)*100;;((C87/C80)-1)*100)
	Raupach CSA	=IF(C80>0;(((C80-7)*-1)-((C87-7)*-1))/(((C80-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A86));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A79));C$1;FALSE))>0);2;1))
	Participants N	221,00

Appendix - Comparative Self-Assessment - Data Analysis

	Cronbach's Alpha	=(COUNT(C102:S102)/(COUNT(C102:S102)-1))*(1-(SUMSQ(C104:S104)/ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A102;combined!Z$2:Z;))))^2))
then	Pre N Survey	=IF(COUNTIFS(combined!$D$2:$D;$A102;combined!I$2:I;">0")=0;;COUNTIFS(combined!$D$2:$D;$A102;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A102));;AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A102))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A102;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A102;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C104;C102));;CONFIDENCE(0,05;C104;C102))
	Participation Rate	=C109/C100
	Cronbach's Alpha	=(COUNT(C109:S109)/(COUNT(C109:S109)-1))*(1-(SUMSQ(C111:S111)/ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A109;combined!Z$2:Z;))))^2))
postthen	Post N Survey	=IF(COUNTIFS(combined!$D$2:$D;$A109;combined!I$2:I;">0")=0;;COUNTIFS(combined!$D$2:$D;$A109;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A109));;AVERAGEIFS(combined!I$2:I;combined!$D$2:$D;$A109))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A109;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$D$2:$D=$A109;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C111;C109));;CONFIDENCE(0,05;C111;C109))
	Diff Abs	=IF(C110>0;C110-C103;)
	Diff Rel	=IF(ISERROR((C110/C103)-1)*100;;((C110/C103)-1)*100)
	Raupach CSA	=IF(C103>0;(((C103-7)*-1)-((C110-7)*-1))/(((C103-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A109));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$D$2:$D$649=$A102));C$1;FALSE))>0);2;1))
	Participants N	74,00
	Cronbach's Alpha	=(COUNT(C125:S125)/(COUNT(C125:S125)-1))*(1-(SUMSQ(C127:S127)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A125;combined!Z$2:Z;))))^2))
2014_2_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A125;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A125;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A125));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A125))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A125;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A125;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C127;C125));;CONFIDENCE(0,05;C127;C125))
	Participation Rate	=C132/C123
	Cronbach's Alpha	=(COUNT(C132:S132)/(COUNT(C132:S132)-1))*(1-(SUMSQ(C134:S134)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A132;combined!Z$2:Z;))))^2))
2014_2_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A132;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A132;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A132));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A132))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A132;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A132;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C134;C132));;CONFIDENCE(0,05;C134;C132))
	Diff Abs	=IF(C133>0;C133-C126;)
	Diff Rel	=IF(ISERROR((C133/C126)-1)*100;;((C133/C126)-1)*100)
	Raupach CSA	=IF(C126>0;(((C126-7)*-1)-((C133-7)*-1))/(((C126-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C126:S126)
	Mean Post	=AVERAGE(C133:S133)
	Diff	=C142-C141
	CSA Mean	=IF(C141>0;(((C141-7)*-1)-((C142-7)*-1))/(((C141-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A132));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A125));C$1;FALSE))>0);2;1))
	Participants N	78,00
	Cronbach's Alpha	=(COUNT(C153:S153)/(COUNT(C153:S153)-1))*(1-(SUMSQ(C155:S155)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A153;combined!Z$2:Z;))))^2))
2015_1_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A153;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A153;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A153));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A153))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A153;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A153;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C155;C153));;CONFIDENCE(0,05;C155;C153))
	Participation Rate	=C160/C151
	Cronbach's Alpha	=(COUNT(C160:S160)/(COUNT(C160:S160)-1))*(1-(SUMSQ(C162:S162)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A160;combined!Z$2:Z;))))^2))
2015_1_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A160;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A160;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A160));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A160))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A160;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A160;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C162;C160));;CONFIDENCE(0,05;C162;C160))
	Diff Abs	=IF(C161>0;C161-C154;)
	Diff Rel	=IF(ISERROR((C161/C154)-1)*100;;((C161/C154)-1)*100)
	Raupach CSA	=IF(C154>0;(((C154-7)*-1)-((C161-7)*-1))/(((C154-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C154:S154)
	Mean Post	=AVERAGE(C161:S161)
	Diff	=C170-C169
	CSA Mean	=IF(C169>0;(((C169-7)*-1)-((C170-7)*-1))/(((C169-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A160));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A153));C$1;FALSE))>0);2;1))
	Participants N	66,00
	Cronbach's Alpha	=(COUNT(C181:S181)/(COUNT(C181:S181)-1))*(1-(SUMSQ(C183:S183)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A181;combined!Z$2:Z;))))^2))
2015_2_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A181;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A181;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A181));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A181))

Appendix - Comparative Self-Assessment - Data Analysis

	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A181;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A181;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C183;C181));;CONFIDENCE(0,05;C183;C181))
	Participation Rate	=C188/C179
	Cronbach's Alpha	=(COUNT(C188:S188)/(COUNT(C188:S188)-1))*(1-(SUMSQ(C190:S190)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A188;combined!Z$2:Z;))))^2))
2015_2_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A188;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A188;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A188));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A188))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A188;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A188;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C190;C188));;CONFIDENCE(0,05;C190;C188))
	Diff Abs	=IF(C189>0;C189-C182;)
	Diff Rel	=IF(ISERROR((C189/C182)-1)*100;;((C189/C182)-1)*100)
	Raupach CSA	=IF(C182>0;(((C182-7)*-1)-((C189-7)*-1))/(((C182-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C182:S182)
	Mean Post	=AVERAGE(C189:S189)
	Diff	=C198-C197
	CSA Mean	=IF(C197>0;(((C197-7)*-1)-((C198-7)*-1))/(((C197-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A188));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A181));C$1;FALSE))>0);2;1))
	Participants N	78,00
	Cronbach's Alpha	=(COUNT(C209:S209)/(COUNT(C209:S209)-1))*(1-(SUMSQ(C211:S211)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A209;combined!Z$2:Z;))))^2))
2016_1_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A209;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A209;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A209));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A209))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A209;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A209;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C211;C209));;CONFIDENCE(0,05;C211;C209))
	Participation Rate	=C216/C207
	Cronbach's Alpha	=(COUNT(C216:S216)/(COUNT(C216:S216)-1))*(1-(SUMSQ(C218:S218)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A216;combined!Z$2:Z;))))^2))
2016_1_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A216;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A216;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A216));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A216))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A216;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A216;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C218;C216));;CONFIDENCE(0,05;C218;C216))
	Diff Abs	=IF(C217>0;C217-C210;)
	Diff Rel	=IF(ISERROR((C217/C210)-1)*100;;((C217/C210)-1)*100)
	Raupach CSA	=IF(C210>0;(((C210-7)*-1)-((C217-7)*-1))/(((C210-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C210:S210)
	Mean Post	=AVERAGE(C217:S217)
	Diff	=C226-C225
	CSA Mean	=IF(C225>0;(((C225-7)*-1)-((C226-7)*-1))/(((C225-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A216));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A209));C$1;FALSE))>0);2;1))
	Participants N	57,00
	Cronbach's Alpha	=(COUNT(C237:S237)/(COUNT(C237:S237)-1))*(1-(SUMSQ(C239:S239)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A237;combined!Z$2:Z;))))^2))
2016_2_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A237;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A237;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A237));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A237))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A237;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A237;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C239;C237));;CONFIDENCE(0,05;C239;C237))
	Participation Rate	=C244/C235
	Cronbach's Alpha	=(COUNT(C244:S244)/(COUNT(C244:S244)-1))*(1-(SUMSQ(C246:S246)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A244;combined!Z$2:Z;))))^2))
2016_2_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A244;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A244;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A244));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A244))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A244;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A244;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C246;C244));;CONFIDENCE(0,05;C246;C244))
	Diff Abs	=IF(C245>0;C245-C238;)
	Diff Rel	=IF(ISERROR((C245/C238)-1)*100;;((C245/C238)-1)*100)
	Raupach CSA	=IF(C238>0;(((C238-7)*-1)-((C245-7)*-1))/(((C238-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C238:S238)
	Mean Post	=AVERAGE(C245:S245)
	Diff	=C254-C253
	CSA Mean	=IF(C253>0;(((C253-7)*-1)-((C254-7)*-1))/(((C253-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A244));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A237));C$1;FALSE))>0);2;1))
	Participants N	86,00
	Cronbach's Alpha	=(COUNT(C265:S265)/(COUNT(C265:S265)-1))*(1-(SUMSQ(C267:S267)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A265;combined!Z$2:Z;))))^2))

Appendix - Comparative Self-Assessment - Data Analysis

2017_1_B	Pre N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A265;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A265;combined!I$2:I;">0"))
	Mean Pre	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A265));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A265))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A265;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A265;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C267;C265));;CONFIDENCE(0,05;C267;C265))
	Participation Rate	=C272/C263
	Cronbach's Alpha	=(COUNT(C272:S272)/(COUNT(C272:S272)-1))*(1-(SUMSQ(C274:S274)/ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A272;combined!Z$2:Z;))))^2))
2017_1_E	Post N Survey	=IF(COUNTIFS(combined!$E$2:$E;$A272;combined!I$2:I;">0")=0;;COUNTIFS(combined!$E$2:$E;$A272;combined!I$2:I;">0"))
	Mean Post	=IF(ISERROR(AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A272));;AVERAGEIFS(combined!I$2:I;combined!$E$2:$E;$A272))
	STDDEV	=IF(ISERROR(ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A272;combined!I$2:I;)))));;ARRAYFORMULA(STDEV((IF(combined!$E$2:$E=$A272;combined!I$2:I;)))))
	CI	=IF(ISERROR(CONFIDENCE(0,05;C274;C272));;CONFIDENCE(0,05;C274;C272))
	Diff Abs	=IF(C273>0;C273-C266;)
	Diff Rel	=IF(ISERROR((C273/C266)-1)*100;;((C273/C266)-1)*100)
	Raupach CSA	=IF(C266>0;(((C266-7)*-1)-((C273-7)*-1))/(((C266-7)*-1)-1)*100;)
	Mean Pre	=AVERAGE(C266:S266)
	Mean Post	=AVERAGE(C273:S273)
	Diff	=C282-C281
	CSA Mean	=IF(C281>0;(((C281-7)*-1)-((C282-7)*-1))/(((C281-7)*-1)-1)*100;)
	TTEST N	"=IF(COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE))>0))=0;;COUNT(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE))>0;ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE))>0)))
	TTEST	"=IF(ISERROR(TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE))>0);2;1));;TTEST(FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE))>0);FILTER(ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A272));C$1;FALSE));ArrayFormula(VLOOKUP(FILTER(UNIQUE(combined!$C$2:$C);ARRAYFORMULA(COUNTIF(combined!$C$2:$C;UNIQUE(combined!$C$2:$C))>1));FILTER(combined!$C$2:$BZ$649;(combined!$E$2:$E$649=$A265));C$1;FALSE))>0);2;1))