Engineers Without Borders Challenge: Implementing Sustainability in German Engineering Education

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Anja Richert took up the position of managing director of the Center for Learning and Knowledge Management of the RWTH Aachen University in February 2011. With a doctorate in Communication Science, she has been working at the IMA/ZLW & IfU Institute Cluster since 2003, from 2008 to 2010 as manager of the Business and Research Division: Knowledge Management. In 2004 Anja Richert completed her degree in Communication Science with a distinction at the RWTH Aachen University. In December 2007, she gained her doctorate in the field of e-learning, likewise with a distinction. In the years 2010 and 2011 she received the International E-Learning Award (IELA) for the projects ROLE and RELOAD with the e-learning solutions developed under her leadership. Furthermore, she is a lecturer at the Mechanical Engineering Faculty of the RWTH Aachen University for a course on learning and work habits (compulsory elective subject for the degree course in Mechanical Engineering). Her main areas of research are the development of agile turbulence-tolerant processes and organizational concepts for knowledge and technology-intensive organizations, the development of knowledge management solutions and e-learning tools (e.g. knowledge maps) for various fields, as well as accompanying research for complex organizational development processes in heterogeneous research networks.

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Sabina Jeschke became head of the IMA/ZLW & IfU Institute Cluster of the RWTH Aachen University in June 2009. She studied Physics, Computer Science and Mathematics at the Berlin University of Technology. After research stays at the NASA Ames Research Center/ California and the Georgia Institute of Technology/Atlanta, she gained a doctorate on "Mathematics in Virtual Knowledge Environments" in 2004. Following a junior professorship (2005-2007) at the TU Berlin with the construction and direction of its media center, she was head of the Institute of Information Technology Services (IITS) for electrical engineering at the University of Stuttgart from May 2007 to May 2009, where she was also the director of the Central Information Technology Services (RUS) at the same time. Some of the main areas of her research are complex IT-systems (e.g. cloud computing, Internet of Things, green IT & ET, semantic web services), robotics and automation (e.g. heterogeneous and cooperative robotics, cooperative agents, web services for robotics), traffic and mobility (autonomous and semi-autonomous traffic systems, international logistics, car2car & car2X models) and virtual worlds for research alliances (e.g. virtual and

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Dr. Hees studied Economic Geography, Politics and International Technical and Economic Cooperation at RWTH Aachen. He completed his thesis on "Regional Organisational Structures in the Building and Construction Industry – Generating Turbulence-tolerant Strategic Alliances Based on the Example of Tradesmen Networks" at the Georg-August University in Göttingen in 2001. The main focuses of his work are strategy consulting, knowledge management in companies and networks, staff and organisational development, team development and individual coaching of executives, supporting change processes, analysis and reorganisation of participation and empowerment processes and training on the subjects of project and time management, creativity, systematic management, change management, network and knowledge management, qualifying people for participation, and overseeing work processes.

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Tags: Engineers Without Borders Challenge, Sustainability, Problem-Based Learning

Abstract

The twenty-first century is highly influenced by globalization, climate change and an increasing dependence on technologies. Education in general needs to foster these trends, but especially engineering education needs to impart knowledge about the necessity and the possibilities of sustainable development to students. The Engineers Without Borders (EWB) Challenge offers an innovative opportunity to integrate sustainability into engineering curricula. Although the EWB Challenge is well established in other countries, RWTH Aachen University is the only university in Germany that has implemented the EWB Challenge into the engineering curricula so far.

This paper aims at presenting the process of implementing the EWB Challenge in Germany. In the course of this implementation, the concept was evaluated with the help of a standardized questionnaire; an overview of the results gained from this evaluation is provided in this paper as well. The evaluation served to gain diverse information e.g. about the perception of the challenge in general, its impact on the amount of knowledge gained by the students, and also about the challenge's potentials for improvement. First analyses show, that the overall quality of the EWB Challenge at RWTH Aachen University was marked as "good". Asides from that, the analyses also indicate that the students most benefit from a great amount of gained knowledge and their improved ability to adapt technologies depending on the situational context and the underlying social and cultural structures. Yet, the results show that there are also aspects of the challenge-concept that need some improvement. One of these aspects is to enhance the students' awareness of the social responsibilities of engineers.

1. Introduction

The twenty-first century is highly influenced by globalization and an increasing dependence on technologies. Likewise, the global awareness about climate change and the importance of reducing greenhouse gas emissions has increased. To approach this 'era of sustainability' (Buys et al. 2013, 123) and its global challenges such as food or water issues, environment, energy or inequality it is necessary to use the benefits and opportunities arising from the impacts of globalization and rapid technology advances.

Engineering education needs to impart this knowledge. The defining problems of future engineers' careers will be rapid change, uncertainty and complexity (Mattiussi 2013, 1). To prepare future engineers to manage these problems and participate in the movement to achieve sustainability it is necessary to integrate concepts of sustainability into engineering education (Belu et al. 2016, 94, Boyle 2004, 147). Sustainability, in this context, means improving the efficiency of processes not only regarding criteria like cost-effectiveness and productivity but also environmental and social factors (Boyle 2004, 148). As this is a thoughtful multidisciplinary approach that includes considerations of economics, politics, quality of life and cultural and social norms, especially the scientific and technological education as well as higher engineering education at universities have to take on the responsibility teaching this approach (Belu et al. 2016, 94).

Although one might assume that there is a general consensus on this matter, incorporating sustainability into the engineering curricula turns out to be difficult (Buys et al. 2013, 123). This could be due to potential barriers that need to be considered when implementing the topic of sustainability into engineering education. According to Boyle (2004, 152) these barriers are a lack of textbooks, lack of examples, lack of time and of knowledge of sustainability among teaching staff as well as acceptance of sustainability by staff and maturity of students.

One opportunity to overcome these barriers is the EWB Challenge (Buys et al. 2013). For this reason, RWTH Aachen University started to develop a concept for implementing it in Germany. This paper aims at presenting the implementation-process of the EWB Challenge in Germany and the first results of an evaluation which was developed and undertaken in the course of it. The first part of this paper provides an overview of the general aspects of the Challenge and the most important facts about problem-based learning (PBL), which are the theoretical background-concepts of the German EWB Challenge. In this part, the paper also provides information on how the Challenge was implemented at the RWTH Aachen University. In its second part, this paper addresses the evaluation concept of the EWB Challenge and illustrates and discusses the results that have been gained so far. In the end a conclusion and an outlook are given.

2. Background-concepts of the lecture

2.1 The EWB Challenge worldwide

The students‘ task within the EWB challenge is to develop sustainable solutions that may actually be implemented in the developing countries by EWB (Cutler, Borrego, and Loden 2011). Students participating in the Challenge are provided with information by EWB on existing problems developing countries are coping with such as energy supply, sanitation and transportation. The concept was first developed in Australia by the Engineers without Borders Association (EWBA) with 24 universities participating in 2007. Since then it has become an integral part of the Australian university program with over 18,000 students from 31 universities participating in the Challenge (Cutler, Borrego, and Loden 2011).

The idea behind the Challenge is to get students to work on real-life problems from the field of development cooperation and devise their own solutions to these problems by using their own technical/engineering backgrounds. To this end, each year, technical development areas and structural problems of specific regions in developing countries are identified and presented to the students. The students' task then is to research on their topic and work out a lasting and feasible solution. EWB, in close cooperation with the local population of the country of destination, will then work on implementing the most promising concepts. In addition to the practical application of engineering knowledge, the students are also able to develop their communication skills, work in multidisciplinary teams and gather knowledge about the engineering design process as well as about globalization (Stappenbelt and Rowles 2009, 2). As per a judgement of the community-organization as well as senior academics and engineers from the industry, the country's best projects are chosen to take part in the national Challenge competition at the end of the course (Buys et al. 2013, 124).

2.2 The concept of Problem-based learning

Embedding the students' learning processes into real-life problems, the EWB Challenge is one typical example for problem-based learning (PBL). The notion of PBL has been developed by medical educators in the 1970s and has been adopted in other educational fields in the 1990s. Since the concept "changes the nature of teaching and learning" (Allen, Donham, and Bernhardt 2011, 27) it is popular and well-known among instructors, lecturers and teachers of different disciplines and institutions. Hung et al. even define the notion of PBL as "perhaps the most innovative pedagogical method ever implemented in education" (Hung, Jonassen, and Liu 2008, 2).

The concept of PBL is used to enhance learning by asking students to solve problems. In contrast to traditional approaches, the main goal of PBL is to guide groups of students to find their own solution for a given realistic problem of a certain complexity (Allen, Donham, and Bernhardt 2011, Hung, Jonassen, and Liu 2008, 4). By using "triggers" from the given problem the students define their own learning objectives (Wood 2003). Teachers and lecturers of PBL approaches are facilitators supporting the group and reasoning processes, but they do not provide direct answers to students' questions. They guide the students, but they do not disseminate knowledge (Hung, Jonassen, and Liu 2008, 5). This reflects the student-centeredness that is typical of PBL. Moreover, a course using the didactical concept of PBL is self-directed, self-reflected and problem-focused (Hung, Jonassen, and Liu 2008, 4).

The purpose of PBL is not only to increase the students' knowledge about a given topic but to also make them gain experiences in fields like communication, teamwork, problem solving, independent responsibility for learning as well as sharing information and respect for others (Wood 2003). In view of this, it is evident that the EWB Challenge clearly is an example for PBL. A list of generic skills and attitudes PBL enhances is provided in figure 1. PBL is a teaching concept that combines both, content-related and generic knowledge acquisition. As it constitutes an effective approach to impart knowledge in a coherent and comprehensive way and integrates the students by letting them set their own learning goals it is also considered a suitable method for motivating and encouraging students (Wood 2003).

Generic skills and attitudes

- Teamwork
- Chairing a group
- Listening
- Recording
- Cooperation
- Respect for colleagues' views
- Critical evaluation of literature
- Self directed learning and use of resources
- Presentation skills

Figure 1: Generic skills and attitudes PBL enhances (Wood 2003, 328)

3. The EWB Challenge in Germany

Although the EWB Challenge is well established in other countries, RWTH Aachen University is the only university in Germany that has implemented the EWB Challenge into the engineering curricula so far. Since 2013, when it was integrated for the first time, the EWB

Challenge has been continuously performed and evaluated in two different lectures at RWTH Aachen University with a close cooperation with “Ingenieure ohne Grenzen e.V.” (Engineers Without Borders, Germany).

3.1 Implementing a new teaching concept

The EWB Challenge at RWTH Aachen University is included in the project ELLI “Excellent Teaching and Learning in Engineering Sciences”. The idea of this project is to develop innovative teaching and learning concepts for the engineering sciences so that the professional competences of (future) engineers may be enhanced. Therefore, in the beginning of the implementation-process, the aim of the German EWB Challenge was to generate a “teaching concept with added value” by integrating real problems of development cooperation into university courses. The teaching concept was meant to enable students to get their own solution concepts implemented in disadvantaged regions in developing countries and thus make a contribution to the sustainable development of these regions.

In order to achieve this, the EWB Challenge is based on four general frameworks. First of all the range of the relevant topics needs to be large enough to allow the students to choose between different tasks and work self-initiated. Secondly, by participating in the EWB Challenge, students, as (future) professional engineers, should be made to reflect on their responsibilities to encounter the issues addressed in the introduction of this paper. Therefore, all of the given topics must be linked to the contents of an engineering study program, but need to be tackled interdisciplinary: the important competency of social responsibility, which also plays a major role in later professional life, is trained as students are required to act socially responsible and also behave conscious with regards to economy and ecology. Thirdly, through problems taken from a real-life context, the students are trained to understand the influence their work could have on the respective regions and they also learn how to adapt technologies to the respective situation as well as the cultural and social structures. Fourthly, the participation in the Challenge aims at improving the students’ team-working skills, their professional communication skills and their presentation-skills. In order to meet these frameworks, the lecture was developed by using the didactical concept of PBL.

Ever since the first launch of the Challenge, lecturers in engineering sciences at RWTH Aachen University are regularly encouraged to include the format into their lectures. Numerous phone calls, visits at institutes and e-mail contacts served to raise the prospect of other German professors participating in the Challenge. As a result of these efforts, the project coordinators just began working on a concept to introduce the Challenge to another German university.

3.2 The process of an EWB run

The first year of the implementation process was primarily used for the project‘s organization and planning. For this purpose, there was a close cooperation with the cooperation partner’s headquarter in Berlin. The results of this cooperation were a detailed plan of the project-structure, including a goal-setting, work packages, milestones and responsibilities for each following project run. A logo was designed as well (see figure 2). In addition, the partner organization – MAVUNO Project in Tansania – for the test-run as well as for the first official run was identified. The test-run took place in the winter term 2012/13. Since the class, in which the Challenge took place for the first time, is an interdisciplinary course for different master’s programs, the participating students were enrolled in their master’s, different to e.g. the Australian Challenge-concept. The task of the students was to develop an isolation- and room concept for a depot in a designated-area. In a final presentation at the end of the winter term, the teams presented their concepts to an interdisciplinary jury consisting of professors, lecturers as well as experts of EWB. In an online forum that was specially created for the EWB Challenge, the students were able to communicate with each other and ask Challenge-related questions directly to the experts of EWB.

Figure 2: Logo of the German EWB Challenge

In the second project-year the project team was able to benefit from the insights gained from the pilot-run. Under a close collaboration with EWB and MAVUNO, relevant problem-areas were identified during an exploration-trip to Karagwe in Tansania. The main topic for the first official run of the project in winter term 2013/14 was the support of the building of a girls’ boarding school in the village of Chonyonyo. Under the slogan “Back to school”, the students developed solution-concepts in the working fields “crusher for feeding biogas plants”, “cooling”, “efficient aquifer” as well as “mobile information system for capturing agrar-information”. In this winter term, three classes participated in the Challenge.

The Challenge of the winter term 2014/15 was conducted in close cooperation with UNICEF, a further partner, and it was titled “Build-Learn-Play. Development of a child-friendly model school in Burundi”. The students worked on preparing training material for the acoustic and equipment-technical optimization of the classrooms and for the technical-didactic design of the external school activity. They also developed a hygiene-monitoring-concept.

Under the title “Building the future. Safe homes for Nepal” the students of the Challenge 2015/16 were focusing on the reconstruction in Nepal after the devastating earthquake in the spring of 2015 had taken place. The students particularly worked on developing concepts for the optimization of existing emergency shelters as well as on earthquake-proof building.

The Challenge of the winter term 2016/17, which was running during the publication-process of this paper, was about cooking and heating efficiently in rural areas of developing countries.

The procedure of the Challenge was developed in the first project year and has been used and improved ever since: by communicating with local partners in developing countries, existing problems are identified by EWB and the project coordinators. Since the groups of students need to be interdisciplinary, the course, the Challenge is integrated in, is interdisciplinary and open to a range of diverse master courses. So far, students from diverse engineering fields like civil engineering or environmental engineering have been participating, but also students who study natural sciences such as biology and students who study social sciences like political sciences have become participants of the Challenge. During a kick-off at the beginning of the term, the students are introduced to the concept of the EWB Challenge and the underlying tasks are presented to them. Through the Challenge booklet and the fact sheets as well as the presentation on the project website, the given problem is visualized for a better understanding. The students then get the chance to work in teams to develop solutions for the given issues, all the while being able to communicate via the online forum with other teams and the experts of EWB. In a final presentation at the end of the term, the concepts are presented and the students get their marks and credit points. Finally, the presented and chosen concepts are taken to the respective developing country by EWB. This process of a typical EWB run is shown in figure 3.

Figure 3: Typical process of an EWB run at RWTH Aachen University

3.3 Interim conclusion

In the terms 2013/14, 2014/15 and 2015/16, the concept of the EWB Challenge and its implementation at RWTH Aachen University were evaluated. The following chapters aim at presenting the methodical basis of this evaluation as well as first results and their discussion.

4. Method

For the purpose of the Challenge's evaluation, a standardized questionnaire, consisting of a total of 17 statements, was developed. Since the course, in which the Challenge is integrated in, is held in German, the original questionnaire is in German as well. For the purpose of this paper, however, the questionnaire was translated and can be found in table 1. All statements in the questionnaire except for the last one are based on a five-point Likert-scale (1 = disagree, 2 = rather disagree, 3 = neutral, 4 = rather agree, 5 = agree). The last statement, which asks of the students to grade the Challenge, is based on a grading-scale ranging from 1 ("sehr gut" = excellent) to 6 ("ungenügend" = insufficient).

1.	I gained a good insight into development cooperation
2.	I could improve my project working skills
3.	I was able to learn to adapt technologies to the given situation as well as to the cultural and social structures
4.	I see disadvantaged regions from a perspective different to the one before the Challenge
5.	I have the feeling that I was able to actuate sth. and helped to increase the quality of living for someone
6.	I was able to make use of my knowledge that I acquired during my studies
7.	I cooperated with other groups through the forum
8.	The info booklet as well as the information on the website, helped me to finish the task
9.	I was pleased with the supervision of the EWB expert in the forum
10.	I became aware of the social responsibility of professional engineers in the framework of the Challenge
11.	I became aware of the characteristics of intercultural collaboration
12.	I learned to better evaluate the influences with regard to disregarded regions
13.	The practical orientation of the seminar increased my anticipation for working as an engineer
14.	I would like to continue to support development cooperation
15.	My presentation skills have improved
16.	The requests and comments of the expert committee supported my learning process
17.	I would grade the overall quality of the EWB Challenge with a…

Table 1: Standardized questionnaire to evaluate the EWB Challenge at RWTH Aachen University

5. Results

Over the years, the Challenge was evaluated by 54 students in total (term 13/14 n = 32, term 14/15 n = 10, term 15/16 n = 12). The overall quality of the EWB Challenge at RWTH Aachen University (statement 17) was marked as 2.3 (good). In the following, the results of the statements 1, 2, 3, 5, 7, 10, 11 and 13 will be discussed in detail. These are the points that best reflect the concept of the Challenge and its ability to implement the idea of sustainability into the curriculum. These results are shown at the end of this chapter (figure 6). Overall, the highest ratings can be found for statement 3 “I was able to learn to adapt technologies to the given situation as well as to the cultural and social structures”. 81% of all students affirm that they gained knowledge concerning the adaption of technologies to the relevant situation based on the underlying social and cultural structures (rather agree + agree).

Statement 2 “I could improve my project working skills” was rated good as well with 72% of all students (rather) agreeing. This number shows that for almost three quarters of the participants the presented Challenge-concept provided the opportunity to gain knowledge in the field of project-related working.

Furthermore two-thirds (63% rather agree + agree) of the participating students state that they got insights into intercultural collaboration (statement 11).

Similar to these positively answered statements, statement 1 was rated highly by the students. 69% of them (rather) agreed that they were able to get a good insight into development cooperation. But here a slight shift appears: In the first run of the Challenge 2013/14, this statement (statement 1) was only answered positively (rather agree + agree) by 47% of the students, while 31% stated that they were not able to get a good insight (rather disagree + disagree, cf. figure 4). In consequence of that result, the focus in the following two Challenge runs was to further enhance development-cooperation skills. In view of the numbers of 2014/15 and 2015/16 (both 100% rather agree + agree), it can be concluded that the efforts that have been made in this respect have been fruitful.

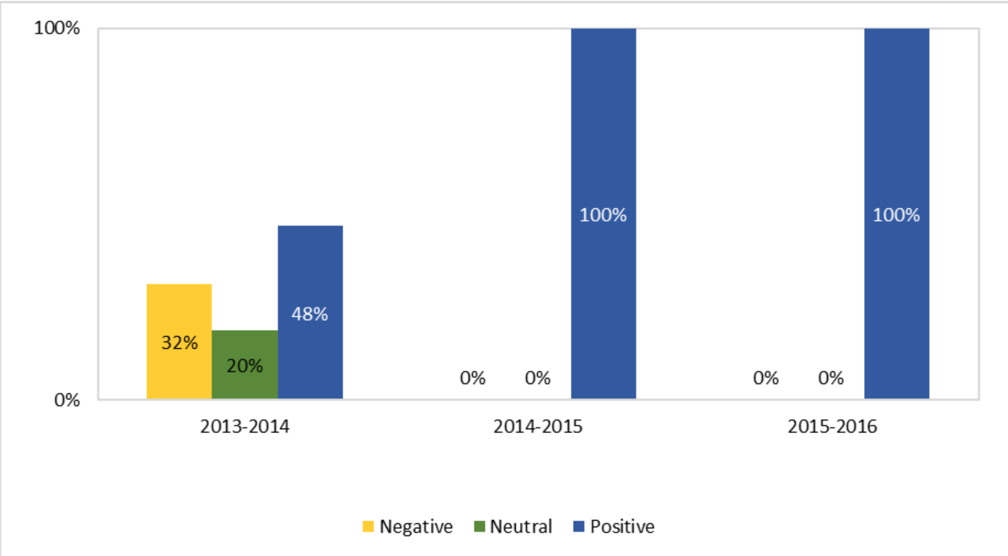

Figure 4: Positive development of the results for Statement 1 “I gained a good insight into development cooperation” over the three project-runs

Similar to statement 1, statement 10 “I became aware of the social responsibility of professional engineers in the framework of the Challenge”, in the first project year, was rated marginally lower than in the following two years. In 2013/14 the majority of the students (44%) answered neutrally when confronted with the statement that they became aware of the social responsibility of professional engineers, while in 2014/15 60% (rather) agreed with the statement and in 2015/16 that number increased to 67% (cf. figure 5).

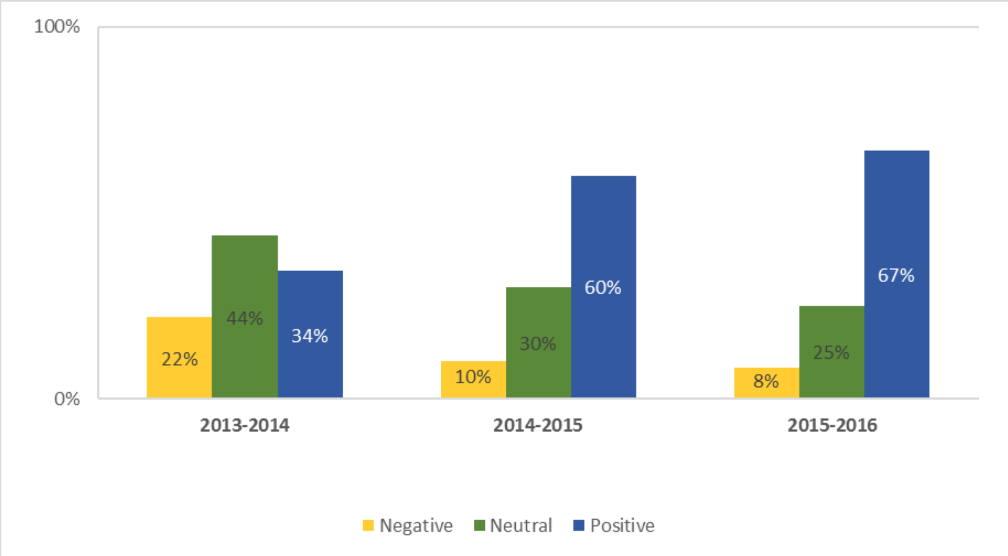

Figure 5: Positive results for Statement 10 “I became aware of the social responsibility of professional engineers in the framework of the Challenge” over the three project-runs

According to the results of statement 5 “I have the feeling that I was able to actuate sth. and helped to increase the quality of living for someone” 48% of all students did not get this specific feeling. This shows that only a minority (22% positive, 30% neutral) of the Challenge’s participants felt like they were working not only for themselves but also for somebody else.

A further result which needs to be pointed out is that only half of the students (44%) (rather) agree to statement 13 “The practical orientation of the seminar increased my anticipation for working as an engineer”, while 20% (rather) disagree (33% neutral and 3% abstention).

The lowest rating can be found concerning the use of the online forum for cooperation with other student-groups. Only 7% of the participating students (rather) agree on using it (statement 7 “I cooperated with other groups through the forum”).

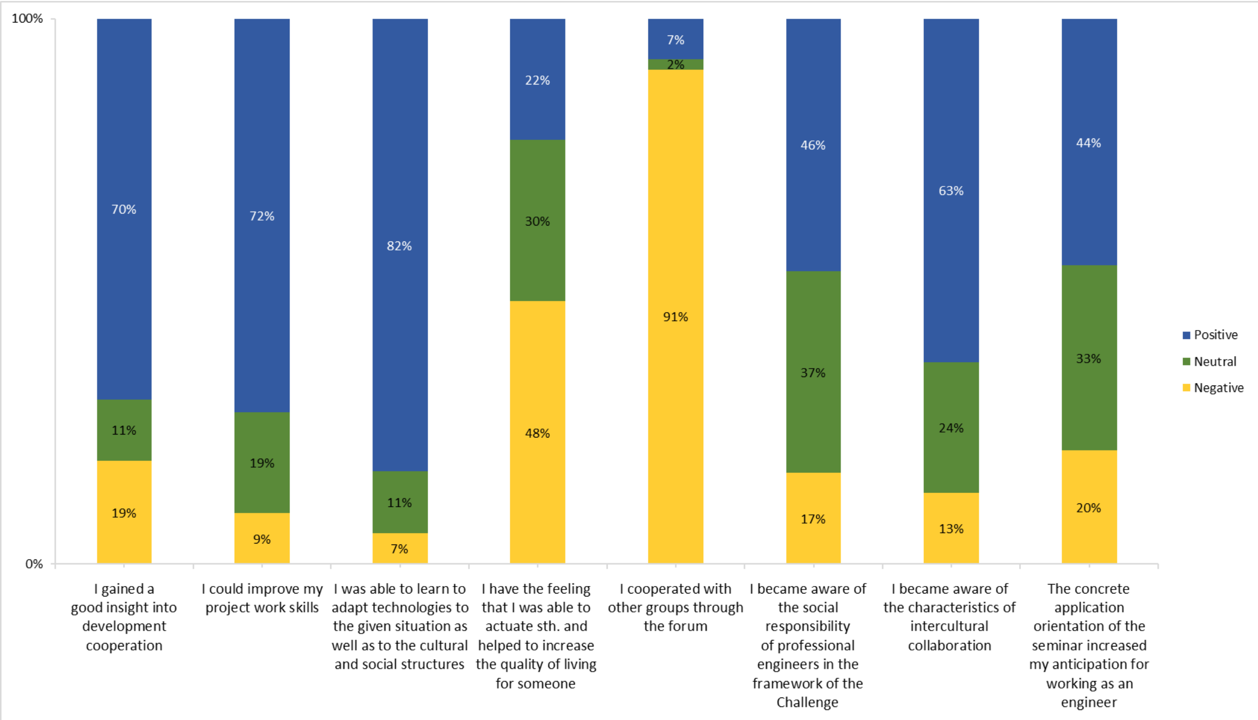

Figure 6: Results of selected statements 1, 2, 3, 5, 7, 10, 11 and 13 over all time periods

6. Discussion

The presented results indicate that the greatest benefit for students is the gained knowledge of adapting technologies to the relevant situation and with that taking into account the underlying social and cultural structures. Possibly, this result can be affiliated to the fact that the lecturers of the EWB Challenge at RWTH Aachen University and the experts of EWB Germany put a strong focus on imparting knowledge on technology assessment: Using technologies in developing countries always requires a high level of respect for the ecological as well as social limits. Against the backdrop of the needed awareness of sustainability, knowledge on technology assessment is important. This result shows the suitability of the EWB Challenge to impart knowledge on technology assessment and sustainability.

The numbers of statement 10 “I became aware of the social responsibility of professional engineers in the framework of the Challenge” increased over the years but still do not reach more than 70% of (rather) agreement. These numbers indicate that there still is potential for the EWB Challenge to increase the awareness of engineers’ social responsibilities. Possibly, there is a connection to the results of statement 5, which makes clear that the majority of students did not feel like helping to increase the quality of living for someone. Increasing the awareness of the students’ social responsibility as engineers could also be a potential way to strengthen the feeling of actually helping somebody else, as the students are made more aware of what they can and should do for others. One possible way to achieve this could be the stronger integration of the students in the implementation-process of their concepts in the respective developing country. So far, the students are only being informed about the implementation of their concepts and solutions through some photos on the website. This rather indirect providence of information is mainly due to the fact that the concept-implementations take place after the semester, i.e. when the EWB class has already finished. One way to further strengthen the students' commitment to the EWB Challenge and its tasks in the future, could be to protocol the implementation of the concepts by taking photos or videos and send them to the students directly. Another possibility could be to interview the inhabitants of the respective regions and ask them about their views on the concept-implementations. The interviews could then be presented to the students (e.g. via a newsletter) and thus allow them to get an insight into how the concept was received in the developing country.

The less positive numbers of statement 7 "I cooperated with other groups through the forum" could be due to the fact that the students do not use the online forum of RWTH Aachen University in general; they might use it for downloading documents only but not for communication. To gain definite insights in this regard, a survey of the students' general user behavior of the online forum would be necessary. Another possible explanation is that there was no need for the students to communicate with other groups, because they felt that all agreements were made beforehand and content related questions were already asked and answered in class. In order to know if this was indeed the case, questions such as "During the term, I exchanged a lot of ideas with participants of other groups and communicated much" need to be added to the questionnaire in the future. To this point, it is not clear if the forum is just not popular enough among the students or if it is not perceived beneficial enough to be used (in this case, it would be necessary to ask why).

Overall, a lot of aims set by the project coordinators were accomplished by the concept of the German EWB Challenge, like e.g. that it helped the students to improve their intercultural collaboration skills. The students also gained knowledge in the field of development cooperation and became more acquainted with working project-related and self-initiated. The students especially enjoyed working on a real life problem. This was especially indicated through qualitative feedback the participating students provided to the lecturers at the end of different Challenge-runs. They appreciated that, different to the regular university context, they got the chance to work on a real project where they can actually apply their knowledge. Still, some students also pointed out how rare this teaching concept in the university context is. They e.g. expressed that they were struggling during their projects, because they are not used to work on real world problems with little structure and a few possible solutions. In their previous classes it was rather common for them to work on problems which only have one possible solution and at the same time being given all the necessary information. This underlines the importance of establishing a teaching concept like the EWB Challenge since this is a suitable method to prepare students for their later working life but it is still not used regularly in the university context. Furthermore, the EWB Challenge helped the students to understand that sustainability means more than just environment. These results are also confirmed by former studies (Cutler, Borrego, and Loden 2011; Buys et al. 2013).

7. Conclusion and outlook

This paper aimed at providing an overview of the EWB Challenge's implementation at the RWTH Aachen University. Furthermore, the evaluation concept and its result were presented, as these are the first results of the perception of EBW Challenge of students in Germany. As a typical example of PBL, the EWB Challenge does not only enhance generic knowledge like team work and communication skills but it also increases content-related knowledge. In particular, it increases the students' awareness of sustainability in diverse international contexts. Therefore, the EWB Challenge was chosen as a suitable method to be implemented in German engineering education and was launched at the RWTH Aachen University in cooperation with EWB Germany in 2013. The challenge-procedure was developed and set in the first two project years and since then the Challenge has been conducted accordingly.

RWTH Aachen University is the only university in Germany that has implemented the Challenge so far, therefore there is no nation-wide Challenge competition like it can be found in Australia, for instance. Due to the fact that previous studies in other countries have shown that such a competition is a further way to increase the students' motivation (Cutler, Borrego, and Loden 2011), implementing such a national competition seems to be a suitable aim for the German EWB Challenge's future. Therefore, the introduction of the EWB Challenge to other German universities is on focus. Currently, efforts are made to extend the EWB Challenge to other German universities.

First results of the evaluation of RWTH Aachen University's EWB Challenge concept reveal some points that can still be improved. One possible way to increase the awareness of the students' social responsibility and at the same time give them the feeling they increased somebody else's quality of life could be to integrate the students more in the implementation process of their concepts. This integration could be strengthened by EWB e.g. by providing more photos of the implemented student-concepts in the respective developing countries. Asides from that, the questionnaire needs to be extended with regard to the students' usage of the online forum. Nevertheless, the results show the positive perception of the EWB Challenge as well. They indicate that the greatest benefit for students is the acquired ability to adapt technologies to relevant situations based on underlying social and cultural structures. The Challenge-organizers' increasing efforts of focusing on development-cooperation reflect in the fact that the overall majority of the participating students now affirm that they were able to get a good insight into development cooperation.

The participation in the EWB Challenge gives students the opportunity to understand the importance of gaining knowledge about all aspects of sustainability. Due to the fact that nowadays sustainability highly influences our world, the twenty-first century is described as the "era of sustainability". Engineering education needs to foster this concept and impart knowledge about dealing with it to future engineers by conducting innovative teaching approaches like the EWB Challenge, for instance.

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