GP124/abs078

Are students competent, active and constructive partners in the improvement of teaching and learning? A text analysis of contributions to idea contests

Katharina Schuster (Katharina.Schuster@ima-zlw-ifu.rwth-aachen.de), Ursula Bach (Ursula.Bach@ima-zlw-ifu.rwth-aachen.de), Anja Richert (Anja.Richert@ima-zlw-ifu.rwth-aachen.de), Sabina Jeschke (Sabina.Jeschke@ima-zlw-ifu.rwth-aachen.de)

Institute Cluster Department of Information Management in Mechanical Engineering (IMA), Centre for Learning and Knowledge Management (ZLW) and Associated Institute for Management Cybernetics (IfU), RWTH Aachen University, Germany

***Abstract**:*

In the Competence and Service Centre TeachING-LearnING.EU students are involved in the improvement of teaching and learning using the strategic instrument of OpenBologna. It is based on the concept of Open Innovation developed and used by companies in the business sector to integrate customers actively in new product developments. The main methods within this strategic instrument are idea contests and lead student workshops.

This paper presents the main results of the first three idea contests, in which 80 ideas were submitted in total. With the method of qualitative content analysis, the students' e-mails through which they submitted their ideas are investigated on a deeper level. As a result, the paper shows if students can be considered competent, active and constructive partners in terms of the improvement of teaching and learning. Moreover, it points out those areas in which the students see the biggest need for action. Since most ideas were submitted to the topics of virtual learning environments, organization/resources and digital technologies in lectures, the results of these topics are presented elaborately. The authors come to the conclusion that especially in the areas of virtual learning environments and digital technologies, students deliver a valuable input for the improvement of teaching and learning in engineering education.

Introduction

Student involvement in the improvement of teaching and learning has many advantages:

- It can foster the students' general engagement in higher education by giving them a voice and strengthening their lobby.
- It brings up ideas that have never been thought about of those who usually shape the content and the didactical principles of engineering education (Schuster et al. 2011).
- It can happen on a micro level via lecture evaluation or it can be integrated in a deeper framework. (Schuster et al. 2010). Therefore it is a flexible instrument of higher education management.

In the light of the Bologna Process, the involvement of students is of high relevance. In 1999, the European Ministers of higher education among others set the goals of harmonising the European higher education area, promoting the mobility and fostering the employability of European citizens

(European Ministers of Education 1999). Although not mentioned yet in the Bologna declaration, the topic of student involvement came up only two years after the bologna declaration. The Prague Communiqué of 2001 states:

> "Ministers stressed that the involvement of universities and other higher education institutions and of students as competent, active and constructive partners in the establishment and shaping of a European Higher Education Area is needed and welcomed" (European Ministers of Higher Education 2001).

In 2010, when the European Higher Education Area was launched, it was stated in the Budapest-Vienna Declaration:

> "We note that adjustments and further work, involving staff and students, are necessary at European, national, and especially institutional levels to achieve the European Higher Education Area as we envisage it" (European Ministers of Higher education 2010).

Within the Competence and Service Centre of Teaching and Learning in Engineering Sciences (known as TeachING-LearnING.EU) students are actively integrated in the research topics. The main goal of TeachING-LearnING.EU is to tackle the challenges brought about by the Bologna Process within the field of engineering education. Examples are to increase the employability of students, to design new teaching and learning concepts or to develop higher education didactics for lectures with large audiences. The strategic instrument for student integration is called *OpenBologna*. It is based on the concept of *Open Innovation*, developed and used by companies in the business sector to actively integrate customers into new product developments.

In this paper we want to pick up on the statement of the European ministers of higher education in the Prague Communiqué. Therefore it will be analyzed on a deeper level, if the students are competent, active and constructive, in terms of the improvement of teaching and learning. The paper depicts the principle of the main method of the strategic instrument *OpenBologna*: the idea contest. It presents the results of a text analysis that has been carried out with all contributions within the first three idea contests of TeachING-LearnING.EU. The methodology of qualitative content analysis is explained on the basis of this case. The paper closes with a discussion of the results and forecast on further research questions.

OpenBologna - student involvement on an operative level

In order to give the reader a better insight which actions *OpenBologna* encompasses, the strategic instrument is described briefly:

The method of idea contests is already spread widely within different contexts. Many idea contests focus on innovative solutions for general business or engineering problems. Often they are connected to a virtual platform (e.g. www.innovationchallenge.com, www.makeitso.org). The German Initiative for Network Information (DINI) focused on the technical infrastructure of universities. So far they called out two student idea contests to the topics "Lively learning environments" and "Student networks" (DINI 2012). The idea contests in TeachING-LearnING.EU focus on topics around the improvement of teaching and learning especially in engineering education. Similar to open innovation, where customers are seen as the experts for the products they buy, students are considered to be experts for how they learn best (Schuster et al. 2011). Each semester TeachING-LearnING.EU calls out an idea contest. By awarding the best three ideas with a prize, the students are motivated through extrinsic incentives. The idea contests have always been sponsored by well-known companies (e.g. Bosch, Hilti, Philips). Moreover, the idea contests give students the chance to influence the learning environments and settings within their field of study which the university offers them. A transparent presentation of which ideas are already being implemented can be found on the website of TeachING-LearnING.EU. The competence and service centre continuously looks for partners amongst the teaching staff who want to "adopt" an idea and who want to implement it in his or her university or lecture. This aspect appeals to the intrinsic motivation and the engagement of the students.

In addition to the idea contests, TeachING-LearnING.EU uses the lead user approach. Lead users are individuals that are experiencing needs ahead of the market trend and are at the beginning of the innovation process (Churchill et al. 2009). In the case of *OpenBologna*, TeachING-LearnING.EU looks for engineering students who are interested in the development of teaching and learning. These students are identified by the idea contests or by their extracurricular activities, e.g. in student associations or as student representatives in University Boards and commissions. In workshops, the lead users or lead students as they are called within the project, develop more elaborated concepts for

engineering education. The whole process of *OpenBologna* is visualized in Figure 1. Since the procedure and the outcome of the lead student workshops are quite different from the idea contests, this paper focusses on the latter.

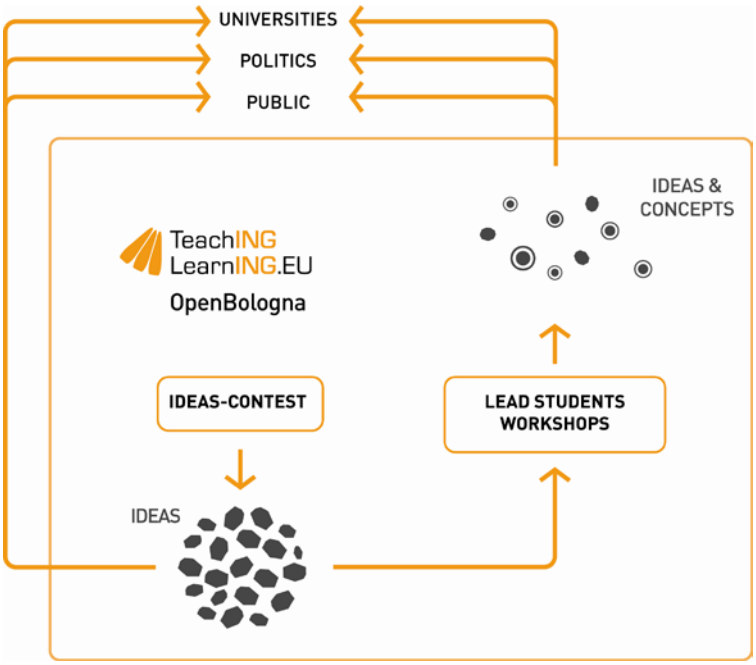

Figure 1 Illustration of the strategic instrument OpenBologna of TeachING-LearnING.EU

TeachING-LearnING.EU called three idea contests so far. The first one had the title '*Tweak your bachelor!'* and dealt with the question on how to improve teaching and learning in engineering education. The second contest was called *'Good teaching 1000+'* and covered the subject of large class management and how it can be improved. For a deeper analysis of this specific topic see Stehling et al. 2011. In the third idea contest, the students had to turn in proposals on how to give engineering education more practical relevance. The title of the third contest was *'Theoretically I can…'*.

In the first three idea contests, a total number of 80 ideas had been handed in from 69 students (see *Figure 2*). It has to be noted that in the third idea contest, a whole course of 34 participants submitted one idea. The ideas were judged by the criteria of quality, practicability and effectiveness. The method of choosing the winners was as follows: Each idea that had been sent in was anonymized. All the team members of TeachING-LearnING.EU in Aachen had to pick the ten best ideas.

These top ten ideas were openly discussed within the teams in Aachen, Bochum and Dortmund. Each group had to select the three best ideas. Additionally each group had to nominate students who also had one vote. Out of these six votes, the three winning ideas were identified.

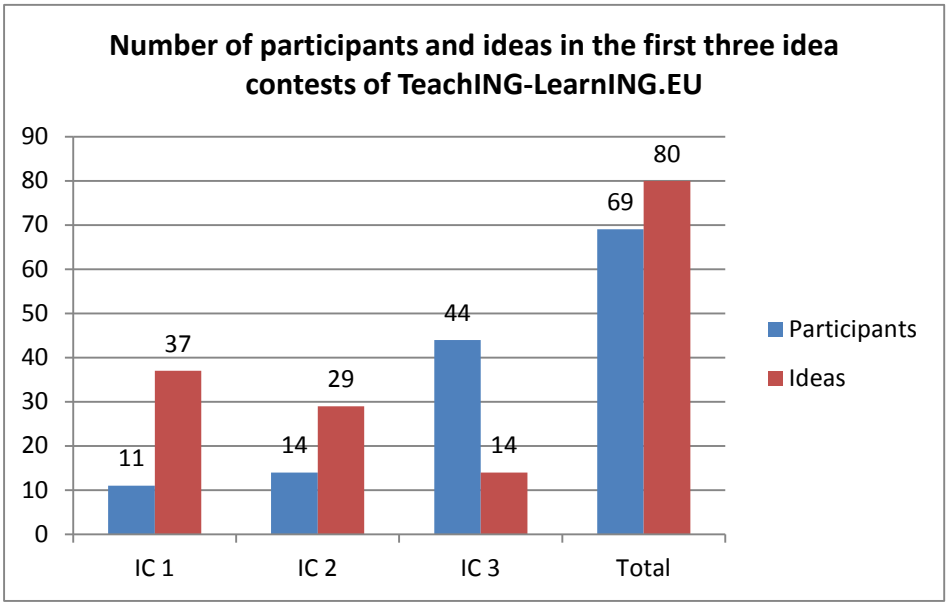

Figure 2 - Participants and ideas in idea contests of TeachING-LearnING.EU

The results of the analysis of the first three idea contests of TeachING-LearnING.EU help to validate the view of students as competent, active and constructive partners in the improvement of teaching and learning. They moreover help to measure the effectiveness of the strategic instrument *OpenBologna*. The research questions of this paper will be introduced within the description of the methodology used.

Methodology - Qualitative Content Analysis

The submissions of the first three idea contests were analyzed with qualitative content analysis. It is not the claim of qualitative content analysis to be representative for the population. Instead, the quality criterion of qualitative research is intersubjective traceability. In general, the method helps to understand, not to explain human behavior. Qualitative content analysis is a method to understand the single steps, that later lead to the interpretation of results (Mayring 2008).

Other than quantitative content analysis, which is used to put frequency distributions of certain information, qualitative content analysis examines the information for its mere content (Mayring 2008). The analysis described in this paper uses the approach of Jochen Gläser and Grit Laudel (2004). For the preparation of the analysis, crude data is extracted from an already existent text. In this case, the e-mails of the participants of the ideas contests formed the text corpus. After the extraction, the data is being processed and finally evaluated.

Figure 3 illustrates the procedure of qualitative content analysis by Gläser and Laudel. In what follows its single steps will be explained. The researchers who were involved in the analysis of the data have not been involved in the jury of the idea contests. The whole analysis was done in German language; the results were translated into English.

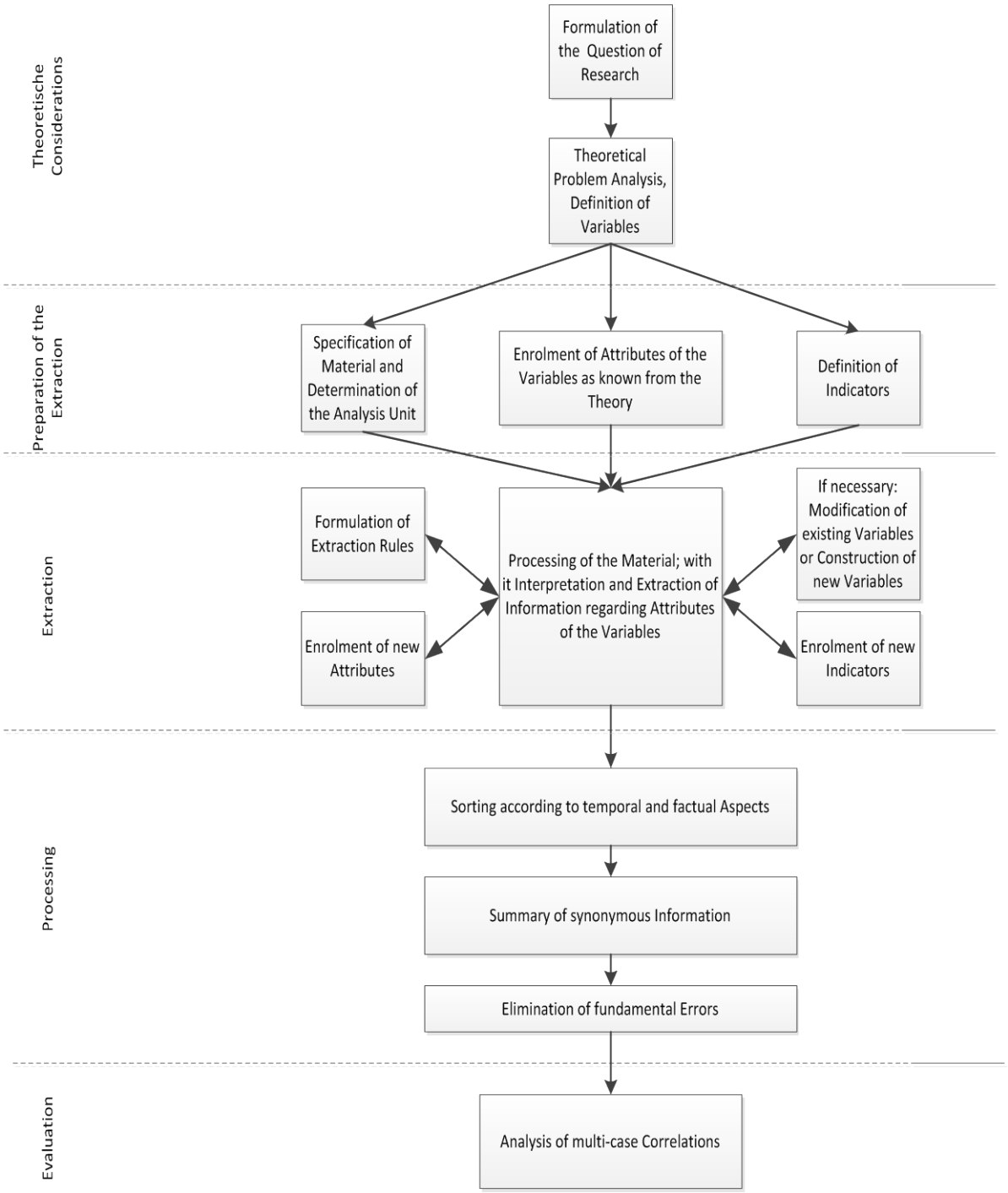

Figure 3 Process of the Qualitative Content Analysis (Gläser & Laudel 2004)

According to the statement of the European Ministers of Higher Education in the Prague Communiqué, the variables of the text analysis are 1. the competence of the students, 2. the activeness of the students and 3. the constructiveness of the students. When the ministers put forward the view of students as competent, active and constructive partners in the Prague Communiqué in 2001, they didn't specify these characteristics any deeper. In order to continue with the analysis, the variables have to be defined. The level of activeness can be revealed by the number of participants and the number of submitted ideas. These numbers have already been introduced and will be

discussed and put into context later on. In order to find out information about the competence and constructiveness, a definition of the terms is necessary.

The Oxford dictionary defines the term *competent* as “having ability, power, authority, skill, knowledge, etc. (to do what is needed)” (Hornby et al. 2005). In order to judge the competence of students to support the improvement of teaching and learning, we will compare the topics mostly contributed by the students to those currently discussed by the engineering education community. Moreover we will discuss the quality of exemplary ideas. This should serve as a first indicator to see if students have “what is needed” for improving teaching and learning in engineering education.

The term *constructive* is defined as “helping to construct; giving suggestions that help” (Hornby et al. 2005). For this exploratory study we will characterize students as constructive if they write about solutions for teaching and learning in a higher ratio than about problems of the current situation. After defining the variables, the corresponding three research questions are:

1. How much do the students write about solutions for teaching and learning? → information about constructiveness
2. To which topics do the students mostly submit ideas? Do they match the topics the engineering education community currently discusses? → information about competence
3. What do the students write about in these categories? → information about competence

The text corpus was generated from all e-mails which were sent in within the first three idea contests. The material was anonymized; greetings and good-bye-phrases were eliminated from the text corpus. The corpus consisted of a great amount of written data, in total 25 pages (Arial font, size 11, single-spaced, no breaks except lists of bullet points). The following analysis used the unit of paragraphs, as the other units seem too small for a proper interpretation (Gläser/Laudel 2004, p204).

To distinctly assign empirical phenomena to theoretical constructs during the extraction, the attributes of the different categories as well as indicators need to be determined previously. A more distinct overview of underlying variables attributes and indicators are shown exemplarily in Table 1. In order to answer research question number one, all parts of the text corpus have been allocated into the function-driven variables *problem*, *solution*, and *others*. In the contests students only had to turn in rough drafts of their ideas. Although the practicability of the idea is an important judging criterion, the students do not have to add an action plan for the implementation of the idea. While the descriptions of the problems refer to actual situations, the descriptions of solutions refer to hypothetical situations and their predicted consequences. Hence, the corresponding grammatical constructions served as indicators for the categories *problem* and *solution*.

Table 1 – Variables, indicators and linguistic markers for research question one

Category	Attributes	Examples	Indicators
Problem	Description of the current situation, explanation of resulting problems for students	“The problem is…”, “it doesn’t make sense that…”	Mostly use of present tense or past tense
Solution	Proposal of how to solve the problem, description of the solution, benefits and advantages, reference of experts to strengthen the argumentation	“It would help, if…”, “it would make sense, if…”, “imagine that…”, “I suggest, that…”, “I know from first hand, that…”, “my professor also likes this idea”	Mostly use of conditional clauses, use of future tense, use of imperative
Others	Introduction of the student, description of how student came to participate, appreciation for the initiative, metatextual elements	“I am…”, “my name is…”, “I study…”, “I hope it helps”, “I also want to contribute…”, “in the following I want to describe the problems”,	None specific

In order to answer research question number two and three, the text corpus has been divided again into three sub-corpora, one for each contest. All parts of the text corpora have been allocated into content-driven variables which are shown in figures 7-9. Because the table with all attributes, examples and indicators is very voluminous for the variables of research questions two and three, it does not appear in this paper.

After the extraction, the method for answering research question one was expanded by a quantitative element. The words that had been written in total in each variable-category were counted in order to measure the proportion. An interesting sub-question for research question one is if the quality of the idea correlates with the proportion of problem-related content and solution related content within the whole text. Therefore the whole analysis was repeated, but now only with the winning ideas. Since the winners of the third idea contest have not been nominated yet, only the e-mails from the first and second contest formed the text corpus.

To answer research question number two, all the ideas that have been submitted were sorted into the content related categories. Again, the qualitative part was expanded by a quantitative element. The number of ideas in each category gives a first impression which topics are the most important from the students' point of view. To answer research question number three, a deeper insight in the quality of the students' input was needed. For this reason the e-mails were extracted furthermore in the content-driven categories. Then, redundant information was eliminated and the content was summarized.

Results

The results of the frequency distribution of the function-driven categories are shown in *Figure 4.*

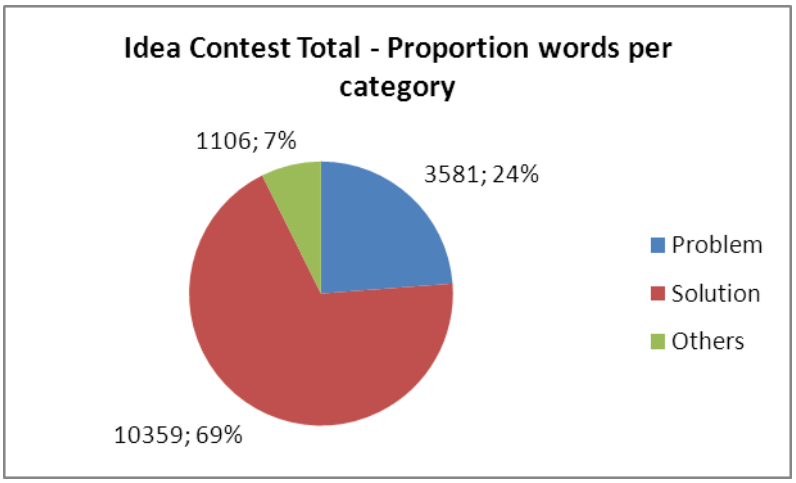

Figure 4 Idea Contests Total - Proportion words per category

Since more than two thirds of the e-mails in total focus on the solution and not the problem, the students can be characterized as constructive. However, the students whose ideas got nominated as one of the three per contest do not show any major difference in the composition of their e-mails (see *Figure* 55).

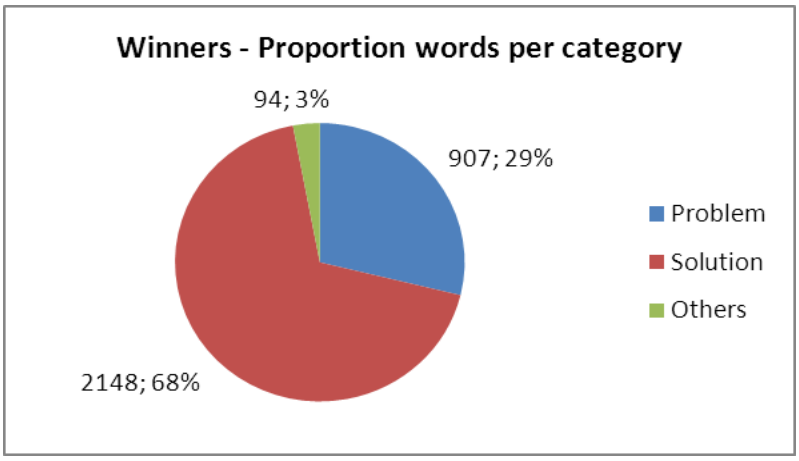

Figure 5 Winners - Proportion words per category

As we can see in figures 6-8, the students have submitted the most ideas to the topic of *virtual learning environments* (27 ideas), followed by *organization and resources* (14) and *digital technologies in lectures* (7 ideas).

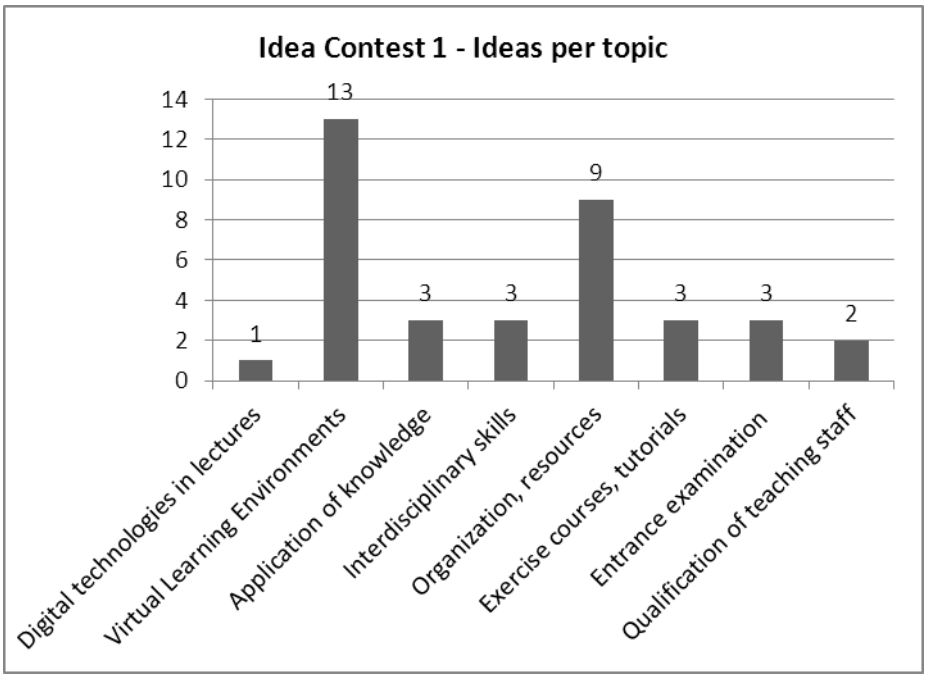

Figure 6 – Idea Contest 1 "Tweak your bachelor"– Ideas per topic

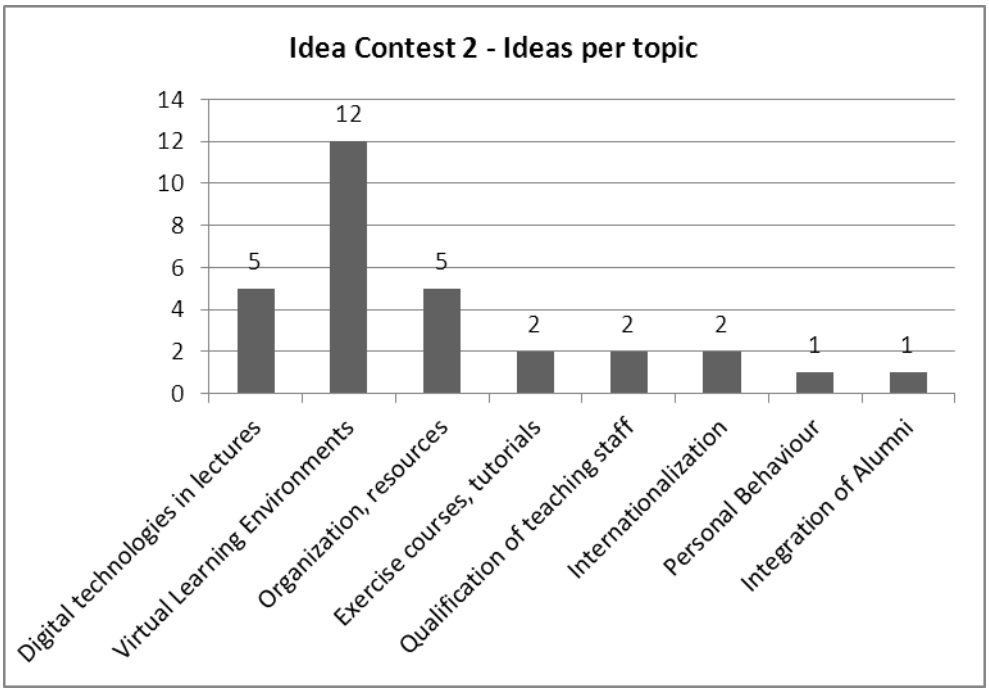

Figure **7** – Idea Contest 2 „Good Teaching 1000+"– Ideas per topic

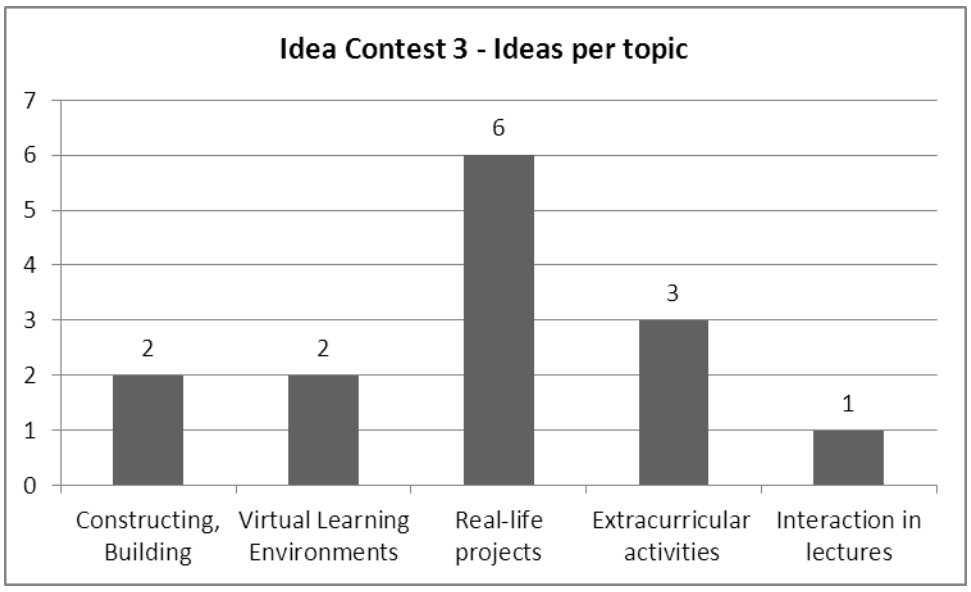

Figure 8 – Idea Contest 3 „Theoretically I can…"– Ideas per topic

The essence of the input the students gave to these topics is exemplarily presented in order to give an insight in the quality of the students' ideas and therefore their competence in terms of improving teaching and learning. The following passages only depict the students' argumentation and do not contain any judgment of the authors.

Virtual learning environments

In this field, the students drew a vivid picture of what universities of tomorrow could be like. The more basic ideas cover data bases e.g. for internships. Many ideas deal with information management systems for learning material. The digital accessibility of scripts, documents or slide of a lecture is

important to the students. They prefer a centralization of all online activities in one web portal instead of every chair using their own homepage to provide learning material. The material should be uploaded at a fixed point in time and should be ordered thematically, not chronologically or alphabetically. The students would like to have the opportunity to download many documents at once since the singular download of material is very time consuming. Evaluations of lectures or professors should also be run via the web portal. The students moreover set great value on the usability and the interface of the web portal. The welcome page should be personalized and should announce lectures or extracurricular events which could be of interest for the user.

From the students' point of view, the service side of such a web portal could have many more functions than simply providing material. One is to introduce characteristics of different learning types so the students can figure out which type they are. Thus, they can optimize their efficiency in learning. Another option is to introduce and to provide software that helps the students to learn and to study. Examples are a special flashcard software, e-mail programmes or simple Firefox-Add-ons. The flashcard software could also be used by teachers for the preparation of lectures by supplying the students with the central terms and their definitions they need for a specific lecture.

More interactive approaches put students in an active role who share their knowledge, help each other and creating content by themselves. On a website called "Uni-(Wiki)pedia" students could add content, connect it and communicate about it. They could also upload the material provided by their teachers in order to share it with each other. They could link video recordings, practice sheets with solutions and references. Thus, an easy and quick access to different approaches would be available. By looking at the communication threads, teachers could discover the biggest knowledge gaps. With this kind of learning portal, content of different faculties or even universities could be cross linked with no regard to institutional boundaries. Kids from school could use the website for orientation to find a degree programme that suits them.

Many ideas were about providing video recordings of lectures, especially in conjunction with large class management. Most stated advantages are the possibility to stop the video in between, to repeat parts which were difficult to understand and to reduce the number of students in the lecture hall, which results in better learning conditions (e.g. less noise and better air). The possibility to repeat the video was considered helpful especially for foreign students.

The lecture could also be streamed via internet, combined with a live chat. Students can watch the lecture from home or if they have a laptop basically from anywhere. They can then send their questions to a list which is also made public on a website. The professor's assistant can then answer the questions while the professor continues with the lecture. This helps the students to overcome their inhibition to ask a question in front of a lot of people. With a corresponding app, the students can also ask questions via their smartphones while sitting in the lecture. The virtual consultancy hour is yet another use case of the same idea. By displaying the questions and answers online, the professor or the assistant have to explain things only once. Virtual whiteboards could visualize their explanations.

The high quality of video recordings was also pointed out. Every university should have a professional filming team which produces high quality videos of crucial lectures. These videos could also be cross linked over universities on a video platform. Students can then communicate about the content and add their own material to it, just like in Uni-(Wiki)pedia. The role of video based content was also picked up in the form of a video contest for students. Professors can distribute topics of the lecture amongst the students at the beginning of the semester. During the semester, the students have to produce a video. The students can use animations, simulations, flip books or any other film technique.

The last field deals with the establishment of a social network just for students at one university. They can submit a minimum of general data such as sex, field of study and the semester they are in. An algorithm creates study groups of people in the favoured size, to the favoured study field or a specific lecture. The network provides online group work rooms but also inherits the possibility to book real existing physical rooms in order to meet face-to-face.

Organization and resources

The general suggestions in this field cover the students-to-staff-ratio. This concerns for example teaching staff, administration or course guidance. One student wished for contact persons for content-related issues, if for example the usual teaching staff cannot help with a problem that occurs in a lecture.

Another important aspect for the students is the exam phase. Many write their exams in the semester break and therefore have little time for recreation. Thus they suggest more room for leisure time between the last exam and the start of the next semester. Another proposal is to let students decide democratically over the dates of their exams, e.g. via scheduling tools like doodle. Having block release courses is another idea to help the students focus and therefore to concentrate better.

More space or the more efficient use of space for learning and studying is important, since many students can't concentrate very well at home. One approach is to capture every seat in e.g. libraries or study halls and display them on a digital platform. Students can log onto that platform and see where seats are still available. Then they sign on in that room and thus give notice that they soon will arrive in that room. Once they arrive, a staff member refreshes the status of available seats of the website. If someone leaves the room and doesn't come back after 30 minutes, the seat will be marked as available again.

For a better time management, it would be useful to be able to buy all the needed learning material needed for one semester at one location, e.g. the university's library. This system would work even better, if students could already order everything they need online in advance.

Regarding evaluation, it would help to have some binding guidelines like in quality management which are obligatory for every university. This national independent evaluation system could cover criteria like organization, outline of the course, articulation of the teacher, use of multimedia etc. Another idea is to let external agents visit unheraldedly and let them monitor and evaluate the lectures.

Digital technologies in lectures

Half of the ideas in this field encompass the equipment of lecture halls. To fit an auditorium with headphone connections would result in the fact that lecturers can be understood clearly by everyone. It would also minimize the general noise level. A special interface installed on each desk could support the interaction of the lecture. A so called idiot buzzer (short for **I did** n**o**t get i**t**) would give the students the opportunity to give instant feedback on the content of the lecture. The students strongly point out that this kind of system needs to be prepared for misusage. This could be realized by tracking the frequency of each button being used and blocking it, if it is used at an abnormal level.

With a simple website, teachers can perform quiz games in the lecture hall. It would be enough if the website provided buttons with a, b, c and d. The questions can then be put up spontaneously within the lecture or of course can also be prepared in advance. The students can log onto the website via their laptops or smartphones.

Two ideas deal with technical gadgets. One is about using green laser pointers, because they can be seen easier than red ones. Another covers the usage of smart pens, by teachers or by students. To be able to relate to the build-up of a mathematical equation or a drawing helps the students with their understanding process.

Discussion of results

At the beginning of this paper we opened up the question, if students are competent, active and constructive partners in terms of improving teaching and learning in engineering education. In order to judge the competence of students, we wanted to see if the topics of the students match the topics the engineering education community currently deals with. Therefore we scanned the programmes, topics and session themes of the following conferences in 2012:

- 119th ASEE Annual Conference & Exposition, San Antonio
- IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE), Hong Kong
- World Engineering Education Forum (WEEF), Buenos Aires
- 40th SEFI Annual Conference, Thessaloniki
- IEEE Educon, Marrakesh
- 4th International Symposium of Engineering Education (ISEE), Sheffield
- International Conference on Innovation, Practice and Research in Engineering Education (EE), Coventry

The topics of *virtual learning environments* as well as *learning technologies* appear very often on the programmes of these conferences. The exact terms and notions vary slightly. Sub-topics are e.g.

game based virtual labs, microcontrollers, tablet PCs (ASEE), online/e-learning, blended learning, computer-based learning, courseware technologies (TALE), educational technology in engineering (WEEF), Information and Communication Technologies (SEFI), IT's and Engineering Pedagogy (Educon), learning technologies - differences in the perceptions of students and educators (ISEE) or technology-supported learning (EE).

In the authors' opinion, the students' ideas within the topic *virtual learning environments* were the most innovative, like the video contest, and also easy to implement, like the virtual consultancy hours. This might be an indicator of new skills and interests of a generation of students who grew up with digital media, which older generations of teaching staff don't have. Various times it became clear that the students didn't consider learning in virtual environments as a substitute for studying in a brick-and-mortar university, but as a supplement. The ideas for digital technologies are mostly innovative, but also hard to implement like the interactive desks. Since *virtual learning environments* and *digital learning technologies* match the themes discussed by the engineering education community, the authors consider the students as competent partners in the improvement of teaching and learning in these two areas.

In the engineering education community, organizational aspects only appear rarely and if, on a more strategic level. It is referred to as curriculum development and quality assurance (SEFI), accreditation and regulations (ISEE) or leadership and administration (TALE). The ideas in the topic organization and resources were rather common and simple and in parts reproduce a one-sided view, like simply demanding more personnel.

As we have seen, students can definitely be considered as constructive partners. Only very few exceptions took the chance to criticize the whole university system. As almost three quarters of all the e-mails consist of solution-oriented text, this characteristic has proven right within this study.

Compared to other online engineering idea contests such as the Australian Make it so Campaign in 2010, where nearly 7000 ideas were submitted within 12 weeks, the participation rate seems devastatingly low. One big difference is that on www.makeitso.org.au, the submissions were public and people could comment on each other's ideas (Lindsay 2011). This way, the contest is even more open than so far in *OpenBologna*. Although the conditions of the two contests are quite different as well, this might be a reason for the relatively low participation rate. For the next idea contest within TeachING-LearnING.EU, it will be considered to follow this more open approach.

Conclusions

We have seen the impact students can make in the improvement of teaching and learning, but we also saw the boundaries of this strategic instrument. The analysis of e-mails submitted by students in idea contests has shown that students sometimes have difficulties to see the university through a teacher's or administrator's eye which partly results in unrealistic demands. But for most parts, it became obvious that students can add valuable ideas to the pool of possibilities of how to improve curricula in engineering education. Especially innovations in digital technologies and aspects about the concept of a virtual university can be considered as their area of interest. In this field, students' opinions and contributions can be a great help for teaching and administration staff. In TeachING-LearnING.EU, this comprehension leads to a stronger focus on topics like *virtual learning environments* and *digital technologies* within the strategic instrument of *OpenBologna*. The next step in research on the effectivity of the strategic instrument is to analyze how many and what kind of ideas of the students are going to be "adopted" by teaching staff in the first step, and then actually going to be implemented in a second step. This will add another important aspect to the question of how students are integrated in curriculum development in the best possible way.

References

Churchill, J., von Hippel, E. & Sonnack, M., 2009. Lead User Project Handbook: A practical guide for lead user project teams. Available at: http://web.mit.edu/evhippel/www/Lead%20User%20Project%20Handbook%20%28Full%20Version%29.pdf [September 17, 2011].

European Ministers of Education, 1999. The Bologna Declaration on the European space for higher education.

European Ministers of Higher Education, 2001. Towards The European Higher Edcation Ares. Communiqué of the meeting of European Ministers in charge of Higher Education. Available at: http://www.ond.vlaanderen.be/hogeronderwijs/bologna/documents/MDC/PRAGUE_COMMUNIQUE.pdf [September 9, 2011].

European Ministers of Higher education, 2010. The Budapest-Vienna Declaration of 12 March 2010. Available at: http://www.ond.vlaanderen.be/hogeronderwijs/bologna/2010_conference/documents/Budapest-Vienna_Declaration.pdf [May 9, 2011].

German Initiative for Network Information (DINI): Wettbewerbe. Available at: http://www.dini.de/wettbewerbe/ [June 25, 2012].

Gläser, J. & Laudel, G., 2004. *Experteninterviews und qualitative Inhaltsanalyse*, Wiesbaden: VS Verlag für Sozialwissenschaften.

Hornby, A.S., Ashby, M., McInstosh, C. and Turnbull, J. (2005): *Oxford Advanced Learner's Dictionary - 7th Edition.* Oxford

Lindsay, E., 2011. Engineering Education 2010 Keynote address by Dr Euan Lindsay, Program Leader - Department of Mechanical Engineering, Curtin Uni on Vimeo. Available at: http://vimeo.com/13756619 [March 16, 2012].

Mayring, P., 2008. *Qualitative Inhaltsanalyse: Grundlagen und Techniken*, Weinheim/Basel: Beltz.

Prensky, M., 2001. Digital Natives, Digital Immigrants. In *On the Horizon*. MCB University Press. Available at: http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf [May 19, 2011].

Schuster, K.; Bach, U., Richert, A., Jeschke, S. 2011. OpenBologna: a strategic instrument for integrating students in curriculum development. *engineering education*, 6(2), S.47 – 56.

Schuster, K., Hees, F. & Jeschke, S., 2010. Dipl.-Ing. Rest in Peace? The Implementation of the Bologna Process in Germany's Engineering Education. In *Proceedings of the 2010 AaeE Conference*. AaeE2010 Past, Present, Future. The 'keys' to engineering education research and practice. Sydney, Australien, S. 38–45.

Stehling, V. u. a., 2011. Teaching professional knowledge to XL-classes with the help of digital technologies. In ProPEL: Professional Practice, Education and Learning. Stirling.

Copyright statement