

Title: A FRAMEWORK FOR PHENOMENOGRAPHIC ANALYSIS AND CLASSIFICATION OF TROUBLESOME KNOWLEDGE IN THE ENGINEERING DOMAIN

Keywords: Course development, Pedagogical teaching tools, Student learning, Teaching and learning in higher education

Presentation format: Presentation

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The design of effective teaching and learning activities must create an experience able to elicit the intended learning outcomes of the educational unit. For this purpose, it is then fundamental to account for the different ways students can experience the specific content taught. This paper introduces a structured approach to perform phenomenographic studies aimed at disclosing the most common student perceptions of a given topic and highlight the patterns that can bring students with poor understanding of the target concept to a more sophisticated perception. The method has been formulated based on a broad literature analysis of related literature. Main inspiration for the proposed methodology are two specific cases in the production engineering domain previously published by the author: those two phenomenographical studies focused on the concept of flexibility and the link product design/production system design respectively. The resulting methodology can be described as follows: the first step is to describe, according to a thorough analysis of the up to date literature, both the subject of the study and its domain. This description is then considered the target perception of the focal topic. In the second phase the students that have already been assessed for the educational unit in exam must be interviewed with open question about both subject and domain. Their answer must be plotted according to sound parameters along two dimension (again subject and domain related) of increasingly sophisticated level of understanding. The result of such interview must be then classified in clusters of understanding that will give the different common perception of the students about the given topic. Finally, the relation among the cluster must be studied with the aim of disclosing suitable teaching and learning activities to help students migrate to a perception cluster close to the above-mentioned target perception.

Title: A pedagogy of hope, change and future action: working towards sustainability learning outcomes

Keywords: Pedagogical teaching tools, Student engagement and motivation, Sustainability

Presentation format: Presentation

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Universities have an important role to play in relation to a transition towards a more sustainable future. Individuals studying today are the future decision makers, professionals and consumers. This study focus on presenting experience from attempts to incorporate different elements of pedagogics and teaching activities aiming at promoting a sense of hope, change of mindsets and action-taking. Thus, this study is trying to address the question concerning the possibility of promoting social change and sustainable development through course design/teaching activities (e.g. Martin 2017; Mintz & Tal 2016; Leal Filho et al 2015; Shepard et al 2015; Shepard 2008; Heyman 2007; van Heertum 2006; Taylor 2001; hooks 1994, 2003; Freire 1992, 1998, 2014; Dewey 1916).

The study focus on the course “Political Economy for Environmental Planners” (AG2142, 7,5 hp), given as an elective course in first year (second cycle). The students are mainly master program students, e.g. from Environmental Engineering and Sustainable Infrastructure (TMHIM), and exchange students. The course focuses on familiarising the students with the fields of politics and economy, which are fields that they as e.g. planners and environmental engineers will have to operate within when they start working. The main purpose is to prepare them for work that involves promoting a more sustainable society. This can for many students mean that they have to challenge their current knowledge, believes and values, i.e. indicating the need of course design that encourages and promotes the changing of mindsets (e.g. through discussions encouraging perspective taking). In addition, a challenge with courses dealing with e.g. the current environmental and political situation in the world is that the issues raised can be kind of daunting for the students. Thus, it is important to explicitly incorporate a pedagogy of hope into the course design. Additionally, in order to further address the possibility of promoting a move towards a more sustainable society the studied course has also specifically tried to put focus on the role and possibility of individual action taking.

Methods for collecting data consist mainly of action research (autumn 2016), course evaluation and focus group interview with students (Feb 2017).

Preliminary results indicate that the course design promoted and enhanced the students’ awareness and thinking of sustainability. It also indicates that the students’ personal commitment and action taking in relation to sustainability, or in other words towards shaping a more sustainable future, was positively affected.

Title: Academic and Professional Values in Engineering Education: A Persistent Tension

Keywords: Teaching and learning in higher education

Presentation format: Presentation

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The tension between the academic and professional aims of engineering education is one of the *remarkably consistent challenges* facing engineering educators. I will trace some historical roots of this issue through the life and work of Carl Richard Söderberg (1895 - 1979), a Swede who emigrated to the U.S. and made an illustrious industrial and academic career. While Söderberg was a proponent for a more science-based curriculum, his rationale was above all related to solving real professional problems, and he later came to criticise the distancing of engineering education from engineering practice. Söderberg's views are compared to the CDIO approach, a present-day reform concept for engineering education. The comparison shows that Söderberg's ideals, arguments, and proposed strategies for improving engineering education, are fully recognisable also in today's discussions. First of all, the similarities can demonstrate the persistence of the tension, in this case spanning more than half a century. In addition, Söderberg and CDIO share a normative vision, an ideal of mutually supporting professional and disciplinary preparation, in both cases implying that the tension does not need to be treated as a zero-sum game. The paths to this ideal were different, however, as Söderberg wanted to improve an overly practical education by integrating theoretical aspects, while the CDIO Initiative wants to improve an overly theoretical education by integrating professional aspects. Reflecting on these insights, the paper identifies several ways to use this kind of historical awareness in engineering education development.

Title: Active Learning at a Distance using Peer Instruction

Keywords: Blended learning, E-learning, Peer learning, Student engagement and motivation

Presentation format: Presentation

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The PROMPT project (Professional Master's Education in Software Development) is a cooperation between academia and industry with the aim of strengthening competitiveness in software engineering and programming for Swedish companies. The courses are at the master's level and offered online as distance education. As such, they subjected to the split attention of the students resulting in considerable attrition. To counteract this, we have developed a method for using peer instruction at a distance to provide social interactions and to promote learning by active engagement in the studied topics. We have also initiated development of an online tool to support this teaching mode.

We follow the basic peer-instruction protocol, as suggested by Crouch and Mazur (2001) and have adapted it from in-class to the online setting. Students need to be matched in pairs or small groups for working together. We have developed support in the tool Scalable Learning that allows the students to engage in discussion in a recorded lecture, when prompted by an inserted quiz. They will first answer the quiz question individually without discussion; then they discuss their answers with the goal of each student to persuasively argue that his or her own answer is the correct one. The discussion topic is clear since it solely pertains to the posed question and hence it can be focus and efficient.

Following the short discussion, the system will provide the question anew for individual answering. Following a round of quiz-discussion-quiz, the video will present a reflection and commentary by the teacher, who has ideally anticipated the difficulty of the question. The process can be repeated several times in an online lecture.

PI at a distance allows students to socialize around learning and will provide increased incentives for participating since the students make commitment to their peers of working together. The discussion phase has been shown during in-class use to promote understanding and recollection of what is learned. Each PI quiz provides also a measurement point of the method's effectiveness since it measures the understanding before and after discussion for each posed quiz question. Hence there are data generated that may be of use both for the students and the instructor.

We have developed the method and the needed system support and will outline it in the presentation with examples from Scalable Learning.

Reference: Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69(9), 970-977.

3 keywords (see above): E-learning, Peer learning, Student engagement and motivation

Session format: Presentation

Title: Adaption of serious games for engineering education for fitting different target groups

Keywords: Blended learning, Course development, Feedback for learning, Pedagogical teaching tools, Project-based learning, Teaching and learning in higher education

Presentation format: Presentation

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The success and competitiveness of European companies are bound to their ability to innovate. This process leads to changes in educational requirements both for higher education and vocational training. Studies have revealed that it is important to provide students and employees with competencies to carry-out daily tasks in dynamic and flexible working environments [1]. Traditional class room settings have shown difficulties in delivering this [1, 2]. Therefore other teaching methods and tools targeting active participation are investigated [3]. Gamebased learning is such a tool [4]. However, there are challenges in adapting and integrating games in existing curricula which requires specific competences of the teacher. Even though this is a well-known problem, there are not many guidelines available on how specific games can be re-purposed to different target groups and different competence levels.. Therefore, this presentation provides some insights on how to adapt multi-user games on re-engineering for engineering education and vocational training. The case studies are from two universities- KTH, Sweden and University of Bremen, Germany. Both institutions have used games as part of their educational offers for decades; the authors have more than 15 years of experience using different types of games. We have selected two role-playing, physical simulation based games that can be implemented in flexible ways. The players build/assemble a product (car/mini lift-truck). Group size varies between 7-14 for the car game and for the mini lift-truck game 16 to 23.

The play time varies depending on group and learning goals, but is round based and mostly around half a day. Typical learning objectives are besides re-engineering also hands-on, process understanding and quality management. The guidelines we will present are based on the results of around 900 participants. Target groups are engineering students, managers and operational work force in production and logistics as well as service businesses. The concept is based on Kolb's experiential learning cycle using constructive learning theory.

[1] BAALSRUD HAUGE, J. et al. (2012) *Challenges of Serious Games for Improving Students' Management Skills on Decision Making*, IGI Global, pp.947-96

[2] CHEVILLE, A.; BUNTING, C. (2011) *Engineering Students for 21st Century: Student Development Through the Curriculum*, Journal of Advance in Engineering Education.

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Title: Are we and our faculty ready to blend

Keywords: Blended learning, Course development, E-learning

Presentation format: Presentation

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Key research questions

Are our faculty prepared for the flexible/blended transition?

What educational resources do we need for this transition?

Aim

The aim of this paper is to find out what our faculty think about blended learning, what their views are on the ever-changing technologies brought to them and how they keep up with learning these new technologies.

Methodology

The participants in this research were our faculty members from the 10 schools at KTH who answered an online survey about teacher support, and face-to-face interviews with our faculty.

Background

This practitioner research is based on my role as a business manager for the Learning Technology unit at the department of Learning, and the many different online initiatives taking place within the unit.

As part of the KTH vision 2027 it states that "E-learning should be an integral part of KTH's education and the training is to be characterized by individualized learning in innovative learning environments." As part of this initiative a Business model in E-Learning was created in 2014 in collaboration with the IT department. The aim of the business model is to reach this vision, and help free up time for increased and more qualitative interaction between faculty and students. Even though we have had this business model in place for 3 years, many of our faculty are still not using the technology available and very rarely for creating innovative learning environments.

The MOOCs project (Massive Open Online courses) has gone from initially doing 6 courses over a 3-year period to offering 19 a year. It has caused a vivid debate regarding the future role and structure of universities (New Yorker 2013 and New York Times 2013) and KTH is no different in wanting to be a big part of this movement.

Researchers and pedagogical developers say that Blended learning will be the defining educational philosophy in the next 20 years. (*Garrison, D. Randy, and Heather Kanuka.2004*). Top world rank universities have started adapting to the trend by integrating online education into their system. MIT announced in 2015 to take a big step towards this by combining free online classes (MOOCs) with its traditional on campus instruction. But blended learning models not only require teachers to adapt their practices, they require higher education systems to rethink models for teacher support, and re-organization in policies and procedures.

Title: Blending Swedish: Optimizing utility through Nordic cooperation

Keywords: Blended learning, E-learning, Project-based learning

Presentation format: Poster

Author

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Blending Swedish, a Nordplus-financed project, is a joint endeavour between KTH Royal Institute of Technology, the University of Iceland, and Aalto University.

The project has as focus the newest, most modern large open online course in Swedish, Learning Swedish (LS) – a course which in September 2016 had more than 45.000 registered users after not even one year online.

The major questions are how this self-paced course, with no teacher support, and no feedback on oral or written production, can best be integrated in blended learning environments, and what support students not in the original target group (international university students coming to Sweden) are most likely to need. The project intend to design strategies and materials to flexibly and efficiently integrate LS in mixed learning environment based on research, proven experience and critical learning analysis of LS, and thus support existing teaching of beginners' Swedish inside and outside the Nordic / Baltic region, help teachers interested in e- learning, and increase the efficiency of the already developed online course.

The work will be driven by teachers from the partner universities but the project will be conducted as a collaborative online effort in which other universities, teachers and students are welcome both to participate in the project and to retrieve information from it, via this project homepage.

Insights and lessons learned in the project will also hopefully contribute to the more general understanding of how to successfully integrate existing online material in classroom teaching, a question made increasingly important by technological advances, increased demands on teachers, and by the sheer mass of freely available online material today.

Title: Bridging the gap in mathematics for first-year students – strategies to work jointly with students for solving the problem

Keywords: Course development, First-year experience in higher education, Student learning

Presentation format: Workshop

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Several studies show a decline in mathematics skills in Sweden as compared to the beginning of this century although improving lately [1,2], which is in line with results on diagnostic tests when students enter KTH [3]. In addition, there is an increasing diversity among students when a larger part of a yearly cohort enters university studies. This may create a gap between the average students' actual knowledge and the knowledge expected by teachers when students enter their first mathematics courses. Attempts to bridge this gap have so far mainly been instrumental [4,5], but other approaches are also needed.

During the workshop, we will start with a short description of the background and how we have worked with students to approach these problems (through student questionnaires and a project course option to create innovative learning applications that should have helped them to study mathematics). We will then invite the participants to discuss two issues:

- i) strategies to gain better knowledge of this problem
- ii) ideas for helping the students to bridge the gap between upper secondary school and KTH

As input to the discussions, we will share some results from our evaluation of these approaches with the participants.

If there are interested participants attending the workshop, we would also like to start up a discussion group of interested teachers to further discuss and investigate these issues.

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[4] Bridging the gap (2017), Mathematical Institute, University of Oxford, <http://www.maths.ox.ac.uk/study-here/undergraduate-study/bridging-gap> (accessed February 7, 2017)

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Title: Challenge Driven Education: Creating Significant Pathways for Cross-Border Sociotechnical Problem Solving in Academic Settings

Keywords: Cross disciplinary courses, Project-based learning

Presentation format: Poster

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Challenge Driven Education: Creating Significant Pathways for Cross-Border Sociotechnical Problem Solving in Academic Settings

Key words: Cross disciplinary courses, Project-based learning

This contribution aims at sharing and discussing some of the ongoing work and ideas in relation to Challenge driven education at KTH. Especially we will present the 3 year project *MIC – Mutual Innovation Capacity* project, funded by STINT (The Swedish Foundation for International Cooperation in Research and Higher Education). In this project, KTH collaborates with two Tanzanian universities, UDSM (University of Dar es Salaam) and DIT (Dar es Salaam Institute of Technology). The higher purpose, with the MIC project as one of the pilots, is to create significant pathways for cross-border education, teaching and research activities, where solving socio-technical problems for a sustainable society is a common theme.

The development of Challenge driven educational activities at KTH is not seen as an isolated phenomenon. The development that has been carried out in the line of the CDIO framework and community is strongly related to Challenge drive education. KTH together with MIT, LiU and Chalmers initiated the CDIO engineering education reform in the year of 2000[1]. In year 2016 the network has app 140 member institutions from all over the world.

Challenge driven education emphasizes that in the projects and case studies which students and academic staff are working on “*the learning takes place through the identification, analysis and design of a solution to a sociotechnical problem. The learning experience is typically multidisciplinary, takes place in an international context and aims to find a collaboratively developed solution which is environmentally, socially and economically sustainable.*”[2]

There are several schools/programs that in various forms bring in socio-technical problems into the academic context, where students are searching for sustainable solutions. Through the Challenge driven education project we are aiming at supporting KTH in order to create spaces and pathways for all our students to be involved in the work with solutions on global socio-technical problems in multidisciplinary and cross-border settings.

[1] www.cdio.org

[2] Malmqvist, J., Rådberg, K. K., & Lundqvist, U. (2015). Comparative Analysis of Challenge-Based Learning Experiences. In *Proceedings of the 11th International CDIO Conference, Chengdu University of Information Technology, Chengdu, Sichuan, PR China*. Recuperado de: http://rick.sellens.ca/CDIO2015/final/14/14_Paper.pdf.

Title: Challenge your course - and get ideas for improvements!

Keywords: Course development, Student learning

Presentation format: Workshop

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This workshop is specifically designed to assist teachers with new ideas about how to improve student learning in their own courses. Scholarly research on successful educational programs has shown that high quality education goes hand-in-hand with a flexible organizational culture and a close connection to every day work [1]. Furthermore, digitalization and societal demands for broader engineering competences (in e.g. sustainability, innovation, interdisciplinary project work etc.) implies the need for changes in the way courses are given. This workshop attempts to create a discussion climate where teachers can actively share and discuss pedagogic ideas that are anticipated as important for their courses. Similar flexible processes were considered to be important for the pedagogical developers project at KTH and have lead to exchange of ideas and new insights [2].

I will start the workshop by shortly describing its innovative approach and clarifying its structure. During the workshop, the participants will work in groups of three teachers. To maximize the possibility for spreading of new ideas, it is recommended that the participants discuss with teachers with whom they have never talked about pedagogics before. Each teacher has 12 minutes for the course challenge during the workshop, among which maximum 2 minutes will be a very short course summary (course name, year of studies, type of students and main goals). If you have any specific problem or questions you primarily want to discuss, this should also be mentioned during these 2 minutes. Then there are 10 minutes for discussions, where the two other teachers can ask questions and come with suggestions for learning activities in your course. You gather these ideas and afterwards you can think about if there were any useful suggestions that you could refine and implement in your course. However, remember that every participant decides what to do with the suggestions they get!

[1] J. Kleijnen, D. Dolmans, J. Willems and H. van Hout, "Effective quality management requires a systematic approach and a flexible organizational culture: a qualitative study among academic staff", *Quality in Higher Education* 20(1), 2014, 103-126.

[2] A. Berglund et al, "The pedagogical developers initiative – systematic shifts, serendipities, and setbacks", 13th International CDIO Conference, Calgary, Canada, 2017 (submitted)

Title: Collaborative course analysis and development at KTH: what's the next step and who needs to do what to make it happen?

Keywords: Course development, Professional skills development, Student engagement and motivation

Presentation format: Workshop

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Purpose of the workshop

KTH has recently developed a state-of-the-art system for course evaluation, based on the Learning Experience Questionnaire (LEQ) [1]. The LEQ has been developed specifically to facilitate collaborative course evaluation and development among teachers and students. While the LEQ itself is available for all teachers at KTH, and the number of individual users is increasing, taking the step to work collaboratively (including the students) is unlikely to happen unless certain actions are taken at various levels in the organization. The purpose of this workshop is to invite managers, administrators, pedagogical leaders and developers, teachers and students to develop a tentative and workable action plan for this purpose.

Theoretical framework

The LEQ itself is based on research on teaching and learning in higher education, and examines a number of factors that have been found to promote deep learning among students [2]. The scientific legitimacy of the LEQ process for collaborative development is based on theory of communities of practice [3]. The workshop will be based on principles for active learning.

Planned work

The LEQ process is available and detailed instructions are found in the LEQ guide [1]. Preliminary, the workshop will be based on a prepared SWOT-analysis of the current state of the LEQ process at KTH. In a first step, participants will be invited to quickly review and complete the analysis. From this, viable actions will be developed for different levels in the organization. An action plan will be compiled by the workshop leaders, with an intention to implement it as part of the overall KTH quality assurance process.

Lessons learned

An important lesson learned, that is also the main reason for organizing this workshop, is that a collaborative process among teachers (and students) must somehow be organized and facilitated if it should be sustained. At least initially, before a community of practice has developed among the teachers.

Keywords

Course development, Student engagement and motivation, Professional skills development

Session format

Workshop

References

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Title: Creating a course with external collaboration partners: challenges and opportunities

Keywords: Assessment, Course development, Doctoral education

Presentation format: Presentation

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Collaborating with non-academic external partners for creating a course can have several benefits; expertise outside the academic organization provides new knowledge and other perspectives on problems than within academia [1-3]. However, there are also challenges associated with such collaborations. Different organizational cultures, perspectives and goals have to be dealt with [3, 4] and it is important for the university teacher who is responsible for assignments and grading to provide a good course design [3]. In particular, intended learning outcomes, learning activities and assessments aligned with the course content the external co-teachers provided has to be planned in a good way.

The work that is presented is related to a doctoral education course offered for all schools at KTH, with adaptation to the research areas at different schools. The course was created in collaboration with co-teachers from the Swedish Patent and Registration Office and KTH Innovation that also provided much of the course content. Here, I present some key points that proved to be important for successful implementation of the course. Firstly, to involve all co-teachers in planning the course and the course content, while as course responsible stressing the importance of well-planned learning activities for the students. Secondly, by connecting assignments and content to relevant research areas, student motivation and active learning among the PhD students could be promoted, although it is somewhat more time-consuming for the teachers. Thirdly, the course evaluation has been a valuable tool for further development of the learning activities of the course.

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Title: Disadvantages of using non-linear video in shallow learning situations - a critical perspective on current trends

Keywords: E-learning, Pedagogical teaching tools, Student learning

Presentation format: Presentation

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Video learning material is becoming more expected in education with its reported benefits to in-person lectures and knowledge transfer [1, 2]. Modern educational methods such as flipped classroom and MOOCs implement video as a learning resource. Furthermore, traditional linear (although asynchronous) video has long been challenged by non-linear video, both in terms of having interactive material [3] and sectioned, indexed contents.

Non-linear video has advantages: interactive transcript functions and searchability contribute to non-linear operation, which in turn streamline access to information [4]. Video material can arguably be seen as accommodating shallow learning and an intermediary to be processed in further teaching activities. While non-linear video is being adopted by learning platforms, we argue that it is important to discuss its capacity for knowledge transfer.

We investigated the non-linear way of using video with a critical approach [5]; in particular whether non-linear video streamlines the retrieval of information. The study highlights what might affect the learning negatively.

In an observational experiment, the same video was presented to ten participants divided equally into two groups, receiving, respectively, linear video and non-linear video. To observe the efficacy and differences between the groups, subjects were in a controlled environment presented with questions that could only be answered from having seen the video. Participants were given 12 minutes to use video the contents and answer ten questions. The linear group correctly answered 72% of the questions whereas the non-linear answered 64%. The difference between the groups' interactions has a p-value of 0.061 on a two-tailed t-test, and we therefore suggest that the amount of interactions can to some extent explain the inferior results of the non-linear group.

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Title: Educational Improvement Ideas From All Students

Keywords: Student engagement and motivation

Presentation format: Poster

Author

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In the development of educational programmes we need to involve the students. The European Standards and Guidelines (ESG 2015) state: "Programmes are reviewed and revised regularly involving students and other stakeholders." We need to know how the students perceive that the programme should be improved. Using just a few student representatives for this has clear limitations, because they might not be representative of all students. Rowley (1995) argues that "gathering relevant, representative and useful student opinion is a necessary part of the quality assurance process".

In the Computer Science and Engineering programme at KTH, we have a unique opportunity to get input from every active student in the programme, through the Program Integrating Course (Kann and Högfeldt 2016). The reason is that one of the intended learning outcomes is "critically analyze and reflect on the structure and performance of the programme and their own study achievements".

In a mandatory questionnaire sent to all students in the five years of the programme in May 2016, we asked each student to give at least one proposal for how the programme could be improved. In this way we got almost 800 suggestions for improvements of the education, at least one from every active student.

We will now sort the improvement suggestions and categorize them. We hope to be able to identify which type of improvements of the programme that are most asked for, and to get a number of good improvement proposals that we would never have thought of ourselves.

Here are four examples of suggestions from fifth year students:

"Have a tool that makes it easier to visualize the education, how courses contributes to certain goals etc? "

"Encourage students to design their code in lab-assignments/projects in a more maintainable way and not just in a ad hoc way."

"if there was a way for me to read student feedback to find the really good courses, that would be of help."

"Make the students read more research-papers, and involve the students in open source projects."

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Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). (2015)

Title: Flipping the digital signal processing classroom

Keywords: Course development, E-learning, Peer learning

Presentation format: Presentation

Author

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In the fall of 2013, I introduced elements of flipped classroom teaching in a course on digital signal processing class at KTH, given to first year M.Sc. students. Since 2014 all traditional lectures have been replaced by online video-supported flipped classroom lectures, the in-class time is mainly used for concept questions answered using clickers, and I am overall very satisfied with the new course structure. This presentation will outline the experiences gathered over the past three years, the pedagogical ideas on which the course development was based, as well as educational results and student satisfaction.

The primary reason for adopting the flipped classroom methods was that I in 2013 started to seriously question the value that I provided to the students through my standard lectures. Although appreciated by students, I was not convinced that the values of the lectures were that much greater than what would be achieved by students simply reading the course book. This prompted me to prepare and record all the key material for the class in the form of voiced over slides, specifically tailored to work well as online videos. The key value of the videos is that they free up time I would have spent passing on static course material in the past. By using the Scalable Learning system for distributing the online videos to students, I was also able to use in video questions to increase the interactivity with the material beyond what I had accomplished in my traditional lectures.

With the videos in place, I repurposed the time in-class when meeting the students without changing the total amount of time. I decided to use the idea of concept quizzes, modeled after the peer-instruction format of Eric Mazur at Harvard: A conceptual question is first asked of each student individually. After the student commits to an answer, there is a second phase of peer discussions. Answers are collected using an electronic clicker system available at the school of electrical engineering. Given that there is no longer any need to cover new material during my in-class time, I am at liberty to spend virtually the entire class using nothing but such concept quizzes and peer-instruction. This makes the combination of concept quizzes and online videos a very powerful combination.

Title: Generating Human-friendly Feedback at Scale

Keywords: Assessment, Feedback for learning, First-year experience in higher education

Presentation format: Presentation

Author

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The purpose of this study was to develop a system called *evabot* that generates feedback for 200+ first year students as they develop coursework in DD1337 Programming. Instead of waiting for teacher feedback, *evabot* provides human-friendly feedback whilst students work.

DD1337 uses formative assessment, where students complete weekly programming assignments. In 2014, assignments were submitted in printed form. This approach had major limitations: it was difficult to execute code, and get an overview of all submissions. Furthermore, feedback came after grading, by which time students were working on their next assignment. In 2015, submissions migrated to KTH Github, available free to all KTH students. This change was motivated by the following reasons:

- Provide students with early experience using version control
- Manage student submissions (and feedback) in an open, online, centralised system
- Develop novel systems that could enhance the student learning experience

The main inspiration for this work is based on the the observations that “...*for students to be able to improve, they must develop the capacity to monitor the quality of their own work during actual production*” (Sadler, 1989), and “...*quality external feedback is information that helps students troubleshoot their own performance and self-correct: that is, it helps students take action to reduce the discrepancy between their intentions and the resulting effects*” (Nicol & Macfarlane-Dick, 2006). The migration to KTH Github created the opportunity to deliver feedback, via the same system used to submit coursework, whilst students are *still in production*. Aspects of quality (common beginner bugs and code style defects) can be readily detected using existing tools and communicated to the student well in advance of the deadline. Finally, the tone of feedback is deliberately scripted to not be condescending, rather it adopts a conversational, friendly and inquisitive tone, as illustrated in Fig. 1.

At present, DD1337 is midway through its second year of successfully using KTH Github with first year students. The *evabot* system has now been developed to the stage where the types of issues relevant to first year students can be encoded, issues can be automatically opened using the Github API, and checkups can be made to see if there has been any attempt to resolve the issue. The next step will be to use student data from the 2016 cohort to determine the most relevant issues to focus on. The first live trials with students will occur in Period 3 in early 2017.

Title: HELPING STUDENTS TO BECOME BETTER LEARNERS

Keywords: Pedagogical teaching tools, Student learning, Teaching and learning in higher education

Presentation format: Presentation

Author

Marcus Lithander⁰

How can we become better learners? One of the most robust findings on improving learning and enhancing long term memory is to continuously test ourselves on the to-be-learned material. The effect of enhancing long-term retention by testing has been proven repeatedly and is referred as the *testing effect* (Roediger & Karpicke, 2006a and Roediger & Butler, 2011).

Although evidence clearly reveals that using *testing* is an effective way to become a better learner - students still don't use testing when they study (Roediger & Karpicke, 2006b; Karpicke & Roediger; 2008). Research results are diverse regarding if students are able to recognize the positive effects of testing during self-regulated learning. This is problematic as correctly monitoring our own learning can make us better learners. Judgment of our own learning guides and optimizes study choices (Metcalfe & Finn 2008) and biased monitoring of our learning can affect studies negatively (Kornell & Bjork, 2008). How can we help students to be aware and use of study strategies that are effective?

Some studies indicate that students are not aware of the positive effects of testing and that students tend to believe that study-only is a more effective way to memorize material than a study-test strategy (Roediger & Karpicke, 2006b; Karpicke & Roediger; 2008). Further on, Kornell and Son (2009) also investigated if learners could recognize testing as an effective way of learning and showed that participants did not recognize testing as an effective way of enhancing memory. So why is it so difficult for students to recognize testing as the effective study strategy it is? Different factors can affect how easy it will be for participants to recognize study strategies that are more optimal for learning. Such factors can for example be; how the material to-be-learned is presented, or in what way the learning phase is setup (Koriat, 1997).

In a recent study by Tullis and colleagues (2013) results indicates that when students are given cues that promotes metacognitive monitoring students can indeed recognize the positive effects of testing.

How can we use these promising results from educational research to improve teaching in higher education? With this short introduction I want to start a discussion on how we can help students become better learners, both by using the testing effect and helping students become aware of the effectiveness of using this strategy.

Title: KTH Education 2027/2028 - A Design Fiction

Keywords: Degree program development, Professional skills development, Student learning, Teaching and learning in higher education

Presentation format: Presentation

Author

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There is continuously a need for organizations to reconsider their roles and the services they provide. Higher educational institutions are not exceptions to this, and yet discussion about the future needs of students and society is often relegated to follow when the day-to-day issues have been cleared. Hence, the need for change, for instance in providing life-long learning and pedagogic improvement, might not get needed attention.

We have during the fall of 2016 engaged a group of faculty members and administrators at KTH together with representatives from our society in an exercise to fathom the future of education at KTH in a ten year perspective. The work initiated with a workshop to collect ideas which has then been further processed in a smaller group in order to be produced as a fictional catalog of KTH education for the academic year 2027/2028.

The finished catalog is an example of design fiction. The purpose is to provide a concretization of a possible future. It allows a discussion of future education, in our case, that is unshackled from today's practices, regulations and unwillingness for change.

The presentation will be based on the finished catalog and will provide glimpses of its contents and the main trends that are manifested therein, and it will describe the work method of design fiction as a means to initiate and inspire change.

Title: KTH Teachers' Perceptions and Attitudes on Pedagogical Aspects in Relation to the Faculty Training

Keywords: Course development, Teaching and learning in higher education

Presentation format: Poster

Author

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This contribution is based upon a selection of results from a questionnaire designed by a group of educational developers at KTH. The questionnaire was sent to all teaching /academic staff including PhD students at KTH in March/April 2016. The purpose with the questionnaire has been to better understand the KTH teachers' perceptions and attitudes on pedagogical aspects in their daily work. 440 respondents gave their view upon various pedagogical aspects. This has entailed for instance the perceived interest in teaching/learning aspects, possibilities and access to support in development of teaching/courses.

In this poster we will share results from an analysis of the questionnaire data, where the focus will be the amount of faculty training courses in the field of teaching and learning in higher education (högskolepedagogiska kurser).

Title: Methods to increase work-related activities within the curricula

Keywords: Professional skills development, Student engagement and motivation, Student learning

Presentation format: Presentation

Author

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Retention is an important area to consider for Universities. The reasons for students to finish their studies and to graduate differ within cultures and for each individual, but there are common factors. Relevance and motivation are two of these factors, which are relevant within this area.

At the overall level the aim of a far-reaching *project* within Work-related Learning, is to find systematic and flexible methods to increase work-related activities within the curricula. These kinds of activities make students more motivated to learn and give them an understanding of engineering skills and a possibility to practice for future professional roles. Results from a redesigned course at KTH, within the program of Engineering Chemistry, show positive results both regarding the examination and students' experiences of learning when adding, among others, activities and learning objectives that are connected to the working life.

The authors redesigned a 9-credit course in the 3rd year of a 5-year program. They studied the experiences and reflections made by both students and teachers after the implemented changes. Some of the mentioned changes were; adding several study visits, using authentic cases, adding intended learning outcomes related to skills and finally making the students reflect in writing after the study visits with the help of a pre-decided questionnaire. The written assignment should contain reflections about the connections between the course subject and the companies; examples on methods, processes and tools that the students have experienced; what kind of areas of professions they could identify and how the visit would influence their choice of master program and future career.

Result

The result shows that the students were clearly motivated by the work-related activities. The reflections made by the students show a deeper understanding of the relevance of their studies and their choice of subject. Further on, even a broadened view of career opportunities.

Example:

“ - The study visit motivates me to study because you'll get an insight into working life and what you are able to do further ahead, that what we're studying has a purpose and a meaning.”

“ - I think that the study visit was very good. It was fun to get an insight into a job that has a connection to what I am studying.”

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Elmgren, M., & Henriksson, A-S. (2014). Academic Teaching. *Studentlitteratur*.

Title: Model-based design for decision making

Keywords: Course development, Cross disciplinary courses, Teaching and learning in higher education

Presentation format: Presentation

Author

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Mechanical Engineering is a five year program, with around 140 students admitted yearly. Twenty percent of these students will study in the Mechatronics and the Machine Design tracks of the Engineering Design master's program. When other program students, international, and exchange students are added, a total of 80-100 students are admitted to these two tracks every year. The tracks seek to enhance the functionality of technical systems by integrating and optimizing mechanical, electronics, and software function carriers.

A model is a simplified representation of an object or a process. A model is a mental, physical or virtual cognitive tool. With the term model we limit our scope to computer-based models. Development of novel products, which is a complex knowledge-creation process, depends on systematic and focused product and process modeling. Engineering design is largely concerned with exploring the entire solution space, creating and exploring system solutions that maximise intended behaviour, minimize unintended behaviour, and avoid accidental behaviour [1]. In the various stages of product development, modelling and simulation covers system exploration, discipline-specific modeling, and system integration.

The purpose of this study is to map how model-based design is educated, trained and used for decision making in first cycle courses in the Mechanical Engineering program and second cycle courses in the Engineering Design master program. Eight course syllabuses in total have been analysed. Wording (e.g. model and tools) were quantitatively measured in the learning outcomes, and Bloom's taxonomy [2] was used to identify verbs to describe student learning. Course descriptions were qualitatively assessed.

To handle physical models during first cycle education is a good practice, but it would be even better if computer models were used in concert with these physical models. It was found that modeling is seldom used in the first-cycle courses even when a course makes use of modeling to predict or understand a specific behaviour. At second-cycle courses, models are used to a much greater extent. This paper discusses whether it is necessary and possible to include the "big picture" already in the first cycle courses, i.e. would we better meet the learning outcomes by introducing model-based design in first cycle courses? Besides, there is a need to work with the CDIO curriculum-design perspectives.

[1]Whitney D.E., Why mechanical design cannot be like VLSI design, Research in Engineering Design (1996)

[2]Biggs J., Tang A., Teaching for Quality Learning at University, 4th ed, McGraw-Hill (2011)

Title: Motives for choosing a double degree programme. A case study in engineering and education

Keywords: Student engagement and motivation, Teaching and learning in higher education

Presentation format: Presentation

Author

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In Sweden, student interest in STEM subjects (science, technology, engineering and mathematics) has been declining for many years, and to make it worse, there is a severe shortage of teachers in these subjects. In an effort to increase students' interest in becoming teachers, a double degree programme in engineering and education called *Master of Science in Engineering and in Education* was started at KTH Royal Institute of Technology in 2002. The programme is given in cooperation with Stockholm University and prepares for three roles: The pedagogical engineer, the upper secondary teacher with the engineering perspective, and the researcher in technology and learning.

The contribution of teachers to the upper secondary school from this double degree programme is significant. According to a study by "Läraryrket", half of those taking a degree in Sweden from a five years teacher programme in the spring 2014 in the subjects physics, chemistry, biology and technology, graduated from this programme. According to a yearly exit survey about 30% of the graduates indicate that they work as teachers in upper secondary school.

This study investigates what motives are expressed in the exit survey for having chosen this double degree programme. Data are available from 48 respondents. The material is analysed in an exploratory approach using content analysis, including manifest as well as latent content (Graneheim & Lundman, 2004). Codes were generated from the data.

The findings identify two major types of motives:

1) Students chose this programme because they found the *combination* of STEM-subjects and pedagogics attractive (expressed 40 times). They express that the different parts reinforce each other and that this combination match their personal interests.

2) Students also chose this programme because they were *uncertain* of career choices and identity, afraid of choosing other specific alternatives, or had a desire for security (expressed 37 times).

Several minor types of motives are also identified. Some graduates express that status was a motive for choosing this programme (6 times), some had strategic motives (5 times), and some express that this programme was their second choice (3 times).

When these motives are compared with motives for choosing other engineering programmes at KTH Royal Institute of Technology (Östling, 2016), there are similarities as well as differences. The programme seems to have fulfilled the ambition to make more students interested in a degree in education.

Title: Perceived drivers and barriers for activities related to Technology Enhanced Learning among educational developers at KTH Royal Institute of Technology

Keywords: E-learning, Pedagogical teaching tools, Teaching and learning in higher education

Presentation format: Presentation

Author

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Abstract

This study identify drivers and barriers for increased use of Technology Enhanced Learning (TEL) in higher education. TEL here refers to the use of technology to enhance and enrich learning experiences [1], in line with the vision at KTH to become a leading university in e- learning.

To identify drivers and barriers we gathered the Educational Developers [ED] at KTH in 2 focus groups, 4 EDs in each group. The EDs are faculty members acting as local change agents, striving towards educationally empowered teachers [2]. Under the assumption that each ED has unique knowledge about the educational situation and pedagogical initiatives that occur within their school, they should be able to provide high quality answers to questions about drivers and barriers in relation to TEL.

Using Force Field Analysis [3] we have identified several drivers and barriers. The most significant drivers found were: dialogues where teachers can share ideas, automatization with the aim to reduce administration and IT support for the teachers (to assist exploration).

While the significant barriers identified were: lack of time for pedagogical development and uncertainty about future staffing, lack of funding for purchases and lack of central decisions. For example, the long wait for a new learning management system significantly dampened the e-learning initiatives.

Another interesting finding was that locally developed systems can act as both drivers and barriers: they are drivers when it comes to solving (local) problems and experimentation, but when these systems are cancelled due to lack of funding, obsolete technology or replaced by centralized systems, they become barriers and discourage use and development.

Further work include a deeper analysis of the results from this study, with the aim to rank the findings based on an extended faculty group, and to develop this abstract into a full paper.

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Title: The KTH Library as a studio for Architecture students – challenges and opportunities

Keywords: Student engagement and motivation, Student learning, Teaching and learning in higher education

Presentation format: Presentation

Author

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We will share our experiences of the move of the School of Architecture to the main campus at KTH and the pedagogical challenges and opportunities that comes with new conditions. The brake up between the School of Architecture and the architecture library and the integration to the main library caused a spatial and social gap between the School of Architecture and the library. The distance was reinforced by the closure of the main library due to renovation and after the opening we needed to reestablish our contact with teachers and students. We are facing three challenges:

Find new ways to establish contact with teachers and students

Find new ways to collaborate with teachers

Find methods to evaluate that students have developed information literacy skills

Research shows several examples on how different partners at campus can collaborate in order to embed information literacy into courses (Wang, 2011). Our ambition is to foster a line of progression from 1st to 5th year. In collaboration with the teachers we design learning activities that meet up the learning goals and are embedded in an authentic assignment to raise the students' motivation (Cotterall & Cohen, 2003, Carlson & Kneale, 2011). We meet the students several times and during workshops the students perform tasks that help them succeed with the larger task at the course. That will also enable the students to continually reinforce their information literacy skills and develop self-regulated learning (Nicol, D. J., & Macfarlane-Dick, D., 2006). A more integrated kind of teaching could make it possible for teachers and librarians to teach together either in the school or in the library. Online tutorials and tasks that give architecture students possibilities to use their artistic skills could be developed which would make the physical room less important.

Carlson, J., & Kneale, R. (2011). Embedded librarianship in the research context: Navigating new waters. *College & Research Libraries News*, 72, 167-170.

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Nicol, D. J., & Macfarlane-Dick, D. (2006) Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education*, 31, 199-218.

Wang, L. (2011). An information literacy integration model and its application in higher education. *Reference Services Review*, 39, 703-720.

Title: The role of teacher/student mentorship in the first year in higher education

Keywords: First-year experience in higher education, Student engagement and motivation

Presentation format: Poster

Author

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This study focus on the role of teacher/student mentorship in the first year in higher education. This mentor relationship carries with it potential benefits for both faculty staff involved as mentors and the students (e.g. Campbell & Campbell 1997; Terrion & Leonard 2007; Colvin & Ashman 2010). For students it has shown to have psychosocial as well as academic benefits, affecting e.g. retention rates, integration into the university environment, academic performance. For faculty staff, in addition to leading to enhanced skills in mentoring, they e.g. benefit by taking part of the students views on the study environment, which can feed into the development of teaching and learning activities.

The study focus on the mandatory course “Introduction to the Planning and Building Process” (Samhällsbyggnadsprocessen, AI1527, 13,5 hp) given during period 1-2 in the first study year of the Degree Programme in Civil Engineering and Urban Management (CSAMH). This course is divided into different parts, where each part is designed to give the students their first experience with different subjects corresponding to the different specializations that can be chosen later on in the education. In addition to this there is a focus on developing the students’ skills concerning academic writing, giving/receiving feedback and carrying through presentations. In relation to the development of these more generic skills the students are divided into smaller groups assigned to six different teachers, in this study framed as mentors, i.e. each teacher is responsible for 25-30 students. This means that during period 1-2 in the first year of study each group of students have extended and close contact with one particular teacher. This can be seen in relation to the normal format with lectures carried through in full class in larger lecture halls, where the lecturers usually only meet the students a couple of times.

The aim of the study is to explore the potential benefits of including faculty/student mentoring activities during the first year of study, as an integrated activity in relation to the subject content of the curriculum. What are the experiences of the students and the teachers/mentors?

Methods for collecting data consist mainly of action research (autumn 2016), focus group interview with students (representing the years 2013-2016), and with the involved teachers/mentors (Feb 2017). This is supported with analysis of course evaluations and short self-reflective essays the students hand in two times during the course.

Title: Threshold concepts in teaching and learning

Keywords: Course development, Pedagogical teaching tools, Student learning, Teaching and learning in higher education

Presentation format: Workshop

Author

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One often experiences ebbs and flows in one's educational development. This non-uniform learning can be linked to key moments of understanding. For example, many people understand that the world is round, which allows us to understand many things including astronomy, and global distances. This concept literally changes someone's world view and cannot be unlearned. Such characteristics define a threshold concept. More formally, a threshold concept is typically described as a distinct core concept that is also transformative. It can also be considered as akin to a porch, opening up a new and previously inaccessible way of thinking (Meyer and Land, 2003).

According to Meyer and Land, common characteristics of threshold concept are:

- a) Transformative: once understood, its potential effect on learning and behaviour is to cause a significant shift in the awareness of a subject.
- b) Irreversible: the change of perspective is unlikely to be forgotten.
- c) Integrative: it exposes the previously hidden interrelatedness of something.
- d) Bounded: the concept has terminal frontiers.
- e) Troublesome: it runs counter to previous knowledge or intuition.

Because threshold concepts are difficult to grasp, students often find themselves stuck in a liminal phase (Meyer and Land, 2003). As such, delayed understanding is often a symptom of threshold concepts that negatively impacts the process of acquiring knowledge (Scheja, 2006).

Understanding how to identify and address these concepts is key to effective teaching. This work attempts to provide specific strategies for moving students past these knowledge hurdles. Moreover, the relevance in understanding threshold concepts is seen through its impact on active learning in the classroom and on class and curriculum design in the broader sense. Ideas from this work can be applied in various academic fields and to all levels of teaching.

Our workshop will start with the birthday problem as a demonstration of a threshold concept that can easily be related to. We will then expand on threshold problems in general and discuss, first in groups and then among the entire audience, our own experiences, and how we can use a double-loop learning structure to adapt our course design and teaching.

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Title: Will This Be on the Exam? - Or, How to Motivate your Students to Learn

Keywords: Student engagement and motivation, Student learning, Teaching and learning in higher education

Presentation format: Presentation

Author

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Motivation is a core concept in theories of learning. Motivation is what makes a student invest time and energy to master a subject or to learn a new skill. How a student manages his or her studies depend largely on the degree of motivation, but also on the degree of demotivation. Past research provides relatively fragmented reasons and settings as indicators for what causes students to be motivated or demotivated in their learning efforts. This paper set out to explore the perceived sources of student motivation and demotivation in engineering courses. To extend the transferability and possibly reliability of our results, the study is drawn on the basis from a well cited study by Gorham and Christophel (1992). This also allowed a comparison to be made based on our results and for the analysis to uncover evidence that deviated strongly between in our comparisons.

In our investigation, questionnaires were sent out to various student groups during the fall of 2015. The questionnaire consisted of two questions: “What characterizes a course that makes you motivated to work hard and do a good job?” and “What characterizes a course that makes you demotivated to work hard and do a good job?”

Group 1 (CMETE) consisted of a population of 180 Swedish students in year 1-3 from the Media Technology program year 1-3. The motivation questions were a part of a larger questionnaire. 69 students answered the questionnaire, corresponding to a response rate of 38 %. Group 2 (CMAST+CENMI) consisted of a population of 601 Swedish students from the Mechanical Engineering, and Energy and Environment programs year 1-3. These students were given a short questionnaire with only the two questions regarding motivation and demotivation. 81 students answered the questionnaire. The response rate were 11 %, 15 %, and 16 % for years 1, 2, and 3 respectively. Group 3 (SAS) consisted of 429 international students studying a KTH for a shorter or longer period during the fall semester 2015. 46 students answered the questionnaire, corresponding to a response rate of 11 %. Similar to the comparing American study, the answers were coded and categorized in terms of sub categories of context, structure and teacher to support further analysis.

The results show that issues regarding the course structure were more important both for motivation and demotivation for the KTH student groups, compared to findings analysed further by Gorham and Millette (2009). Furthermore, there are comments about the teacher's ability to explain and the teacher's attitude to the students to a much greater extent than the teacher's subject knowledge in itself. This highlights the importance of pedagogical and didactic skills for teaching staff. One conclusion is that teachers have an enormous potential to influence student motivation both positively and negatively, and it is of great importance that teachers are both aware of, and have the tools to handle this.

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