FACULTY ADOPTION AND PERCEPTION OF TEACHING METHODS: TRADITIONS, TECHNOLOGY & TRICKS

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ABSTRACT

Different methods and technologies supporting the learning process are discussed, and many times also applied, in most higher education institutions. Using versatile, activating methods, instructors can help students make connections among key concepts and facilitate the application of the acquired knowledge to new settings (CDIO Standard 8). Some early adopters are willingly experimenting with new approaches, whereas others prefer utilizing more traditional settings. However, the effect of these methods, and utilization of emerging educational technologies, are often critically discussed by at least a part of the faculty. There has been a series of educational developments piloted and implemented at the Department of Information Technologies at Åbo Akademi University, too. In addition to the general goals to improve learning as well as to meet the challenges connected to student attrition typical in ICT-engineering education, the dual-campus environment has required novel approaches as students are not always physically present. In this paper, the current structure of the M.Sc. in Computer Engineering curriculum, and the different methods and educational tools recently applied at the department are presented. The faculty members' experiences, reflections on the different approaches, and their possible impact on learning results and teachers' workload are analyzed based on semi-structured interviews. Also, future insights are discussed based on the results.

KEYWORDS

Active Learning, Computer Science, Curriculum Development, Learning Analytics, Learning Methods, Project-Based Learning, Standards 3, 5, 8, 10

INTRODUCTION

Globalization, new technologies, migration, international competition, changing markets, transnational environmental and political challenges are all addressed as drivers for the need of new learning methods in a working paper from Unesco by Scott (2015). Still, much of teaching is performed using the traditional lecturing model, where the teacher/lecturer talks

the students through the material. This model originates from the model of copying written material by one reading, the rest writing it down. This was the copying machine before technology brought in alternatives. The technology of printing books changed things a lot, not necessarily needing to copy the book itself, but emphasizing the part of books that the teacher found important. Activating students was performed by making them write down and take notes.

Today, most information ever produced is available on any handheld device in a few seconds. The information might even be produced almost at the same time as it is consumed. This enables completely new ways of learning and sharing of information. TED Talks (www.ted.com) founder Chris Andersson (2016) gives a good example of this by the dancing group Legion of Extraordinary Dancers that performed a stunning show by learning from YouTube. A new generation is growing up with access to all information produced, sharing how-tos, and guidelines using social media. This generation is hard to activate using the traditional learning-by-writing-down pattern. Therefore, the educational industry, higher education institutions as a part of it, is looking for new learning and teaching methods that motivate and activate students.

Different methods and technologies supporting the learning process are discussed and applied in most higher education institutions. The CDIO Initiative emphasizes that active learning methods engage students directly in thinking and problem-solving activities. Using versatile, activating methods, instructors can help students make connections among key concepts and facilitate the application of the acquired knowledge to new settings (CDIO Standard 8; www.cdio.org). The increasing volatility, uncertainty, complexity, and ambiguity of the world challenge educators to help students develop a reliable compass and navigation skills to find their way during their career. For example, embedding decision skills into engineering curricula has been considered essential for future engineers to prepare them for unforeseen situations (Rouvrais, LeBris & Stewart, 2018).

The field of Computer Science and Information Technology is closely-coupled to the rapid technological development, and also the engineering education institutions in this domain have been very active in developing their curricula and applying new teaching and learning methods to respond to these challenges. For example, the development of first-year student experience and activities have been reported by several authors (e.g., Teo, Tan & Wah, 2013; Martinez & Muños, 2014; Marasco et al., 2016). This field is also ideal for different project-based learning applications since many of the professional industrial R&D activities are implemented as complex projects. CDIO-oriented project-based learning case studies and developments have been documented, for instance, by Kulmala, Luimula & Roslöf (2014), Nyborg, Probst & Stassen (2015), Mejtoft & Vesterberg (2017), and Säisä, Tiura, & Matikainen (2019).

Typically, some early adopters are willingly experimenting with new approaches, whereas others prefer utilizing more traditional settings. However, the effect of these methods, and utilization of emerging educational technologies, are often critically discussed by at least a part of the faculty. At the same time, as proactive seeking for new, improved ways to enhance the learning process is needed, one can argue that many experiments are done without structured planning and analysis of the outcomes. It can also be argued that sometimes developments are implemented due to external requirements (the old method is no longer possible to use), or alternatively just because of a desire to try out new technology and gadgets. Creating a clear shared vision to guide educational development and providing support to the faculty members is important to facilitate the process (Andersson et al., 2012). In addition to different training programs, also mentoring approaches and other peer-focused activities have been

found useful to help the teachers to realize that "just" preparing good lectures is not enough but, instead, they should focus on planning the students' learning process and come up with active learning experiences to induce this process. (Loyer & Maureira, 2014).

There have been several educational developments implemented at the Department of Information Technologies at Åbo Akademi University (ÅAU) as well. In addition to the general goals to improve learning and to face the challenges connected to student attrition typical in ICT-engineering education, the dual-campus environment has required novel approaches as students are not always physically present. The aim of being able to scale courses to suit the needs of small vs. very large groups has also been affecting the work. Several different methods and tools have been utilized during this process. For example, learning journals, flipped classroom applications, self-correcting assignments, virtual lectures, mini-projects, and capstone-type project courses have been introduced. Although ÅAU is not a member of the CDIO Initiative at the moment, the development of the M.Sc. in Computer Engineering program has been inspired by the CDIO Standards for some time already. For example, the Master-level project course in Software Engineering and the competitive elements connected to it (Roslöf, Björkqivst & Virtanen, 2012; 2017) have connections to the CDIO framework.

In this paper, the current structure of the M.Sc. in Computer Engineering curriculum, and the different methods and educational tools recently applied at the department are discussed. The faculty members' experiences, reflections on the different approaches, and their possible impact on learning results and teachers' workload are analyzed based on semi-structured interviews. In addition, future insights and potential research topics are studied.

DEGREE PROGRAMME STRUCTURE

The Degree Program in Information Technology at ÅAU is a combined B.Sc. and M.Sc. program in the ICT domain. The focus is set to develop the students' competences to apply the principles of Mathematics, Engineering, and Computer Science to develop new computer-based solutions to fulfill the needs of our modern society. The Computer Engineering specialization leading to a Master's degree in technology [in Swedish: Diplomingenjör; ÅAU is the only Swedish-speaking university in Finland] has a special emphasis on the engineering of software-intensive systems, with a focus on cloud computing, the industrial internet, as well as safety-critical and autonomous systems. The total extent of the program is (180+120) 300 ECTS (European Credit Transfer System) credits, and it is planned to be completed in (3+2) 5 academic years (Åbo Akademi University, 2020). The curriculum structure is illustrated in Figures 1 and 2. The student who is accepted to the Bachelor's program can continue directly to the Master's studies after completing the B.Sc. degree.

Vipunen (https://vipunen.fi/en-gb/), the Finnish education administration's reporting portal maintained by the Ministry of Education and Culture and the Finnish National Agency for Education, provides statistics on the student flows of the higher education institutions in Finland. The data is categorized by the fields of education. That is, the degree programs in the field of Information and Communication Technology at ÅAU are displayed jointly, and the details of the B.Sc. and M.Sc. (Tech.) programs in the Computer Engineering specialization are not directly available. Yet, the overall figures provide an overview of the volume and efficiency of these programs. During the past ten years (2009-2019) 417 students have started the Bachelor-level education (having the right to continue to the Masters without a new admission process) and 246 the Master-level education in the field of ICT at ÅAU. Respectively, a total of 289 B.Sc. and 315 M.Sc. students have graduated from these programs during the

past ten years available in Vipunen (2008-2019). The intake volumes to the different programs have varied and, thus, it is not possible to make any specific interpretations based on this data. Yet, the success rate of the programs during this period is 69% on the Bachelor-level and 48% on the Master-level. Although these challenges are present in all fields of education, engineering is one of the main areas of concern dealing with student attrition. In general, approximately only one-half of the students entering engineering education ever graduate (Shuman et al., 1999), and the field of ICT is considered to be one of the most challenging domains due to the high demand of these professionals. In other words, the drop-out rates of the ICT programs at ÅAU are rather typical, or even satisfactory, in the global context. However, there is room for improvement.

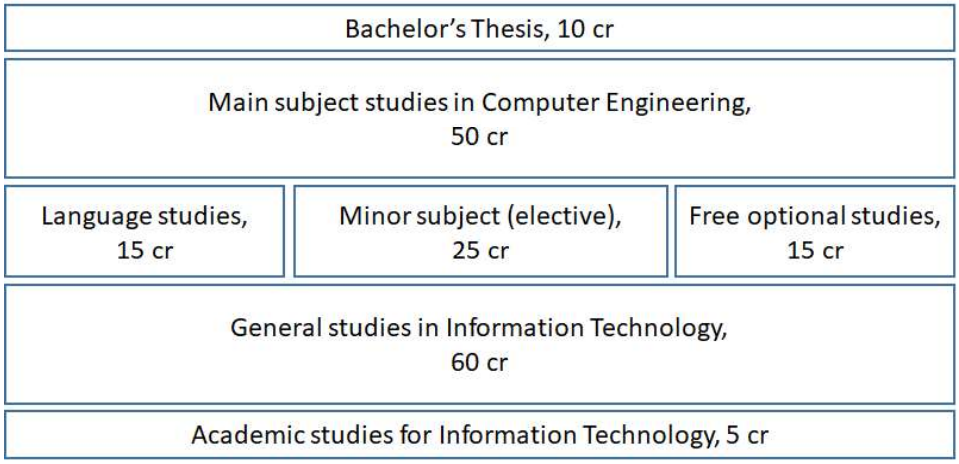

Figure 1. The curriculum structure of the B.Sc. Degree Program (180 ECTS credits) in Information Technology (Computer Engineering specialization) of ÅAU.

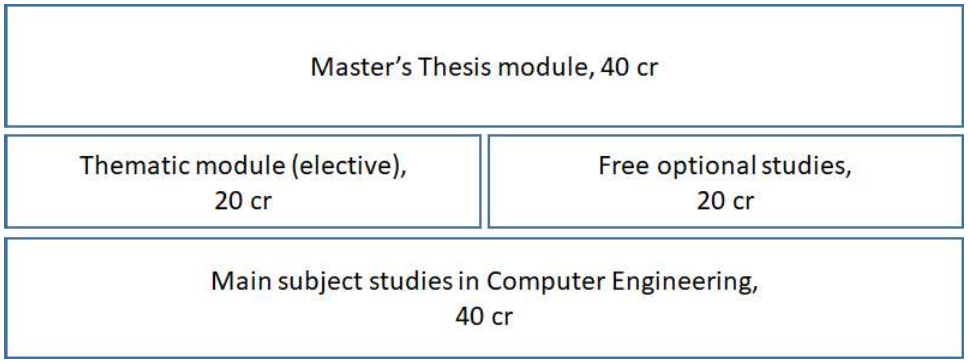

Figure 2. The curriculum structure of the M.Sc. Degree Program (180 ECTS credits) in Information Technology (Computer Engineering specialization) of ÅAU.

The engineering education at ÅAU also has the challenge of being given on two campuses, one in Turku and one in Vaasa. The campuses are more than 300 km apart, so giving a course that is available for students on both campuses requires planning the course to support this. The main methods here have so far been lecturing over video links, using local exercises, and lecturers visiting the other site for a couple of days. On the other hand, this also supports students that already during their studies have started their working career and can take advantage of course virtualizations.

In the ÅAU ICT programs, there have been ongoing activities for improving study program performance. Study program performance is here means how the program works overall – including student performance, drop-out-rates, student throughput, and teacher workload. These activities have included planning in subgroups with their own topics. These topics have included learning and teaching methods, program overview, and curricula, as well as marketing and student recruitment. So there has been a long history of discussing how to improve. These discussions have motivated many to implement changes to the courses. Among methods tested are learning journals, flipped classroom, automated exercises, project- and problem-based learning. During the last academic year (2019-2020), many courses were produced in parallel as virtual courses, where all lecture-room-time was recorded and provided online for students that could not physically attend the lectures.

RESEARCH QUESTIONS AND METHODS

The research question of this study was to find out how the faculty members of the Department of Information Technologies apply and perceive the different learning and teaching methods. Besides, the goal was to gather their experiences on possible utilization of different tools, applications, and platforms to support their work and the students' learning.

The faculty members' experiences, reflections on the different approaches, and their possible impact on learning results and teachers' workload are analyzed based on semi-structured interviews. The interview consisted of 9 quantitative and 9 qualitative questions. The department has 14 full-time faculty members currently (excluding the first author of this paper). The study was presented in a faculty meeting, and an open invitation to participate in the interviews was submitted to all.

In total, ten interviews were conducted that provided rather nice coverage of the department's teaching staff. The interviews were performed during December 2019 and January 2020. All the interviews were conducted face-to-face, and the responses were documented jointly by the author(s) and the respondent during the discussions. Most of the interviewees had several years of teaching experience. Both the average and median of the teaching experience was 18 years, ranging from 1 to 33 years. Eight respondents defined their primary teaching role as course-responsible teachers, one as a lecturer and one as an exercise instructor. The number of courses that the interviewees have been giving during the past five years was 44.

The interviews were performed by the authors, one of which is part of the regular faculty staff of the department. This might have affected the interviews and biased the answers. Also, the department curriculum, i.e., computer science and engineering, might bias the interviewees' answers, as they may perceive that an ICT-education should use more ICT-tools than other curricula. This possible bias cannot easily be removed, so it is acknowledged, but not handled in the results. All the discussions were experienced as relaxed and open. That is, the authors believe that the received results were not heavily affected by the setting.

RESULTS FROM INTERVIEWS

The objective of the interviews was to study the faculty members' opinions and experiences of new teaching and learning methods. It should be noted that even if these methods are here called *new methods*, many of them have been around for quite a while. Hence, the

interpretation should be *new* in the sense that they are new for the course, for the study program, or the faculty member him/herself.

The interview started with finding out the interviewees' interest and willingness to test new learning methods in general. In Figure 3, the respondents' own willingness is compared with the experience on the willingness of the rest of the department. In general, there seems to be quite a good atmosphere for exploring new ways of learning and teaching. Especially the feeling of freedom to test new methods is almost at the top.

The learning environment and technology should also support new learning and teaching methods. For example, other room setups than a traditional classroom can be required, the facilities might need support for group activities, the infrastructure should support video recording and editing, and tools for enabling online material distribution should be available. The results illustrated in Figure 4 indicate that the available learning environment is usually not considered an obstacle. However, the responses differ between the interviewees.

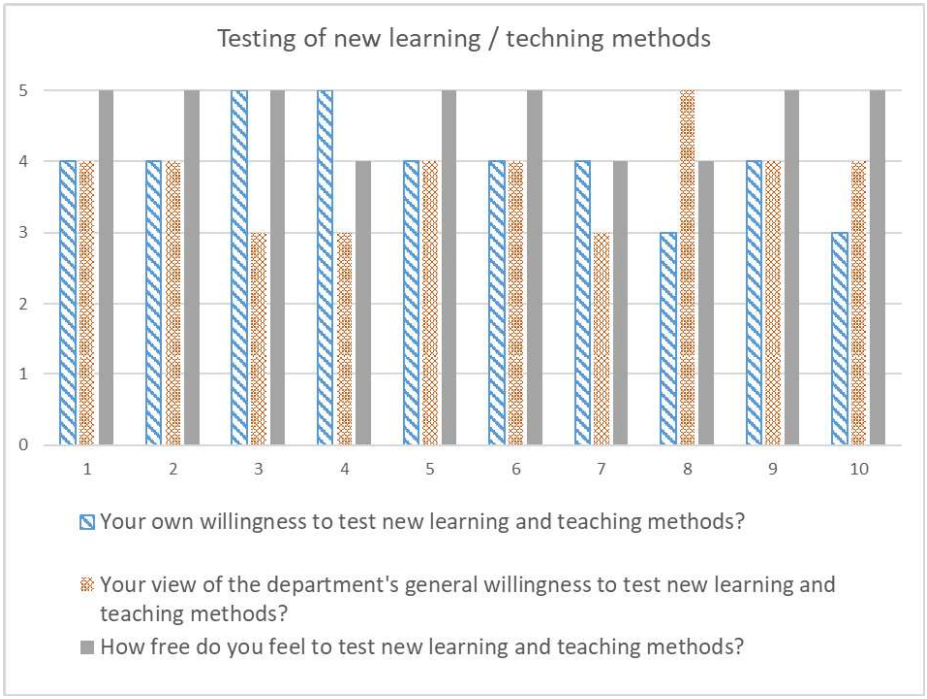

Figure 3. Willingness to test new learning and teaching methods and experience on the freedom to implement new pilots.

Another quantitative question was to find out the interviewees' expectations on their workload due to the introduction of new methods in the end. The average was 2,4 (in scale: 0 decreased a lot – 5 increased a lot), showing a belief that the workload should be slightly reduced. However, most of the lectures stated that changes are not implemented primarily to decrease their workload but to increase quality. If practical work related to a course is reduced, more time is available for course development and quality improvement. This was a common comment; nobody believed that their workload would actually decrease, but the time will be used to improve the quality of the courses.

The workload did not change too much; for example, online students tend to contact me via private channels that take a lot of time. I tried to steer them to common discussion channels; it often takes more time to answer questions online than face-to-face. [Respondent 6]

For courses in which the fundamental theory is "constant", it is worth it [the workload decreases]. But if the content needs to be updated all the time, the saving of time is not as clear. [Respondent 9]

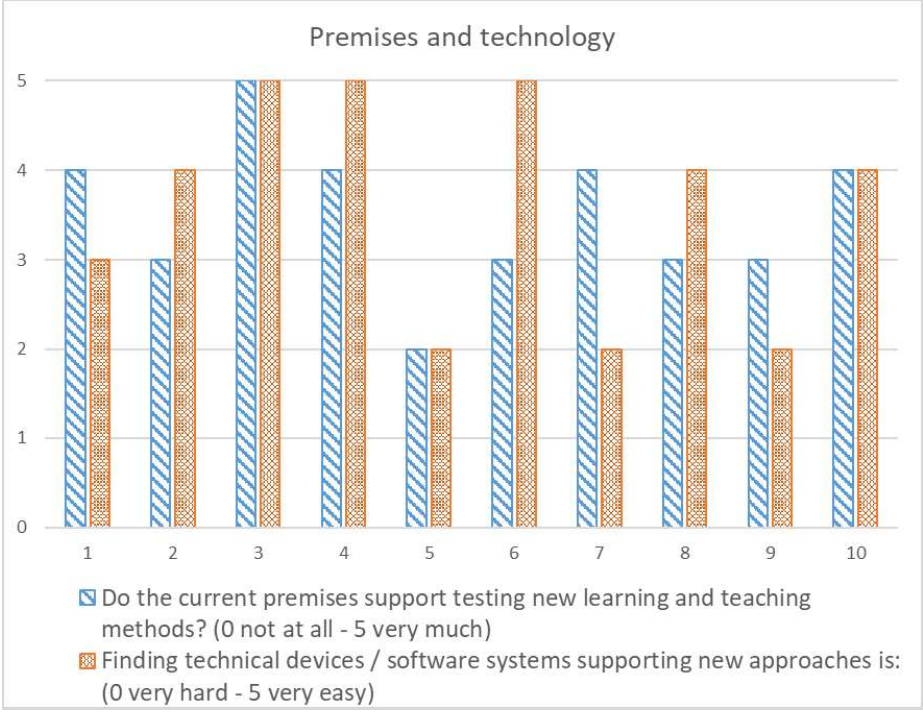

Figure 4. Does the learning environment (premises and technology) support the use of new learning and teaching methods?

The number of teachers using specific teaching methods is shown in Figure 5. The most common method is still the traditional lecturing model with exercises. However, problem-based and project-based methods are regularly used to increase motivation among the students. Furthermore, some lecturers use gamified learning applications and learning journals to increase student motivation and to activate them during the course. One teacher provided fully online courses.

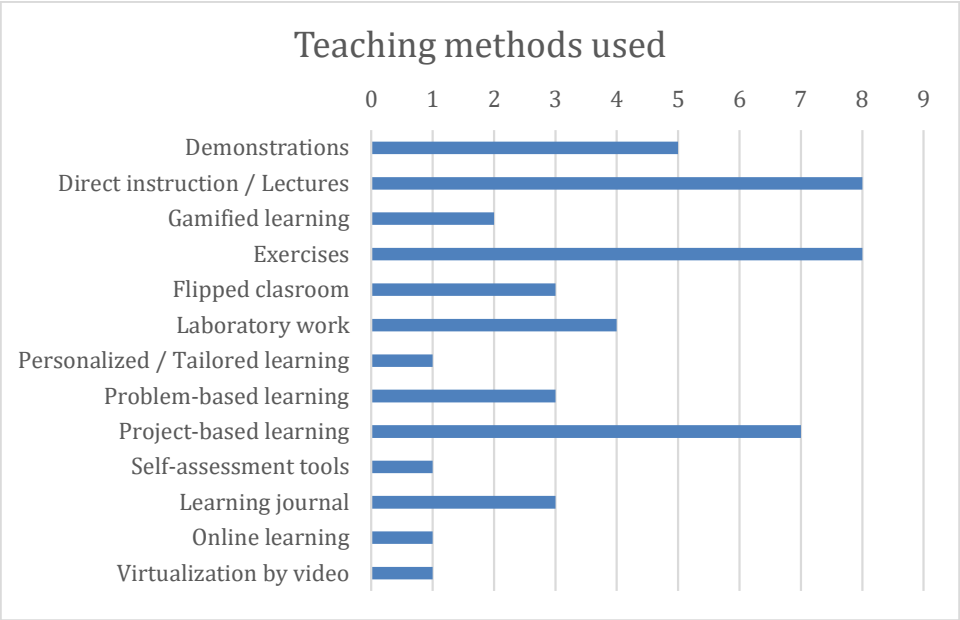

Figure 5. The number of lecturers using a specific learning and teaching method.

One of the questions was why the teachers had selected to test these methods. The most common answer was that they wanted to motivate and activate the students. The objective was to transfer the learning time from passive listening to more active "learning by doing" to get the students involved in practical activities and group work. The reason for self-assessment tools, like self-correcting exercises, was to take away work from "boring" exercise correction and to use it to provide feedback to students either on a personal or a group level instead.

> Activating methods, pair work, and teamwork; "doing" during the lectures. The students shall WORK. [Respondent 3]

> To make the course content more motivating. The traditional methods are not attractive; teamwork works well if just the team functions. [Respondent 7]

We also asked the respondents' opinion on the benefits of the change, and if the learning results were affected. Common answers were that the benefits are visible when the students work more actively, and they work as groups. But also concerns were mentioned – interactive methods only work when the students are motivated and active. Naturally, this interactivity depends on the teacher's ability to facilitate the process. Yet, the teachers cannot force students to learn; that requires work by the students themselves, too. Improvement of the learning results (grades and throughput) were mentioned, but very significant conclusions on learning outcomes improvements were hard to derive.

> Course results have improved, especially the feedback (to the teacher) on what they have learned during the course has become much clearer (what has been considered difficult/easy etc.). [Respondent 7]

> No relevant change was noticed with the small group of mine. Fundamental motivation plays a greater role. [Respondent 8]

It was also asked whether the utilization of new learning methods also require the course content to be updated or not. Almost all respondents answered that this is the case. That is, introducing new learning methods also leads to transforming the course into an updated and more interesting format. In general, introducing a change, the system can also be improved. And for sure, without any changes, no improvement can happen.

There were also several requests on learning analytics that could be useful for the faculty members. Most of these included a need to get detailed and direct feedback on the course content. Information on which parts of the course were good vs. not so good from the students' learning perspective and, for example, how much time the students used for the different parts. Which course elements get the students' attraction, and for how long? If there is video material available, which parts of them are actually watched, and how long or how many times?

As a general comment, there was concern that the increasing side-streams (e.g., open university students and other life-long learning participants) of students are not fully supported by the current course implementations. These students are not automatically following the same model as full-time students, but they might be a larger share of all students in the future. Furthermore, the motivation and (pro)activity of the students was again emphasized as the key to good learning results. Open discussion and different ways to share good ideas and practices among the faculty were considered very important. Guest experts on active learning and teaching methods should be invited to give advice. Finally, a comment from the youngest among the interviewees: "There is great value also in "old-fashion" lectures and exercises, given that they are well-planned and inspiring."

CONCLUSIONS

The main outcome of this paper was to present the results of interviews performed among the faculty members responsible for the learning and teaching activities of the ICT degree programs at the Åbo Akademi University, Finland. Also, background information on the program and its context were discussed. The objective was to study and share the faculty members' views on the question of the title, "Do new tricks & tech really support the learning process?"

As a general conclusion, the answer to the question of whether new learning and teaching methods, application of educational technologies, and "tricks" is worth it or not, is YES. Different changes, new methods, and alternative ways to learn and teach do usually improve the learning process according to the interviewees. Yet, all the development steps do not necessarily lead to rapid improvements in the learning results, and, sometimes, several iterations are required. These efforts may also require more resources than the results save on short notice.

It is important that the teachers have an interest in developing their courses, and that the environment supports that in different ways. The Department of Information Technologies at ÅAU clearly has a culture that supports the faculty to develop their work and actively try different alternative ways forward. If no changes and pilots take place, it is certain that no positive development steps are taken either. However, as another conclusion, one could say that the most successful improvements do not necessarily come from the methods themselves, but more from the teachers' objectives and desire to activate the students during the courses. New methods and tools may help to achieve this increased level of learning activity. To reach good learning outcomes, we need processes that motivate and activate students of today.

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BIOGRAPHICAL INFORMATION

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