ACTIVITY-BASED COURSE DESIGN AND THE ROLE OF LEARNING ASSISTANTS

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ABSTRACT

The context for this study is the course *Introduction to Analog and Digital Electronics* piloted during the autumn semester 2020 with 120 first year students. Through the use of observations and interviews, we explore how the use of learning assistants can help in the design and co-creation of learning environments that explicitly support students in their individual development of reflective skills in large first year engineering courses. Grounded in the qualitative analysis of the empirical material and the literature, we argue that activity-based course design in combination with the use of learning assistants can be an important element in engineering curriculum development.

1   INTRODUCTION

For engineering students to be able to solve problems in their future profession, it is essential for them to be able to actively participate in and experience engineering practices during their education and connect these experiences to theory [1]. In this process of learning from experience and integrating it with theory, it is essential that students engage in reflective practices [2]. Building on Dewey's work [3], we argue that learning is a continuous reorganization, reconstruction and transformation of experience, and that reflection is a meaning-making process that helps students to move from one experience to the next with a deeper understanding of the experiences.

It is, however, important to notice that not all students will automatically engage in reflection, and it has therefore been proposed to frame and integrate reflective activities explicitly within courses [4]. Engaging in reflective activities right from the beginning, when entering higher education, emerges therefore as an important goal in the re-design of engineering curricula. A major hindrance for these efforts is the large number of students in typical first year engineering courses. This leads to the question of how to design and create learning environments that explicitly support students in their individual development of reflective skills [5] in large first year engineering courses.

In this study, we will approach this question and explore how the use of learning assistants (more experienced students) can help to overcome some of the limitations regularly experienced when integrating reflective activities in large courses. In our analysis and discussion, we draw mainly upon the qualitative analysis of interviews with both students and learning assistants, as well as the research literature on learning environments and course design.

2   RESEARCH CONTEXT AND DESIGN

The context for this study is the course *Introduction to Analog and Digital Electronics* (ADE) planned for approximately 700 first year students in electrical engineering, computer science and communications. A pilot for 120 students was given during the autumn semester 2020. Through activity-based course design, the course aims at combining the planned and predictable from lecture-based teaching with the exploratory and participatory from problem-based learning [6].

At the heart of this approach are recurring 3-hour long *Experience – Reflect – Practice* (ERP) sessions. Over the period of a semester, the students have 20 ERP-sessions and each session contains a mix of different activities like practical experiments, theoretical reasoning and calculations. Students are encouraged to work in groups in a large designated open work area suited for collaboration, but those who like to work on their own are allowed to do so.

Instead of traditional lectures, each ERP sessions is preceded by a classroom assembly. During this maximum 45 minutes long assembly, teachers will take up themes that have been identified as difficult during the previous ERP session, as well as provide some framing and information for the coming ERP session. The topics for

the assembly are generated during weekly meetings between learning assistants and teachers and are based on recurring questions and challenges they have encountered when interacting with the students. All activites were mainly done physically at campus, but with the possibility of following digitally if necessary.

When it comes to hand-ins, the students deliver individual reflections focused on the activities they participate in once a week rather than solutions to an assignment or lab report. To allow for facilitation and support of all students, learning assistants take an active role in the course [7]. They support the students during the ERP-session and have individual meetings with each student every other week to discuss the students' reflections and progress from the two preceding weeks. There were 8 learning assistants involved in the course, which comparable to similar courses at NTNU and as such resources will not pose a limitation in the implementation process.

To explore the role that ERP-session play in the course design and how the individual meetings are experienced, we used a qualitative research approach. Data was collected through observations of individual meetings towards the end of the course and individual interviews with students (n=4) and learning assistants (n=4). Students were recruited from the entire student population in a self-selected manner. Learning assistants were recruited based on the already recruited students to ensure a match in the student-learning assistant pairs. The interviews lasted between 20 and 50 minutes and were recorded and transcribed. They were conducted and transcribed by Carvajal, who is not part of the teaching team in the course. The interviews were held in the participants mother tongue, Norwegian, and only the sections used here have been translated to English.

For the analysis, the interviews were pooled together and a general inductive analysis approach [8] was used to identify, analyse and describe patterns and themes within the data. The material was read and re-read to explore what role ERP-sessions play and how they are experienced. Through this iterative process, we identified different themes that emerged from the interviews. These themes were further explored by considering relevant literature and using it as an additional perspective to develop and deepen the analysis. In this study, we will focus on two themes from the analysis: course design and individual meetings. In addition to the interview data, we draw upon some quantitative results from an end-of-year survey given to the students in the course (n=45).

3   RESULTS

From the survey, we observe that most students appreciate the design of the course, 96% of the respondents answer that they are overall satisfied or very satisfied with the course. The students were also asked to assess the degree various activities contributed to their understanding of electronic systems. Here, 87% reported that the *ERP sessions* to a large or very large degree increased their understanding; 84% reported this for *interactions with peers*; and 87% for *interactions with learning assistants during the ERP-sessions*. With regard to *interactions with learning assistants during the individual meetings*, 56% said it had to large or very large degree

influenced their understanding, and 23% reported little or very little increase in understanding.

Based on the interviews, we will in the following section focus on the students' and the learning assistants' experiences with the activity-based course design and the individual meetings between student and learning assistant.

3.1 Course design

From the interviews, it becomes clear that the students and learning assistants are aware of the course design and its connection to their learning. Furthermore, the students state clearly that they prefer the structure of this course compared to their other course which have a more traditional design. From their point of view, their involvement in the discovery and exploration through the ERP-sessions contributes greatly to their learning:

> «I think it is absolutely brilliant really! I wish that all my courses were like this, because I felt that I was left with new learning after every single session, and it may sound quite strange that you do not do that in all the courses, but there are many courses I in fact feel that you are not left with leaning after each session. But, here it was like something new and you were part of the whole process itself. So for me at least it has been a really good way to work» (S4).

The students point out that it is important for them to take ownership of their own learning and to participate in discussions:

> «I have not had any courses that are organized in the same way, so much self-learning or like you have to experience and learn from. I really think that a lot of people have been content with it because you have room for discussions and can experience things yourself as well» (S2).

By situating active experiences of electronic phenomena at the center of the course, the students' curiosity is stimulated giving them the opportunity to think about their own questions, resulting in reflections where experiences are related to theory:

> «[...] in ADE I feel that it has been sort of like *« why does the current go there? »* *and then we get an explanation for it and then «ok, but that make sense » and then I remember it. So, I really think that the course has suited my curiosity very well*» (S3).

While many courses aim to foster independence and reflective approaches with respect to content, the learning assistants report that this course motivates students to reflect regularly on their own learning processes in addition to the content:

> «Because it is not something you just say, *«We will teach you to reflect, and that it is important that you become independent, and that you think about what you can and what you cannot»*, *all the course coordinators says that regardless, if you ask them. But here it actually becomes a task for the student to do it, be set to reflect, and you have to do it once a week*» (LA4).

Through further comparisons with courses with similar content but different designs, it becomes apparent that the students believe that learning through experiences facilitates the entire learning process and leads to more understanding. To some degree on the expense of rote theory memorization:

> «I really think it is interesting. And I like the way it is organized, because the difference in relation to other courses that are quite the same is that we learn more, it makes it easier, one

understands it in a more practical manner. While others may learn even more theory and knowledge about the things, but they do not understand the why» (S1).

This is echoed by the learnings assistants, who also highlight that the students have learned a large amount of theory without realizing the extent due to the design of the learning experiences:

> «And then they have learned quite a lot the first year, in fact they have learned a lot of theory, but they have not felt it themselves that they have had a lot of theory, so the course has been altered... it has been done in such a way that they feel that things are going well and that they understand things, even though there is a lot» (LA3)

As the course is organized around activities with an extensive support system through collaboration with peers and the learning assistants, students who cannot or do not want to participate in the course at campus can find the course more difficult than their peers. Participation is a key factor of the learning process in this course and the students recognize this clearly:

> «[...]If you are not sitting in [the working area] when you are working with it, where one kind of has access to all the learning assistants and resources, then it was quite difficult to work with the subject. [...] » (S4)

Overall, the students and learning assistants emphasize that the course design facilitates the students' learning and development of knowledge and understanding through a focus on discovery, exploration and a support system of peers and learning assistants.

3.2 Individual meetings

An important part of the support system mentioned above is the obligatory individual meetings between student and learning assistant. While collaborating in small groups with their peers can be beneficial with regard to both motivation and understanding, the students can choose to not ask their peers questions due to concerns that they will slow down the progress or reveal a lack of knowledge, thereby losing some of the benefits of the collaboration. The individual meetings with the learning assistants, on the other hand, provide a dedicated arena for students' individual needs and based on the interviews and our experiences it appears that they are comfortable asking questions without considering the needs of their peers in those meetings:

> «The greatest learning outcome is probably getting things explained until you understand them. Because when you are working, it is quite normal to just understand things halfway and then one wants to move on, you do not want to be the one that linger or halter the work. While here you have a quarter of an hour of conversation that is only devoted to your competence, so you can ask until you receive the answer you want or you understand it. So, that is perhaps one of the best things about those conversations in relation to groupwork» (S1).

This is supported by the learning assistants who experience the individual meetings as a safe space for the students, where the student can ask questions freely as only the learning assistant and student are present:

> «They can talk to someone in private because some might feel that is a bit embarrassing to say that «*I did not understand this*» in front of the other students and then they have... I think

that a big benefit of them being able to come and ask us questions in a confined manner is that there is only one person that are listening» (LA3).

To succeed as learning assistants, they must have the skills to create a safe environment and at the same time be knowledgeable enough to meet the students' expectations on the course curriculum. This is noticed by the students who report, when comparing experiences, varying levels of competence among the learning assistants:

«I find it very nice to be able to ask someone who knows it a little better, but unfortunately there has been a big difference between the learning assistants, because some know both the inside and outside of the course, while others are a little like that they do not completely understand all of the principles» (S1).

Similarly, from the learning assistants' perspective, the usefulness of the individual meetings was greatly influenced by the student's preparation and motivation, which differed from student to student:

«Some students were very engaged and prepared, had a lot of questions and got a lot out of the conversations. And others, they did not have anything with them, they did not have anything they were wondering about, something that made it very difficult for me to try to figure out what they were thinking about» (LA2).

As a result of these differences between the students, the learning assistants explained that they developed different strategies to handle the diversity in the student population; asking questions to lead the students into discussions or reducing the time dedicated to the meeting:

«But then I started asking different kind of questions to try to get them started. And now it is not like I must force them to have a conversation, if there is nothing to talk about then there is no point anyway»(LA1).

The ability to guide the students through these conversations is an additional skill required by the learning assistants in their role in this course. This along with the ability to create a safe environment and a mastery of the course content results in high requirements placed on the learning assistants. This is also reflected upon by the learning assistants themselves, who identify the importance professional self confidence in this role:

«You have to have professional self-confidence, or at least confidence, to keep doing it this way, because having to ask questions...to ask the correct questions, be curious and such, requires that you also have belief in your own skills and certitude that you actually know this, otherwise it will be very difficult» (LA4).

To summarize, the individual meetings fill an important role in the course design. These meetings give the students an arena where they can fill the gaps in their understanding. By using learning assistants as facilitators, it is possible to use activity-based course design in courses with many students. However, the effect of the individual meetings is highly dependent on the mindset of the student and the competence of the learning assistant, which is reflected in both the interviews and survey.

4   DISCUSSION

From the survey and the interviews, we see that the activity-based course design appears to support students in their learning process. The survey shows that a large majority of the respondents were satisfied with the course and that the organization supports their learning. While the students interviewed were recruited through self selection, and therefore might have a bias, we believe the results of the survey support the findings from the interviews and allow us to use them to explore the effects of this course organization further.

By situating the ERP-sessions at the center of the course, instead of lectures or written material, the students become curiosity driven and are required to continuously reflect on their own mastery. Collaborative work and learning assistants are important elements to address gaps in students learning through discussions with peers or through the individual meetings.

One success factor of the course design, identified by both students and learning assistants, is active participation of the students in the organized learning activities and conscious use of the support structures in the course. Discussions with peers and with learnings assistants are highlighted as important to learning both in the interviews and the survey. Students that do not actively participate will therefore have less opportunities for reflection and potentially learning compared to their peers.

A safe and inclusive learning environment is therefore paramount to allow a diverse group of students to participate in the learning activities and benefit from the activity-based course design. To co-create this type of learning environment requires a particular focus on the social dynamics between students, between students and learnings assistants, as well as the physical learning space. The social environment needs to be based on and embrace values of support, trust, and collaboration, rather than competition [9]. Furthermore, learning assistants and teachers need to act as role models and live these values and emphasize the importance of exploration, discovery and reflection rather than finding the "right answer". In addition, the physical space needs to be designed in a way that is conducive to collaboration and discussions [10].

As underscored in the interviews, mastering the role as learning assistant in this course requires a professional self-confidence. The learning assistants need to master the course content while simultaneously being able to reflect on their own position as role models who foster a certain type of social learning environment. As this course is planned to be given to approximately 700 per year, the learning assistants must be aware of that they both need to work together to create a supportive learning environment and as a group be independent facilitators as the course faculty cannot follow every assistant closely. Based on the initial empirical findings in this pilot, we are, however, positive that an activity-based course design where learning assistants play a central role is possible and a suitable approach for large first-year engineering courses. By involving learning assistants in new ways, we can overcome challenges and limitations with teaching resources that traditionally constrain first-year course activities.

5   SUMMARY AND ACKNOWLEDGMENTS

Grounded in the qualitative analysis of the empirical material and the literature, we argue that activity-based course design in combination with the use of learning assistants can be an important element in engineering curriculum development. In order to be able to upscale the ideas outlined here and to apply the concepts to other courses, it will be important in the future to gain even more insights into how learning environments can be co-created with students, learning assistants, and faculty, as well as how this affects the learning process, and how the learning assistants understand and develop their role within the course. Finally, we would like to thank all students and learning assistants that have been part of this pilot.

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