EVALUATION OF NOVEL LEARNING SPACES FOR MIXED ON-CAMPUS AND ONLINE STUDENTS

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ABSTRACT

This paper will evaluate the effects of new learning spaces for mixed on-campus and online students. In 2015, the Electronics Engineering study programme at Aarhus University School of Engineering (ASE) in Herning decided to provide an online learning option in addition to the traditional classroom instruction. Consequently, the flipped learning approach was introduced in both the online and on-campus teaching, allowing online students to join the classroom teaching synchronously and asynchronously. However, due to a high dropout rate, various initiatives for improving online student retention have been implemented since 2016, and despite heavy legislation affecting the university, which makes it almost impossible to work full-time while also studying full-time, the majority of the 2016 online student intake is still actively engaged. A number that continues to increase with the 2017 and 2018 intakes. From 2016-2017, data was collected and evaluated to gain further insight into what it is like to be an online student. The findings have led to new strategies for collaboration, student-centred learning and optimised learning spaces for how we conduct flipped learning at ASE in Herning. Some of the new strategies have been introduced to the 2018 student intake; among these are *Slack* and *RealTimeBoard*. Likewise, new ways of team collaboration, where the students sit in their teams at round tables, have been implemented. Each team consists of a mix of on-campus and online students, and the lecturers connect to the students' (virtual) workspaces via an iPad, thus combining a physical and virtual experience in the learning space. Conclusion is that organising the classroom with round tables together with RealTimeBoard supports the strategy of creating a more modern classroom with a student-centred approach to learning and a better integration of on-campus and online students, while Slack was not considered an appropriate 'candidate' for a modern communication platform.

KEYWORDS

Online learning, flipped learning, teamwork, personal skills, socialising, engineering workspace, interaction, retention, Standards: 1, 2, 3, 6, 7, 8.

BACKGROUND

The background for introducing the online learning option at ASE in Herning was a critically low intake of students in 2014. The teaching staff related to the study programme initiated a process that should lead to a strategy for increasing the intake. To understand and conceive the problem, several tools were used, including the university's own development method 'EUDP' (Embedded Unified Development Process), which is compliant with the CDIO concept. Quite early in the process, it was decided to offer an online concept with the mission to:

- Create a study programme with both on-campus and online students.
- Create a great study environment for both on-campus and online students.
- Include unique teaching methods.
- Stand out positively from existing engineering programmes.
- Give the students the opportunity to follow the teaching independently of time and place.

To offer the study programme as an online option, it was necessary to implement the flipped learning approach in teaching. A process started in the spring of 2015 where the teaching staff was to 1) *conceive* the concept (i.e. gain an understanding of flipped learning), 2) *design* the concept (i.e. create explanatory videos), 3) *implement* the concept (i.e. integrate the videos into the university's learning management system 'Blackboard') and 4) *operate* the concept (i.e. conduct flipped learning in the teaching). Subsequently, the CDIO process has been repeated through several iterations, as we learn and experience new things all the time.

With only eight students in 2014, our goal was a student intake of 40, which we reached in August 2015. However, the dropout rate remained very high, particularly among the online students, and consequently, several strategies to improve the learning and reduce the dropout rate were initiated. Among these are:

- Mixing teams of on-campus and online students.
- Informing the students about the workload before they begin their studies.
- Organising a social event before semester start.
- Coaching the students in effective studying and study planning.
- Introducing project days where all students must attend on-campus sessions.

The strategies have resulted in reduced dropout rates going from 67% (2015) to 50% (2016) to 38% (2017) and to 20% (2018).

In 2016, the Danish Accreditation Institution published a report that focuses on Massive Open Online Courses (MOOCs) (MOOCs – Kvalitet og perspektiver, 2016). Although MOOCs have positive features, there are some concerns in terms of learning environment, intentions, interaction, motivation, dropout rate, etc. For instance, the MOOCs dropout rate is more than 90%, which is the main reason why we have chosen another online learning method.
At ASE in Herning, we have three categories of students: On-campus students, synchronous online students (who follow the teaching online at the same time as the on-campus students) and asynchronous online students (who follow the teaching online wherever and whenever they have the time to study). When looking at the dropout rate for each of the three categories of students, the dropout rate for the 2018 intake so far is:

- On-campus students: 0%

- Synchronous students: 23%
- Asynchronous students: 47%

The dropout rate for the asynchronous students is still too high and calls for a further reduction. In conclusion, however, it seems that the strategies implemented to reduce the dropout rate have had a positive effect. One of the most effective tools has been to emphasise to the applicants that having a full-time job while studying full-time is not an option. Surveys show that the number one reason for dropping out is lack of time (H. Slavensky, P. Lysgaard, 2018).

SCOPE AND METHOD

This paper will evaluate three new initiatives toward novel learning spaces for mixed on-campus and online students: The modern classroom as an interactive learning space as well as the use of Slack and RealTimeBoard as modern communication platforms. The effects of lower dropout rates cannot be evaluated yet, but student satisfaction based on qualitative interviews and quantitative surveys can and will be measured.

THE MODERN CLASSROOM AS AN INTERACTIVE LEARNING SPACE

Inspired by Bergman and Sams (2014) and P. Young et al. (2016), it was decided to establish a modern classroom as an interactive learning space with on-campus students in their teams and online students represented via monitors. The primary aim was to foster team spirit and facilitate a student-centred approach to learning instead of the traditional classroom instruction (H. Slavensky and P. Lysgaard, 2018). When introducing the online learning option in 2015, the teaching was flipped by creating video sessions for the students to be watched before an in-class lecture, and the time in class was spent on exercises and enhancing the students' engineering learning space. This corresponds to the CDIO Standard 6 ('Engineering Workspaces') and the CDIO Standard 2 ('Learning Outcomes'), i.e. personal and interpersonal skills. Watching the videos at home corresponds to the two lowest levels of Bloom's taxonomy (remembering and understanding; see Figure 1 below), while the time spent on exercises in the classroom (the learning space) is applicable to Bloom's higher levels of taxonomy (applying, analysing, evaluating and creating).

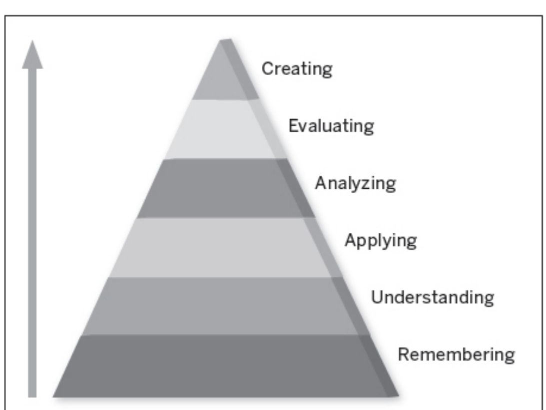

Figure 1. Bloom's taxonomy (J. Bergman and A. Sams, 2014)

From 2015 to 2017, the learning space was not well established; the physical setup in the classroom was still traditional rows of tables and chairs, facing the lecturer sitting at a desk. Although the students were divided into teams based on their Insights profile (Insights Discovery, 2019) and the statement from the CDIO Syllabus report (2001) ("Graduating engineers should be able to conceive-design-implement-operate complex value-added engineering systems in a modern team-based environment"), the students sat randomly in the classroom. In addition, not all team members were represented in the classroom, and as a result, the lecturer could not support the students team by team. Starting in August 2018, it was therefore decided to reorganise the classroom, seating the students in their teams at round tables in small 'table islands' (see Figure 2 below).

Figure 2. Students seated at the round tables

At each table island, two to four on-campus students and two synchronous students were represented. The on-campus students were invited to have a dialogue with the synchronous students via virtual Adobe Connect meeting rooms. This setup worked well, but unfortunately, it also created too much noise in the classroom. Therefore, noise-dampening materials in the form of partition walls were installed.

Figure 3. Introducing partition walls as noise-dampening material

In Figure 3, the classroom partition walls between the teams can be seen. The students, however, disliked the walls and removed them. In order to create ownership, the students were encouraged to find the setup *they* preferred. In addition to the noise level, the students indicated that the tables were too small; they suggested bringing back the big squared tables, and arrange these as islands instead. As to the noise level, the students proposed the use of headsets in the learning space. This way, the noise from the loudspeakers from the synchronous students was removed, but the setup made it difficult for the lecturer to interact with the teams. It was suggested to integrate a 'plugin', enabling the lecturer to enter the room via a PC or mobile phone by running Adobe Connect using headsets. The outcome was a solution where the lecturer used an iPad and a wireless noise cancellation headset. As stated previously, each team has been enrolled in individual Adobe Connect meeting rooms, to which the lecturer can log into when supervising a team. In Figure 4 below, the final setup, which has been used by the author of this paper in the autumn of 2018, can be seen. The setup has proven to be a very efficient workspace, where the students can go through the cycle of conceiving, developing and implementing (a product, process or system). In fact, a quantitative survey conducted among the online students showed that they would prefer the rest of the teaching staff to implement the same setup in their teaching. Thus, starting in January 2018, the 2nd semester students will have the same setup in all classes.

Figure 4. Introducing iPad and headsets

In the traditional classroom, students usually need help from the lecturers when they are stuck on a difficult problem. This is most often the case when they work on an assignment at home or when the lecturer is unavailable (J. Bergman and A. Sams, 2014). With the interactive learning space concept, the lecturer is available as a facilitator and expert when needed, and, additionally, the students can help and motivate each other. However, this concept is only valid for on-campus and synchronously students. The asynchronous students face the same problems as in the traditional classroom; the lecturers are not available during weekends or at other times outside of normal working hours. In order to help the asynchronous students, each team consists of both on-campus and online students, ensuring that the asynchronous students can get help from fellow students (however not always in time). Another way of motivating the asynchronous students is to offer interesting project-based courses, where they can join the class synchronously or asynchronously. The social aspect of studying is extremely important, and thus, two project weeks during each semester, where all students must be present on campus, are held. In order for the students to conceive and design as well as implement anywhere at any time, the students are equipped with a ‘lab-in-a-box’. On campus, we have various lab facilities for implementing and operating the projects, providing a unique learning space compared to the traditional classroom instruction.

MODERN COMMUNICATION PLATFORMS

A qualitative analysis on student socialisation and learning spaces (Slavensky and Lysgaard, 2018) has revealed that the students at the Electronics Engineering study programme in Herning do not have a specific favourite communication platform, but the online students agree that Skype, Facebook, Discord, email, Google Drive and Trello work well. None of the online students uses the Adobe Connect platform or Blackboard, both of which are provided by the university. One reason could be that the students often experience sound problems with Adobe Connect in the learning space. Another reason could be that Adobe Connect and Blackboard do not offer the same ‘smooth’ connection as the students’ preferred platforms; they have to log into the systems with their username and password, which is more inconvenient than using their smartphones. This could call for other modern communication platforms supported by the university (Slavensky and Lysgaard, 2018). It should be noted that the use of modern communication platforms is solely for supporting collaboration *between* on-campus and online students; it is not to provide information about the students to the university. When implementing a new communication tool, it is also important that the university has approved the tools to comply with the General Data Protection Regulation (GDPR).

Slack

In the conceive phase, the cloud-based team collaboration tool Slack came up by recommendation from the CDIO development lab. According to Slack's website, Slack is a workspace facilitating team communication to enhance workflow by organising communication in channels and supporting integration with commonly used services and apps. Slack offers access to the collective information of a class (Slack, 2019). As mentioned above, the university currently uses Blackboard as an internal communication and learning platform for all courses and activities. The students generally like Blackboard, but they do not use Blackboard when communicating and collaborating. Thus, when learning about Slack, it was decided to try the platform for communication and collaboration between on-campus students and online students.

Before implementing Slack to the students, it was introduced to the teaching staff. Having tested the platform, the lecturers found Slack useful for communicating and sharing information, so it was decided to introduce Slack to the students who started in August 2018. In Figure 5 below, the setup of Slack on 23 February 2018 is illustrated. The # channels represent the 1st semester courses, and the channels with a lock icon are private channels visible to the lecturers only.

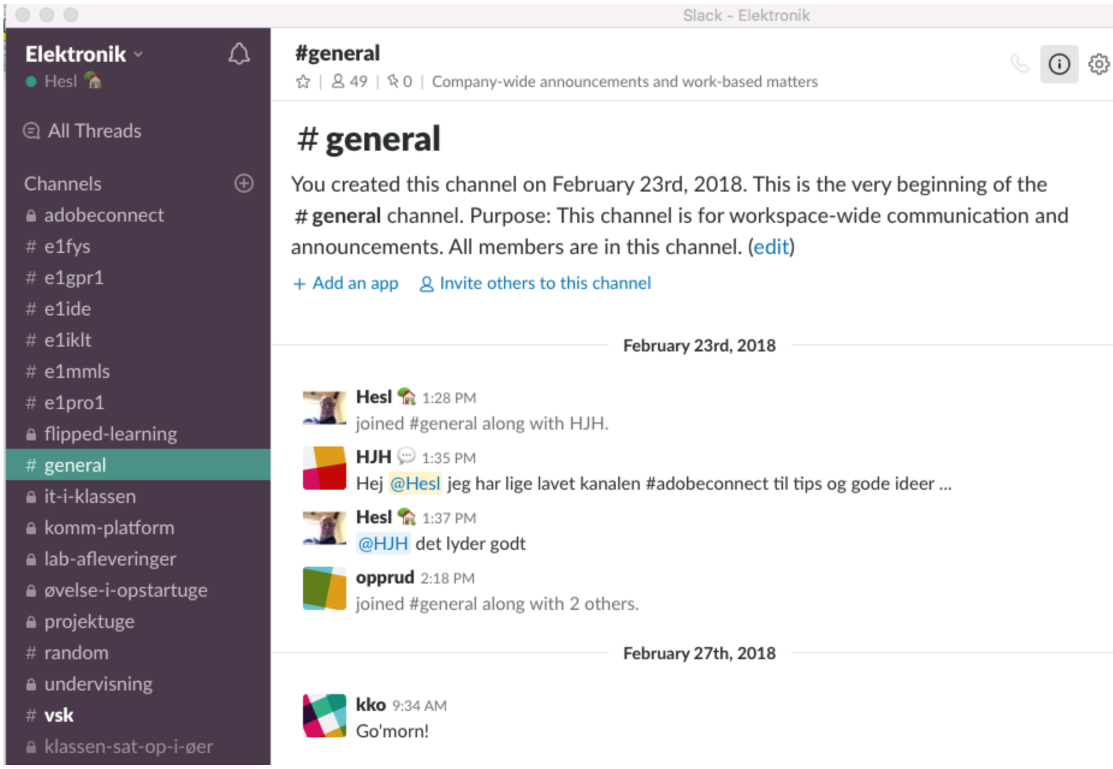

Figure 5. The first setup of Slack (23 February 2018)

In Table 1 below, the channels, members and posts are listed. The table reveals that only half of the students have added themselves to the channels, and only a few have posted items on the channels. The '# vsk' has the lowest number of members, but the highest number of posts (the last posted on 5 December 2018). The reason for the relatively high number of posts on this channel could be that the course lecturer has used Slack for saving official course documents as a supplement to Blackboard.

Table 1. Slack channels, members of the channels and posts

Channel	Members	Posts
# e1fys	22	2
# e1gpr1	29	8
# e1ide1	22	5
# e1iklt	19	0
# e1mmls	22	0
# e1pro1	20	4
# vsk	12	22

Due to the low number of members and posts, it was concluded that Slack was not used as intended or hoped. Despite the fact that it was properly introduced to the students, and the students were encouraged to use it, it was not their natural choice. Some students reported that they did not see any clear need for Slack; others said that Slack was too complicated/confusing to use. Consequently, Slack was not considered an appropriate ‘candidate’ for a modern communication platform to support collaboration between the on-campus and online students in Herning.

RealTimeBoard

RealTimeBoard is a cloud-based whiteboard service. It enables simultaneous and real-time synchronised collaboration and communication activities by any number of team members across any number of infinitely large whiteboards (RTB, 2019). In contrast to Slack, it filled a gap in the portfolio of collaboration tools. RealTimeBoard is geared towards productive team collaboration, specifically with features for interactive joint visual problem solving, visual team organisation with Scrum boards, etc. Hence, RealTimeBoard directly supports the teams and interpersonal focus of the engineering programme (and of CDIO). RealTimeBoard was deployed to a pilot team consisting of two on-campus students and five online students. Of the five online students, three to four were asynchronous and one to two were synchronous (with one living in the GMT+8 time zone). For this team, RealTimeBoard became a central component in a collaboration toolchain also consisting of SharePoint for file storage/sharing, Facebook groups for posting short messages, news and updates (both formal and informal) as well as Adobe Connect for conducting online meetings. It was found that RealTimeBoard could support the learning objectives and interpersonal development focus of the students in three major ways.

First, using RealTimeBoard as a collaboration tool enhanced the appeal of and decreased the barriers to participating in the joint learning space. For the students, the flipped learning preparation at home can support the basic learning objectives of remembering and understanding concepts and methods from the curriculum (Bloom’s taxonomy, Figure 1). Reaching the higher learning objectives towards mastery of the curriculum however requires an in-depth application, analysis and evaluation of the theory to problems. Indeed, this is where RealTimeBoard fits in. A key finding was that the asynchronous students benefitted from the material written on the whiteboard developed in the synchronous learning space, although they had not attended the classes. The whiteboard served both as a visual artefact of what had taken place during class and as a reference/source that could support the students in their own problem solving later on. To illustrate this point, one asynchronous student reported (translated from Danish), “It is great that I can go on the board and keep track of what the others have worked on during the day. I use that a lot.”

Second, RealTimeBoard supported the problem-based process of the semester project exceptionally well. The project was a ‘make-it-fly’ type of project with a well-defined end goal but allowing a relatively free process through the CDIO phases with a competitive element added for extra motivation. Solutions for several interdependent elements of the project had to be conceived, developed and implemented, each step requiring coordination and joint problem solving. A key success factor in having non-co-located students develop interdependent solutions was the ability to easily share, refer to and annotate technical documentation. It was a common observation that a question or request for information, presented visually or in text by one student, was resolved later by another student through pinning explanations, measurements, drawings or annotations directly together with references to technical documentation.

Third, the observations above indirectly illustrate the key point that better and simpler tools for collaboration can reduce barriers for teams of mixed on-campus and online students to productively cooperate and thereby develop their interpersonal skills.

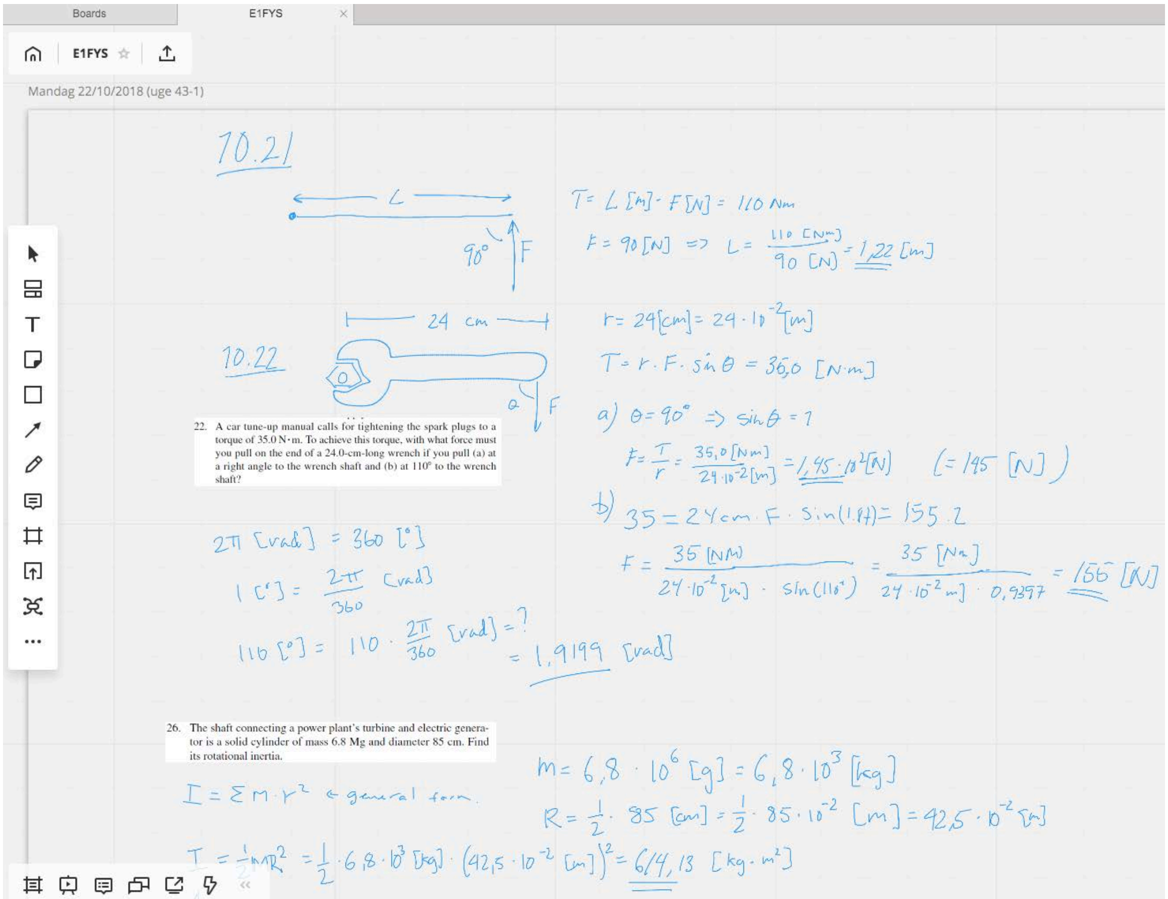

Figure 6. Example of online visual collaboration on a problem in a physics lesson

A qualitative interview showed that the team found RealTimeBoard a key success factor in the 1st semester. It was a factor in the successful delivery and good collaboration process for the semester project. Additionally, it also contributed to increasing the efficiency of the learning space for individual learning in the courses. In conjunction with a voice connection over Adobe Connect, the tool has been important in the social integration process and the cohesion of a highly distributed team.

CONCLUSION

This paper has evaluated three new initiatives toward novel learning spaces for mixed on-campus and online students: The modern classroom as an interactive learning space as well as the use of Slack and RealTimeBoard as modern communication platforms. The results of our efforts are not yet reflected in lower dropout rates, but based on qualitative evaluations of student satisfaction, we can conclude that organising the classroom with round tables together with RealTimeBoard can support the strategy of creating a more modern classroom with a student-centred approach to learning and a better integration of on-campus and online students. Slack was not considered an appropriate ‘candidate’ for a modern communication platform, supporting collaboration between the on-campus and online students in Herning. Based on this learning, the university will further develop and implement better student-centred approaches to learning. In particular, we will need to find best practices for facilitating online learning that is effective and engaging for all students, including asynchronous students. Perhaps asynchronous students need more flexibility than the current learning paths offered to our on-campus and synchronous students today.

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BIOGRAPHICAL INFORMATION

Henning Slavensky is an Associate Professor in electronics as well as study mentor at the Electronics Engineering study programme at Aarhus University School of Engineering, Herning, Denmark. His current research focuses on collaboration and learning spaces in a setup of both online and on-campus students.

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