Abstract

In 2015, the Electronics Engineering degree programme at Aarhus University School of Engineering in Herning decided to offer an online learning option concurrently with providing traditional classroom instruction. Following this initiative, the student intake increased significantly, primarily because the programme appealed to a completely new target audience. With the online opportunity, it was decided to implement the ‘flipped classroom’ approach into both online and on-campus teaching, meaning that online students were able to join the classroom teaching synchronously and asynchronously. Moreover, Insights Discovery Personal Profiles were introduced, and based on their profiles, the students were divided into online/on-campus teams with all colour energies represented in each team (blue, red, green and yellow). In addition, the students’ practical skills were taken into account, making sure that at least one person in the team had vocational training. To enable online students to communicate with each other and the lecturers, an e-learning platform via Adobe Connect was established. At semester start, the online students attended an introductory course, where they were introduced to the learning platform and could meet their fellow students. However, despite these initiatives, a high dropout rate of online students enrolled in the study programme in 2015 was observed.

Personal conversations with the programme mentor have shown that one of the factors influencing the online students’ decisions to drop out is their full-time job; having a full-time job while studying full time is very time-consuming. Another reason for the student dropout is a feeling of disconnection with their fellow students and the campus environment. Consequently, various strategies to motivate and retain the students were implemented with the 2016 intake. Potential students were invited to a clarifying conversation, where it was specified how many hours a week the student is expected to study. Here, the issue of the work-family balance was also addressed. This ‘screening’ has certainly made it clear to the students what is expected of them. In addition, we have seen a decrease in students with full-time jobs who, thus, are able to join the teaching synchronously, engaging them much more directly. This, combined with a new strategy of forming mixed teams of online and on-campus students, has boosted the student life satisfaction significantly and improved the online students’ interaction with on-campus students. Today, online students take much more responsibility, as they also want the on-campus students to be successful. Conversely, on-campus students now feel more responsible in that they must ensure that the online students do not feel isolated, e.g. by providing them with information and electronic devices that they need to complete a project at home or via the mobile kit ‘Lab-in-a-box’.

Since September 2015, 11 out of 14 online students have dropped out the study programme, i.e. a dropout rate of 79%. Compared to this, the dropout-rate of the online students enrolled in September 2016 with the implemented new strategy, has been reduced to 43% (10 out of 23).

Keywords: Online learning, flipped classroom, Insights Discovery, teamwork, student life satisfaction, mentoring, interaction, retention.

1 INTRODUCTION

The current paper is a continuation of the paper “Energising Electronics Engineering: Improving Learning by Flipping the Classroom and Going Online” [3]. To set the scene, a small summary of the paper is provided in the following.

In 2014, the student intake at the Electronics Engineering degree programme in Herning, Denmark, was exceptionally low, and the education in its then form was no longer sustainable. It was therefore decided to rethink the study programme completely. Based on lessons learned previously about reducing the dropout rate and improving the quality of the education [5], the vision of the new study programme was ‘more and better engineers in Herning’. The idea was ‘to create a degree programme which included both on-campus and online students’; ‘to have a good study environment for both on-
campus and online students’; ‘to include unique teaching methods’; ‘to stand out positively from existing engineering programmes’; and ‘to give the students the opportunity to follow the teaching independently of time and place’ [1]. The goal was a minimum intake of 35 students, and the method was to ‘energise’ and redefine the teaching concept supplemented with an extensive marketing effort.

While maintaining the traditional classroom instruction, it was decided to offer an online learning option, and following this initiative, the ‘flipped classroom’ approach was implemented into the teaching. The structure of a flipped course roughly follows the STREAM learning design model (Figure 1). The lecturers publish videos, texts and exercises in the Blackboard Learning Management System at least one week in advance on any given lecture/lesson so that the students can access the teaching material out of class. For each class, the students must take a test in or out of class (online). Based on the results of the test, the lecturer adjusts his/her presentations and exercises to cover areas that seem particularly difficult for the majority of the students. Subsequently, the students (on-campus and online) engage in exercises in class or online. The lecturer helps where needed, while at the same time taking into account the actual skill level of the students. Since all presentations are streamed and recorded, asynchronous online students can watch these from home at a time suitable for them.

At the Electronics Engineering degree programme, all classrooms have been designed with an eye to the online teaching. The equipment consists of a control PC with a 50”/60” confidence monitor and an 84” touchscreen connected to the lecturer’s PC, displaying and streaming the lecturer’s desktop. Two high-resolution pan-tilt-zoom (PTZ) cameras provide ambience and visual cues to the online students, including the additional option for shooting close-ups of e.g. components in connection with demonstrations. Two-way sound between on-campus and online students/the lecturer is possible via microphones built into the ceiling as well as attached loudspeakers. During lessons, online students can interact with the lecturer and their fellow students by asking questions via chat.

Figure 1: The STREAM learning design model.
Figure 2 above presents a screenshot from a session via Adobe Connect. To the left, the two video streams are shown with the chat below, and to the right, the content of the lecturer's screen, which is streamed to the 84" touchscreen, is displayed.

All lessons are recorded and made available immediately after class. In parallel with the lessons, an Adobe Connect supervision add-in has been created for each course in Blackboard, where the students can interact with the lecturer, e.g. by sharing their screens, resources, etc. When interacting via the supervision add-in, some synchronous online students prefer that the lecturers use headsets to exclude noise from the classroom. The lecturers usually supervise the online students via the supervision add-in when on-campus students make exercises in class.

To facilitate teamwork between on-campus and online students, all teams have access to webcams, e.g. when making lab exercises (Figure 3).

Figure 3: On-campus students interacting with an online student represented on a double robotic [7].
Online students who follow the teaching asynchronously have access to the teaching material and follow-up Q&A, if any, immediately after a class has ended. In addition, this group of students, who often study at night and on weekends, can schedule meetings with the lecturers outside of regular office hours. These meetings take place via the Adobe Connect supervision add-in. In addition, there is a continuous follow-up per email.

On-campus students have gained more opportunities with the new online classroom layout compared to the traditional classroom layout. The students are encouraged to log on and e.g. take screenshots of the teaching to supplement own note-taking. Moreover, visually handicapped students can use various IT tools on their own PCs while following the teaching. Additionally, our evaluations show that both online and on-campus students make use of the teaching recordings both in their daily work as well as when preparing for examinations.

With the online initiative, the student intake increased dramatically from 10 in 2014 to 31 in 2015 and to 40 in 2016 following an intensive marketing effort. However, with the 2015 intake, 11 out of 14 online students have dropped out the study programme, i.e. a dropout rate of 79%. This paper will address the issue of how can we can maintain a steady increase of student intake by offering online education, while at the same time improving the online student retention rate.

2 METHODOLOGY

The methodology used to develop and improve the Electronics Engineering study programme is based on action research [6], which in our case involved an eight-step process:

1 Identification of a problem to be studied
2 Data collection
3 Organisation, analysis and interpretation of the data
4 Development of a plan to address the problem
5 Implementation of the plan
6 Evaluation of the results
7 Identification of a new problem
8 Repetition of the process.

In the following sub-sections, each step is described.

2.1 Identification of a problem to be studied

The problem became clear when we realised that the dropout rate among online students admitted to the degree programme in 2015 was quite high.

2.2 Data collection

Based on the personal conversations with the online students, who had withdrawn from the programme, the data was collected, i.e. the students’ reasons for dropping out.

2.3 Organisation, analysis and interpretation of the data

The personal conversations revealed that the primary factors influencing the dropout rate were 1) having a full-time job while studying and 2) feeling a sense of disconnection from the campus environment.

2.4 Development of a plan to address the problem

To address the problem, we made a plan for the 2016 intake. It was decided that clarifying conversations with potential (online) students were to be conducted before semester start, and in the first semester, we would continue to make use of Insights Discovery Personal Profiles; however, this time we would form mixed teams of both on-campus and online students.
2.5 Implementation of the plan

We implemented the plan in the spring of 2016 starting with the clarifying conversations. Following the plan, we have conducted Insights Discovery tests and workshops in the autumn of 2016/spring of 2017 with all students admitted in September 2016.

2.6 Evaluation of the results

The evaluation of the results will be treated in section 3 (‘Results’).

2.7 Identification of a new problem

Having evaluated the results and reflected on the learnings from our work, new challenges have emerged, which are described in section 4 (‘Conclusions’).

2.8 Repetition of the process

The teaching staff at the Electronics Engineering degree programme will focus on improving the education, and as new problem areas arise, the various steps of the process will be repeated.

3 RESULTS

In the following, the strategies and tools we have used to boost student life satisfaction and engagement and improve online student retention are described. These are ‘Clarifying conversations’, ‘Teamwork and Insights Discovery Personal Profiles’, ‘Insights Discovery workshops’ and ‘Mentoring’. Moreover, the results of our work are presented and evaluated.

3.1 Clarifying conversations

Since 2016, potential students have been encouraged to attend a personal conversation with the head of the study programme or the programme coordinator/programme mentor to clarify whether the education is relevant or realistic for the student to complete. One of the things we focus on at the conversation is whether the potential student is in fact motivated to complete the education. Do they have the drive and passion for electronics and software that it takes? Moreover, we stress that they must be prepared to spend 40–50 hours per week studying. Therefore, if they have a full-time job, we want to make sure that they are motivated and can find the time to study the estimated 40–50 hours per week. We also address the work-family balance; if the potential student is married and/or has children, we want to make sure that the family is prepared for the workload ahead. By the end of the conversation, we will know whether the student is ready to apply for the study programme, be it online or on-campus. If they choose to study online, we inform them about the synchronous online opportunity, since this option is the closest to being physically present in the classroom. Clearly, they will not have the opportunity to be part of the campus environment, but they can ask questions at the same level as the on-campus students, and the lecturers can involve them in the teaching in the same way as the on-campus students. Finally, we encourage the students to follow the lessons physically on campus as much as possible or even move to Herning.

Below, the characteristics of the online students admitted to the study programme in 2015 and 2016, respectively, are outlined.

- **Characteristics of online students admitted in 2015:**

  A typical online student admitted to the degree programme in September 2015 has a full-time job, is married and has children. His/her motivation for studying is the prestige/coolness of being able to complete a university education, while at the same time having a full-time job; a job which s/he does not really find interesting, and therefore is motivated to replace with a high in-demand job with a higher wage. The student does not spend more than 10–20 hours studying, s/he follows the teaching asynchronously, and does not have a need for social contact with other students; this need is already covered by the student's family and colleagues.

- **Characteristic of online students admitted in 2016:**

  A typical online student admitted to the degree programme in September 2016, i.e. after we implemented the clarifying conversations, does not have a job (a few work 10–20 hours per week). Like in the case of the 2015 intake, the motivation for studying is the possibility to pursue
a dream job. The student is highly focused on studying, and strives to follow the teaching online synchronously. Finally, the need to socialize with fellow students seems to be greater compared to the 2015 intake, as s/he has no or little social life with colleagues.

3.2 Teamwork and Insights Discovery Personal Profiles

When the students have been admitted to the degree programme, they receive a welcome letter with various practical information prior to semester start. In the letter, we ask them to complete a questionnaire with their motivation for studying, their goals, educational background, current job, why they decided to apply for the study programme, if they have any practical skills, etc. In the letter, we also provide a link to an Insights Discovery Personal Profile test, which they must take. Insights Discovery is a psychometric tool based on the psychology of Carl Jung. It has been built to help people understand themselves, understand others and make the most of the relationships that affect them in a workplace. The Insights Discovery methodology uses a simple four-colour model to help people understand their style, their strengths and the value they bring to the team. These are called the colour energies, and it is the mix of red, yellow, green and blue energies that determines how and why people behave the way they do [4]. The programme mentor at the degree programme uses the results of the tests to form teams and conduct an Insights Discovery workshop at an introduction seminar before the semester starts.

The Electronics Engineering degree programme is divided into seven semesters. From the first to the fifth semester, the students work on projects designed to let them apply their theoretical knowledge into concrete practical solutions. Already in their first semester, the students learn how to make projects based on the way projects are conducted in the ‘real world’ outside the university. Using the Embedded Unified Embedded Development method (EUDP) [2], the students are introduced to project management, the importance of making and following a plan and the importance of having the correct specifications in an agile, user-centred process. They also learn to document their findings in a report. Additionally, they learn the power of working on individual tasks in a team with complementary competencies and personal profiles. This is different from a group, where everyone works on the same task at the same time, only together.

As mentioned above, the Insights Discovery Personal Profiles together with the students’ practical skills comprise the dataset that enable the programme mentor to form ‘dream teams’. To prevent conflicts from arising when practical problems occur in the labs, we stress that at least one person in each team should have vocational training.

With the 2015 intake, we chose to divide the students into on-campus and online teams, respectively. We decided to do so, as we could see potential problems arising with the online students often being physically away from campus. Meanwhile, we quickly learned that the online students tended to withdraw more often than the on-campus students did; they felt disconnected with the campus environment and did not take responsibility for their fellow team members. We therefore decided to change the composition of the teams with the 2016 intake. While we continued to divide the students into teams based on their Insights Discovery Personal Profiles and practical skills, we chose to pair up the students in teams of typically three online and three on-campus students. The outcome has been that the online students now feel they are a part of the university community; they know that if they drop out, the rest of the team could face many problems, e.g. when completing a project. Moreover, the on-campus students can more easily provide the online students with short messages and hints from the lecturers, and the on-campus students, on the other hand, can draw on the online students, who are typical older and have work and life experience. The on-campus students often tend to do a task themselves, because it seems easier, but we advise them to delegate tasks and responsibilities to their online fellow students.

3.3 Insights Discovery workshops

When the students attend the introduction seminar prior to semester start, we conduct, as mentioned above, an introductory Insights Discovery workshop, where the Insights Discovery is explained, including the four colour energies, the Insight Wheel with its 72 sub-types as well as communication strategies for the different profiles (Figure 4). The idea of this introductory workshop is to get the students to know, understand and respect each other, while also learning to understand themselves and developing team communication strategies. They realise that we are all in the same boat, and they need to help each when facing challenges.
At the introductory workshop, all students are physically represented; however, the subsequent workshops may be conducted with some students being away from campus. The only thing we need to take into account here is the different time zones. At the workshops, we use the Adobe Connect platform to communicate with the online students. In 2015, the online students only attended the introductory workshop, but in 2016, all students were present at all workshops. Some of the workshops conducted during the first year are “Effective study teams”, “We listen to each other’s messages”, “The effect of personal styles in teams”, “Finding common ground” and “Your importance to the team”. These workshops really develop the students’ team skills and strengthen their ties with one another and the university, thereby boosting their life satisfaction and engagement.

Figure 4: The introductory Insights Discovery workshop at the introduction seminar.

3.4 Mentoring

Based on their initial questionnaires and Insights Discovery Personal Profiles, continuous mentoring and conversations with both online and on-campus students have produced some valuable insights in terms of the students’ motivation, goals and barriers. At least twice a semester, we meet with each student, e.g. at workshops or individual meetings with the programme mentor. The aim of the mentoring is to help the students focus on and reach their goals as well as help them boost their life satisfaction and engagement. Based on the Insights Discovery Personal Profiles, we try to find ways to avoid different obstacles. Often we need to involve the entire team to solve a difficult situation. Some of the outcomes of the mentoring is that the students feel valued and listened to; they feel that someone cares about them, and they have a strong sense of belonging to the education and the campus environment.

3.5 Summing up the results

By offering the Electronics Engineering degree programme as an online learning option in 2015, the student intake increased dramatically from 10 in 2014 to 31 in 2015, as stated previously. The initial results showed that the study programme not only recruited students from across the country and age groups; the new teaching method (flipped classroom) also increased the learning results for both the online and on-campus students, cf. [3]. However, the dropout rate of the online students was rather high. Consequently, the above strategies to motivate and retain the students were implemented with the 2016 intake, and the results from these can be seen from Table 1 below.
Table 1. Student status as of 27 April 2017.

<table>
<thead>
<tr>
<th></th>
<th>2015 On-campus</th>
<th>Online</th>
<th>Total</th>
<th>2016 On-campus</th>
<th>Online</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>17</td>
<td>14</td>
<td>31</td>
<td>17</td>
<td>23</td>
<td>40</td>
</tr>
<tr>
<td>Dropout</td>
<td>4 (24%)</td>
<td>11 (79%)</td>
<td>15 (48%)</td>
<td>2 (12%)</td>
<td>10 (43%)</td>
<td>12 (30%)</td>
</tr>
<tr>
<td>Active students</td>
<td>13</td>
<td>3</td>
<td>16</td>
<td>15</td>
<td>13</td>
<td>28</td>
</tr>
</tbody>
</table>

Table 1 shows that the number of online students has increased from 14 in 2015 to 23 in 2016 despite the fact that we may have ‘discouraged’ some potential students to apply for the study programme, having conducted the clarifying conversations. This is an increase of 61% resulting from an intensive marketing campaign. The total number of students admitted to the degree programme was the same in 2016, i.e. 17 students. With regard to the online students admitted in 2015, 11 have dropped out, which out of an intake of 14 online students is a dropout rate of 79%. Out of a total of 23 online students admitted in 2016, 10 have dropped out, which gives a dropout rate of 43%. As to the on-campus students admitted in 2015, 4 out of 17 have withdrawn, which gives a dropout rate of 24%. With the 2016 intake, this number has been reduced further; only 2 on-campus students out of 17 have dropped out, which gives a dropout rate of 12%.

We did not have any clarifying conversations with students who chose to study on-campus, which indicates that there are of course other factors influencing the high decrease in the dropout rate for both online and on-campus students. It can be difficult to measure, but we are convinced that forming mixed teams has indeed boosted the students’ engagement and responsibility. In addition, the intensive use of Insights Discovery Personal Profiles, workshops and continuous mentoring have certainly also contributed to the lower dropout rate among online students.

4 CONCLUSIONS

Our results show that it is possible to boost student life satisfaction and engagement, and thereby improve online student retention.

The clarifying conversations have proved to be very fruitful in ensuring that the online students 1) have the drive and passion for studying electronics engineering, and 2) know what is expected of them in terms of workload. Moreover, the decision of forming teams of on-campus and online students has increased the online students’ responsibility and engagement as well as made them feel more connected to the campus environment. On-campus students, on the other hand, now profit from the (typically older) online students’ work and life experience. With the intensive use of Insights Discovery workshops, the students have become much more aware of their own strengths and, at the same time, they have developed their communication strategies, which they can use in their team and further professional work. The continuous mentoring has helped both online and on-campus students stay more focused on their goals and reach these, which again has boosted their life satisfaction and engagement, and thus, influenced their decision to stay enrolled in the university.

Having conducted the Insights Discovery Personal Profile tests and workshops, the programme mentor has gained a comprehensive insight into the students, both at an individual level and as teams. However, the teaching staff at the degree programme does not have the same knowledge about the students; they have no contact with the asynchronous online students, and the communication platform for the synchronous online students is not optimal. Therefore, the further work will focus on delegating and spreading the information about the online students as well as improving the online synchronous communication platform.
Some students find the study programme very time-consuming, which could be related to flipping the learning; besides the traditional teaching material (books), they also have to watch quite a large amount of videos and take several understanding tests, which take more or their precious time. Further effort will be spent on optimising this situation.

Finally, we need to facilitate a better way for the students to communicate with each other, as they are not impressed with the Adobe Connect e-learning platform we offer today.

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REFERENCES