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## EARLY INTERVENTION FOR IMPROVING STUDENT PERFORMANCE BY DETECTING NON-ENGAGEMENT

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### Abstract

During the Covid-19 pandemic, both teachers and students had to face many challenges, especially due to the lack of in-person classes. To address those challenges and to make up for the lack of in-person lectures, teaching modalities had been changed, which yielded unexpected benefits. For example, students started to engage more in online lecture sessions via chats, polls, and quizzes. Online lectures were recorded enabling students to revisit them as a valuable study aid, this was particularly useful for international students where English is not their first language. Post Covid-19 pandemic once the teaching was back on-campus, we decided to go with the blended mode of teaching, where we adopted all the positive things that helped in engaging students during our online teaching such as live quizzes, breakout rooms, polls, making lecture content recorded for online viewing, etc. and tried to implement them in the in-person classroom. Running this mode of teaching and learning for 2022, we have received mixed student feedback and academic results. In this paper we first reflect on the strengths and weaknesses of this approach, highlighting what worked for us and what did not, and then we propose ways to mitigate those weaknesses. Specifically, we propose an approach to tackle the lack of student engagement in the modules by identifying the students who are not engaging in the module and making early interventions either to modify the classroom activities or to motivate those students so that they re-engage. There are some key indicator metrics for identifying the non-engaging students, such as attendance in the practical lab/support sessions, log-in details to the servers where the experiments are being run, and results of classroom interactive activities like quizzes, polls, etc. It would benefit the students if these key metrics are utilised right from the start of the module in order to detect the students who might fall behind and perform poorly.

**Keywords:** *Student performance, student engagement, teaching delivery, blended learning.*

### 1. Introduction

Teaching during the COVID-19 pandemic was very challenging, and educational institutions had to adapt many approaches to address those challenges, some of those approaches worked beyond expectations, and some of them simply failed. For example, online chats, polls, and quizzes helped in improving student engagement in the online classroom, but at the same time, there were students who became uninterested/demotivated to attend the online lecture sessions due to a number of behavioural, emotional, or social factors such as lack of direct interaction with fellow students, feeling isolated being online, poor internet connection, etc. (Bergdahl, 2022). In this paper, we are referring to student engagement in terms of their attendance in the classroom, and participation in the classroom activities. Post COVID-19 pandemic, once teaching returned on-campus, many institutions started to mix the online delivery of teaching with in-person classroom lecture sessions to get the benefit of both worlds. This specific type of learning approach is often referred to as ‘blended learning’ (Graham, 2013), which has been widely adopted across higher education well before the COVID-19 pandemic.

Online teaching during COVID-19 gave birth to many new online or internet-based teaching mechanisms and tools as well as increased the use of existing technologies and showcased how some of these can be effective and useful through their extensive usage across various educational institutions ranging from primary schools to big size universities (Khosla, Mittal, Goyal, & Chachra, 2021). This evolution of online teaching has brought a new dimension to blended learning. Here at Queen’s University Belfast (QUB) we also decided to go with the blended mode of teaching by adopting all the benefits that we learned from online teaching during the pandemic.

In this paper, we will first highlight the strengths and weaknesses of our approach for blended learning (Section 2) that we conducted in the academic year 2022/23, and then we propose how to deal with the lack of student engagement through analysing data from our online learning platform and providing

intervention to improve overall student academic performance (Section 3). Finally, we will conclude the paper by discussing how effectively our proposed approach can help in improving student performance and what we plan to do next to improve the approach (Section 4).

## 2. Blended learning: a case study

Blended learning is a learning approach where face-to-face lecture sessions are integrated with online interactions (Graham, 2013). Many Higher Education Institutions (HEIs) started to adopt this approach even in the early 2000's and they used to refer to it as the "new traditional model" (Ross & Gage, 2006) or the "new normal" (Lewis & Parsad, 2008) in the delivery of course materials. In 2008, a study was conducted by the U.S. Department of Education to investigate distance learning in the U.S., which found that 35% of HEIs in the U.S. offered blended learning courses (Lewis & Parsad, 2008).

Post COVID-19 the adoption of blended learning is clearly increasing across all sizes of HEIs because of the evolution of online learning mechanisms, technologies, and tools that we have seen during the pandemic (Singh, Steele, & Singh, 2021). Moreover, COVID-19 forced those who would normally resist a change to these modes of delivery to adapt, and in that sense, COVID-19 was a catalyst for a cultural change. A study organized in 2020 found that students' interest towards online learning approaches has increased as they now believe this may be the new normal post COVID-19, and they are now more inclined towards the use of technology in education (Sim, Sim, & Quah, 2020).

However, the question remains: how the students are performing in such a blended learning environment that is equipped with modern technologies and online teaching mechanisms that were revolutionized during the pandemic? We have tried to answer that question by highlighting what worked for us and what did not or could have been better, and then evaluating students' academic performances against their online classroom activities that we have recorded in our approach of blended learning at QUB in the academic year 2022/23.

### 2.1. The case study

For this paper, we have considered a Stage 3 (FHEQ6) (UK Quality Code for Higher Education, 2014) module in Cloud Computing consisting of 241 Computer Science and Software Engineering students, which was delivered in semester 1 of 2022/23 in a blended learning format. This module was chosen for the case study as it had a large cohort of students with mixed capabilities and diverse student engagements. Table 1 shows how the teaching and learning methods were divided between face-to-face and online delivery for this module.

Table 1. Face-to-face v/s online delivery.

	Face-to-face	Online/ Remote
Delivery of lecture sessions/materials	Lectures were delivered physically in the classroom (usually 2 hours per week). Lectures were also recorded and posted online on Canvas (Virtual Learning Environment)	Lectures/ demos are also carried out online via MS Teams (usually for 1 hour per week).
Lab sessions	Face-to-face lab sessions were provided, but it was optional to attend.	Students had the option to perform their lab work remotely and ask questions online or do the lab work at their own convenient time.
Assessment	Students had the option to work in the lab and get in-person support from teaching staff during lab hours.	Students had the option to book online meetings with teaching staff to get support in their assessments.
Support sessions	Face-to-face support sessions were allocated on request during the office hours of the module owner.	Online drop-in sessions were available where students could ask questions in a discussion forum in Canvas or the module's Teams channel.
Classroom activities	Live Vevox chats, polls, quizzes, etc. were carried out during the face-to-face lecture sessions to keep students engaged.	Live Vevox chats, polls, quizzes, etc. were also carried out in the online sessions.

Some of the methods that are listed in Table 1 worked well for both the students and staff, but some did not work as expected. We have discussed some of them under strengths and weaknesses as follows.

#### Strengths:

1. **More flexibility in learning:** lecture sessions were delivered physically in the classroom as well as recorded for future viewing. This allowed the students to watch or revisit the recorded videos and learn the subjects whenever they wished to, and the practical labs were designed in such a way that the students

could do all the lab work remotely. The Module Evaluation Questionnaire (MEQ) reflected students' satisfaction regarding this flexible learning approach.

2. **Improved student engagement:** students were always encouraged to chat online with the teaching staff to discuss their queries and they were also motivated to participate in live polls or quizzes. These online activities significantly helped in improving student engagement in terms of students' participation in the classroom as compared to what we used to have before COVID-19.
3. **More options to interact with the instructors:** with the availability of online services, students had more options to interact with their instructors even outside the lecture sessions, for example, students were given the opportunity to book slots for MS Teams video call with their instructors to discuss their issues. This particularly helped the students who were too shy or hesitant to ask questions in front of everyone in the classroom.

#### Weaknesses:

1. **Lack of face-to-face interaction:** it was not mandatory to join the lectures/labs in person, there was no attendance requirement for the module, and so, even though face-to-face lectures/labs were always available, some students preferred watching the lecture videos uploaded online or doing the lab work online remotely. This resulted in losing the benefits of face-to-face interaction in a blended learning approach.
2. **Lack of presence:** students were not required to turn their cameras on during a live lecture session, so, most students used to keep their cameras off while attending the online lecture sessions. This made it hard to realise students' presence in the online classrooms, eventually making it difficult to understand whether the students are following the lectures or not as their facial expressions were not seen.
3. **Students' non-engagement:** although online classroom activities increased student engagement in terms of students' participation in the classroom, some students used to trick their attendance in the online lecture sessions by simply logging in the online sessions, without actually watching the lectures or interacting with any of the class activities, like polls, quizzes, etc. This resulted in the non-identification of inactive/non-engaging students, who could have been provided with necessary support/motivation in the early stage of the module, as opposed to identifying them at the end, when they appeared with their issues in understanding even basic topics, and when there was nothing much that could have been done to help them.

## 2.2. The solution

One of the key solutions to address the weaknesses that are identified in our blended learning approach is to find out the students who are not being active or engaging in the face-to-face classroom or online activities such as watching the recorded lecture videos, joining online polls, quizzes, etc. at the right time, well before it's too late to act upon it. Once those non-engaging students are detected, instructors can either modify the classroom activities to fit them or try to motivate those students so that they engage more in the module. This will eventually help to improve students' overall performances in the module.

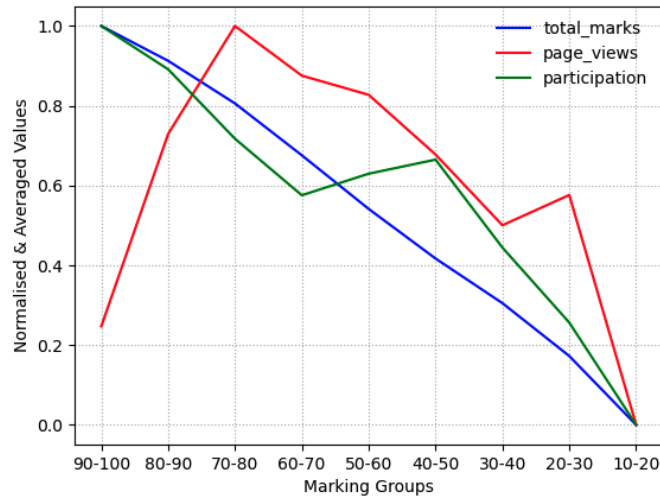
Based on our experience of running the CSC3065 module using a blended learning approach, we have identified some key indicator metrics for detecting the non-engaging students, such as, attendance in the practical lab/support sessions, log-in details to the servers where the lab experiments are being run, logs from our online platform (Canvas) covering student page views (on online materials), student participation on online activities such as quizzes, polls, etc. We have mapped these metrics to students' overall performances in Table 2.

Table 2. Mapping indicator metrics to students' performances.

Metrics	Student Performance
Attendance in the practical lab/support sessions	<ul style="list-style-type: none"> <li>- Students who attended in-person practical labs and support sessions usually did well (scored 70% or above) in the final results.</li> <li>- Students who did not attend the in-person labs or booked any support session generally had issues completing the final assessment. They contacted the module owner very late, just a few days before the exam or coursework submission, and those students mostly failed the module.</li> </ul>
Log-in details to the servers	<ul style="list-style-type: none"> <li>- Students who used the servers for running their practical lab works/experiments on a regular basis for longer hours, usually scored high marks (scored 70% or above) in the final results.</li> <li>- Students who completed all the lab worksheets in a timely manner by attending the weekly in-person lab sessions performed well.</li> </ul>
Logs from Canvas	<ul style="list-style-type: none"> <li>- Students who were active online, viewing the online study materials and participating in the classroom activities such as quizzes, polls, etc. on a regular basis also did well in their final results.</li> </ul>

To understand how the indicator metrics can be mapped to student performance we have analysed the logs (page views and participations) that we have monitored from Canvas for the CSC3065 module (in the academic year 2022/23) and students’ overall academic results (total marks). Figure 1 presents the normalized (max-min normalization for comparison between the metrics) and averaged values of the aforementioned metrics in different marking groups.

Figure 1. Student performance v/s student online activities.



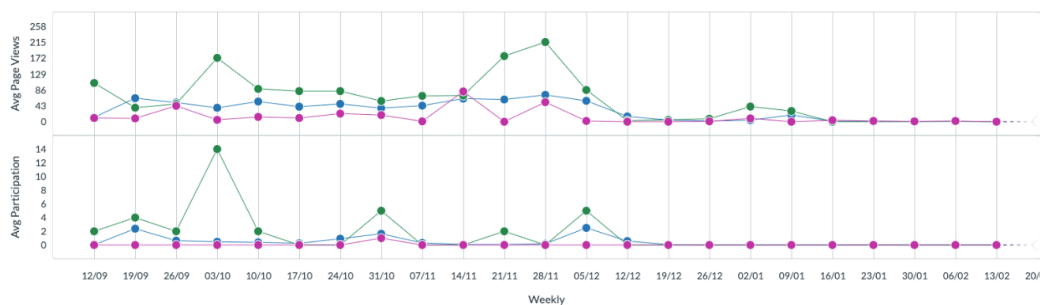
From the figure, we can observe that students’ marks drop as their online activities decrease; however, the curves for page views and participation do not smoothly decline along with the marks and there are exceptions for page views for students who scored high marks in the range 80-100. This observation gives us some assurance that Canvas logs on students’ online activities can be mapped to their overall academic performances, but definitely in order to get more reliable results we need to analyse more of the indicator metrics as we have identified in Table 2. Analysing the other indicator metrics is considered in future work due to time restrictions.

### 3. Early intervention for improving student performance

To improve students’ overall performances or to help students score high marks, as a teaching staff we have to identify the non-engaging students at the right time (e.g., well before the assignment deadline) through the indicator metrics, and then do an early intervention to help students change their approach towards the module and its requirements. Figure 2 shows the weekly online activities (average page views and participation) of a high scoring (89/100) and a low scoring (12/100) student, which are compared against the average online activity counts of all the students in that module.

From the figure we can see that the average page views and participation of the high-scoring students were mostly higher than the average counts of all the students in those weeks, whereas the average page views and participation of the low-scoring students were mostly lower than the average counts of all the students and also, lower than the high scoring student. This observation further supports our proposal to use these indicator metrics and run some statistical analysis in order to identify the non-engaging students even in the early weeks of the module and make the necessary intervention.

Figure 2. Student weekly online activities: high-scoring student (green) v/s low-scoring student (purple) v/s average activity counts (blue) [the graph is taken from Canvas for the same module that we used in the case study].



### 3.1. Applying different approaches for early intervention

Once the non-engaging students are detected, we can apply different approaches for early intervention and support the students. A couple of the approaches are highlighted here:

- **Change the teaching approach:** focus more on the non-engaging students, and try to give some extra support to them; for example, ask them questions more regularly, making sure that they are being attentive in the classroom activities. Also, if they do not attend the lectures then send gentle reminders to find out if everything is going well or if there are any issues that they are facing.
- **Modify the module classroom activities:** make the online classroom activities more interactive by bringing new questions, new strategies to ask questions, rearranging polls, quizzes, etc. so that non-engaging students can connect to them.

## 4. Conclusion and future work

In this paper, we have attempted to propose a solution for detecting non-engaging students in a blended learning mode of teaching where a good percentage of learning is carried out online and students still lack of motivation to attend classroom lectures whether it is online or in-person. Our solution is based on the analysis of the online data that we are able to collect from our virtual learning environment, Canvas. We have presented some preliminary analysis results, which show us the potential of using some key indicator metrics such as Canvas page views, participations in online polls, quizzes, total student marks, etc. for detecting non-engaging students. However, the results are based on a limited number of indicator metrics for a single module as a case study. As a future work, we will consider analysing more of the Canvas metrics that can be mapped to the students' academic results from different types of modules, and deploying machine learning algorithms to proactively detect the non-engaging students right at the beginning of the module. Also, we would explore more on how to take the right intervention approach to help students re-engage in the classroom.

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