

WIP: Unflipping the Classroom: Analyzing the Consequences of Toning Down Blended Learning

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Abstract—This research WIP paper describes the case of a first-year engineering course which, contrary to modern trends in education, reduced the presence of blended learning in its methodology, transitioning from the flipped classroom and intensive continuous assessment models back to traditional instruction. Typically, blended learning methodologies like the flipped classroom are regarded to have the positive effects of improving engagement and fostering a student-centered learning approach. However, there are also concerns regarding the potentially increased workload that this system imposes on students. This study analyzes course resource usage trends by students, comparing the final year under the blended learning method with the first year after the switch to traditional instruction. More specifically, the volume of student activity, its timing throughout the semester, and the preferred types of resources are compared between both methodologies. The study found that, in terms of time spent interacting with resources, there was not a significant decrease between both iterations of the course, although the types of resources favored by students do vary between methodologies. Additionally, the activity distribution throughout the semester is observed to be heavily influenced by the timing of exams in both scenarios.

Index Terms—analytics, blended learning, continuous assessment, flipped classroom, learning management systems

I. INTRODUCTION

In modern times, the emergence and generalization of information technologies allowed the implementation of online and digital-based features in educational scenarios. One of the most important examples of this trend is the emergence of blended learning technologies in all kinds of scenarios, but especially at the university level. Blended learning models combine traditional, face-to-face instruction with online learning elements. One of the main advantages of blended learning is that it promotes a student-centered learning approach. This is not the case in traditional instruction, where the teacher is responsible for establishing the pace of the course and the way students should work. In a blended learning setting, students have a greater degree of freedom to direct their own learning process, choosing the most appropriate way to make progress through the course. This fosters the acquisition of

self-regulated learning abilities and can also improve student engagement [1].

However, many researchers and educational practitioners have also pointed out drawbacks associated with blended learning. For example, Kaur notes the non-trivial challenge of ensuring an efficient use of technology by students, as well as successfully adapting the design of the course to the new teaching methodology [2]. Buran and Evseeva mention that the higher reliance on students' motivation to make progress in the course can sometimes be counterproductive, and that lower retention rates were observed in blended courses compared to their traditional counterparts [3]. And, from the students' perspective, several authors report discontent by some learners with aspects such as the increased workload or the reduced direct interaction with teachers and peers [4], [5].

This study reports the case of a first-year engineering course which, after following a blended learning methodology for several years, switched back to traditional instruction in the 2022/2023 academic year. Before this change, the course implemented the flipped classroom system: a blended learning model in which activities that traditionally take place in the classroom are instead carried out outside of classroom hours, and vice versa [6]. This transition also entailed a change in the assessment method, going from a series of low-stakes tests distributed throughout the semester to just two higher-value exams.

The aim of this study is comparing student activity trends, in terms of interactions with course resources on the learning management system (LMS), between the last year of blended learning and the first one back under a traditional instruction system. The questions that need to be answered are: were there significant changes in students' resource usage habits after the switch in methodology? What types of resources are favored by students in each scenario? And, did student workload actually decrease when going back to traditional instruction?

The rest of this paper is structured as follows: Section II details all relevant information regarding the target course for the purposes of this study. Section III explains the followed analysis methodology. Section IV shows the preliminary results of the study. Finally, Section V provides some closing thoughts and outlines avenues for future work.

II. CONTEXT

A. Course description and evolution of teaching methodology

This study analyzes the case of a first-year Computer Architecture course taught as part of the Telecommunications Engineering degree at the University of Vigo. The course, spanning a 17-week period, consists of two parts: theory, where students learn fundamental aspects of informatics and computer architectures, and lab, where students are required to solve increasingly complex assembly problems with the help of a computer.

Over the past decade, there have been several points at which the teaching and assessment methodologies applied in this course changed, most notably affecting the theory part. Starting in 2016, the flipped classroom system was adopted, in which lectures were recorded for students to watch at home ahead of an hour-long weekly session in the classroom. Additionally, the flipped classroom methodology was combined with an intensive continuous assessment system in which short exams (between 10 and 15 minutes long) were carried out during most of the in-classroom sessions, for a total of 12 exams. The grade obtained by the student in the theory part of the course depended exclusively on the score obtained in these exams [7]. Starting in 2019, exams were carried out every two to three weeks instead, reducing the total number of theory exams from 12 to 6.

The flipped classroom and intensive continuous assessment methodologies did not apply to the lab part of the course. Instead, this part was assessed with 3 practical exams carried out throughout the semester.

This system was kept in place until the 2021/2022 academic year. At this point, the academic board raised concerns regarding the potentially excessive workload that the flipped classroom and intensive continuous assessment systems imposed on students. Therefore, from the 2022/2023 academic year onward, the teaching methodology applied in the theory sessions was reverted to traditional instruction, with the teacher delivering lectures during the in-classroom session. These sessions were still carried out on a weekly basis, but their length was increased to two hours each. Additionally, the number of exams was reduced to just 2: a midterm exam and a final one. Compared to the exams carried out in previous years, these were significantly longer (about an hour long) and had a much higher individual value towards the final grade of the course. As for the lab part, the teaching methodology did not change, but the number of exams was also reduced from 3 to 2.

In order to incentivize students to study regularly throughout the semester after the number of exams was reduced, a series of quizzes were carried out during most of the theory and lab sessions. These quizzes consisted of multiple-choice questions ran in a similar way to platforms such as *Kahoot!*¹: questions would be displayed in class for all to see, and students could choose their answer using their smartphones or personal

computers. In each theory and lab session, one quiz would be played, lasting no longer than 5 minutes. Depending on how many of these quizzes were answered correctly, students could obtain up to 10% extra credit in each of the exams performed during the course.

It is worth considering that, in all cases, students could also opt to do a single final exam covering all course contents, instead of multiple smaller exams throughout the semester. However, this option is not encouraged, and only a very small minority of students chooses this assessment method each year.

Students who fail the course are given a second opportunity in the form of a final exam carried out at the end of the academic year.

B. Supporting digital platforms

This course relies on two online platforms to manage its resources and tasks: the institutional LMS at the University of Vigo, based on Moodle, and the e-assessment platform BeA [8].

All course resources, including documentation for the theory sessions, lab assignments, and self-assessment activities, are progressively uploaded to the Moodle LMS as the course progresses. These resources also include the video lectures that students needed to watch ahead of every in-classroom session under the flipped classroom system. Starting in 2022/2023, video lectures were still made available on Moodle for the students' reference, even if they were no longer instrumental to properly follow the subject due to the return to a traditional instruction model. On top of course resources, Moodle is used as a communication channel between teachers and students, using forums, direct messages, and an announcement board. Scores obtained in exams are also published on the Moodle LMS.

On the other hand, BeA is used to handle every aspect related to theory exams, carried out on paper during the in-classroom sessions. Additionally, starting in 2022/2023, a quiz feature was implemented in BeA specifically to carry out the newly introduced course activities after the return to traditional instruction [9].

III. ANALYSIS METHODOLOGY

A. Data sources

As aforementioned, the main purpose of this study is comparing resource usage trends between academic years 2021/2022, the last one implementing the flipped classroom and continuous assessment systems, and 2022/2023, the first one going back to traditional instruction and a lower number of exams. Namely, it will be important to analyze the volume of interactions with course resources, as well as whether some types of resources are favored over others by students.

This analysis will be performed using logs exported from the Moodle LMS. Every time a user performs an action on the platform, such as logging in or accessing a course resource, a log entry is recorded. When considering a log file containing information over an extended period of time, it is possible to reconstruct sequences of actions that students

¹*Kahoot!* website: <https://kahoot.com/>

perform consecutively: for example, a student may log into the LMS, review documentation for a theory session, and then carry out a self-assessment activity. Each sequence of actions will be referred to as a *session*, characterized by its length (the number of logged events), duration (the amount of time that the session lasted, calculated using the timestamps associated to each event), and the types of actions that were performed.

Each log entry can belong to one of the following categories:

- *Login*: Entering the main course page on the Moodle LMS. These events usually signal the start of a session.
- *Theory*: Accessing a document related to the theory part of the course.
- *Lab*: Accessing a lab assignment.
- *Video*: Accessing a video lecture.
- *Self-assessment*: Accessing, performing, submitting, or reviewing a self-assessment activity.
- *Forum*: Viewing or posting a message to a forum.
- *Other*: Other actions not strictly related to course contents, such as viewing the gradebook, checking the announcements board, or signing up for exams.

The results shown in this paper were obtained as a result of a descriptive analysis procedure performed on the Moodle logs. Additionally, student performance statistics corresponding to both of the analyzed academic years are included, in order to observe whether the switch in teaching and assessment methodologies had any significant impact on the scores obtained by students in the course.

B. Student sample size

The total number of students enrolled in the course was 204 in the academic year 2021/2022 and 199 in 2022/2023. However, not all of them were considered for this study. The assessment criteria in this course establish that students who are retaking the subject, but obtained a passing grade in either the theory or the lab part in the previous academic year, are allowed to keep that grade and redo only the part they failed. This was an extraordinary measure applied in academic years affected by COVID-19 restrictions. Naturally, students who are exempt from one of the two parts are going to behave very differently in terms of use of course resources, so they were excluded from the study. This condition applied to 22 students in the 2021/2022 academic year and 11 in 2022/2023.

After disregarding the aforementioned sets of students, the sample size was 182 for the 2021/2022 academic year and 188 for 2022/2023. These sample sizes were considered close enough so that data from both academic years could be compared without any normalization procedure being performed.

IV. RESULTS

A. Moodle activity volume

Figure 1 shows the number of events logged by Moodle as a result of students interacting with the course page and its resources in the 2021/2022 and 2022/2023 academic years.

As it can be observed, after the switch in teaching and assessment methodologies there was a noticeable decrease in the total amount of logged events. Looking at the different

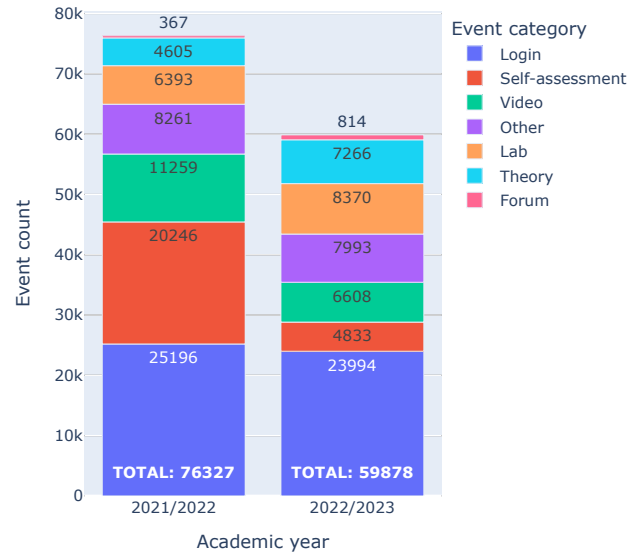


Fig. 1. Volume of events observed in the Moodle logs, classified by event category.

event categories, the two in which this decrease was most noticeable were Video and Self-assessment. These two kinds of activities were core elements of the course under the flipped classroom system, in which students were required to watch video lectures ahead of in-classroom sessions and were encouraged to complete the self-assessment exercises in order to review the newly learned course contents. Going back to traditional instruction, these resources were still available for the students' reference, but were no longer instrumental to follow the course.

It is worth keeping in mind that the first self-assessment activity in the 2021/2022 academic year was actually mandatory in order to progress further in the course, while no activities in 2022/2023 were compulsory. However, even if that specific mandatory activity was disregarded, the event count for self-assessment activities in 2021/2022 would be 16559, still far greater than the 4833 observed in 2022/2023.

On the other hand, the usage of theory and lab documentation increased. This, once again, was a consequence of the switch in teaching methodology, replacing video lectures as the most important types of resources. The use of forums, while also rising in the 2022/2023 academic year, was still relatively negligible.

B. Moodle activity timing

Figure 2 shows the evolution of the number of events in the Moodle logs over the 17-week period spanned by the course.

The distribution of logged events, representative of student activity on the platform, is clearly influenced by the timing of exams. In the 2021/2022 academic year, the exams corresponding to the theory part—the one that requires a more intensive use of Moodle resources—were held during weeks 3, 6, 8, 10, 13, and 15. Meanwhile, in 2022/2023, the midterm exam was held in week 11, while the final exam was held at

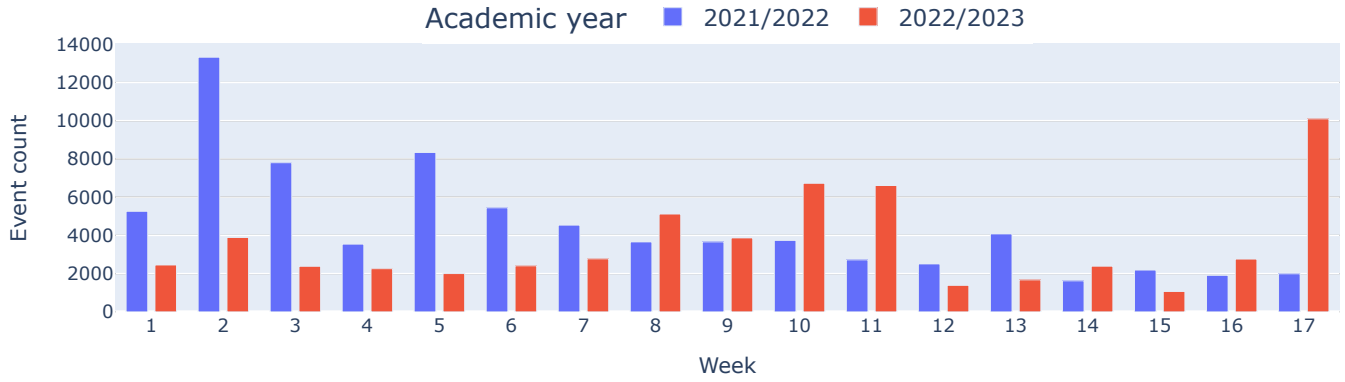


Fig. 2. Distribution of the number of events in the Moodle logs per course week.

the end of week 17. It can be seen that some of the highest spikes in Moodle activity correspond to weeks in which there is an exam, or those immediately preceding them.

During the 2022/2023 academic year, as a consequence of the absence of exams, there was an acute drop in student activity during the initial weeks of the course. The quiz system, while useful as a mechanism to prevent students from completely disengaging from the course, did not have nearly as strong an impact as the intensive continuous assessment system implemented up to the 2021/2022 academic year.

It is also important to note that the activity volume in the second half of the course is noticeable lower than that of the first half, especially in the 2021/2022 academic year. This can be attributed to some students dropping out of the course after the first few weeks, typically after obtaining unfavorable results in the first exams.

C. Session analysis

Table I displays the most relevant statistics regarding the LMS sessions which students carried out during the 2021/2022 and 2022/2023 academic years.

TABLE I
SUMMARY OF SESSION STATISTICS

Metric	2021/2022	2022/2023
Total number of sessions	9518	8856
Average number of sessions per student	52.30	47.11
Average session length (events)	6.72	4.18
Average session duration (minutes)	22.27	20.04

The statistics regarding sessions also suggest that overall student activity on the Moodle LMS decreased in 2022/2023 compared to 2021/2022. The sharpest decrease, in relative terms, is observed in the average session length: from 6.7 events per session to 4.2, a difference of over 37%. Comparatively speaking, the change in the average duration of each session is much milder. These data indicate that, while students generally performed fewer activities in each session during the 2022/2023 academic year compared to 2021/2022, they tended to spend a greater amount of time in each individual activity.

Therefore, the total time spent by students in sessions during the 2022/2023 academic year was not significantly lower than in the previous iteration of the course.

The average number of sessions undertaken by each student throughout the course also saw a slight decrease. However, this does not necessarily imply that there was a significant change in session patterns for most students. Observing the distribution of sessions shown in Figure 3, the ranges for the second and third quartiles of students regarding the total number of sessions throughout the course are very similar. In this case, the average value is slightly skewed due to the presence of outliers with very high numbers of sessions, which there were more of in 2021/2022 than in 2022/2023.

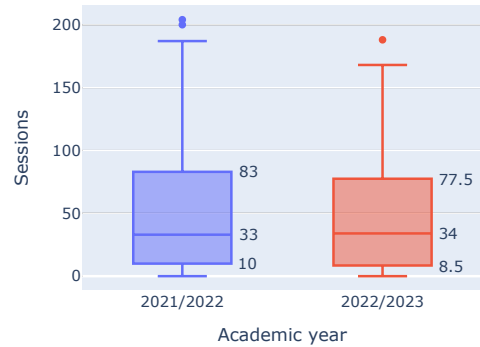


Fig. 3. Distribution of the total number of sessions that students engaged in during the course.

D. Student performance comparison

Table II provides a summary of statistics regarding student performance in the course across both analyzed academic years.

This particular course typically presents poor success rates compared to concurrent subjects in the same semester. Nevertheless, it can be observed that the passing rate improved in 2022/2023 compared to 2021/2022: 32% of students who did not drop out from the subject passed it without requiring a second opportunity exam, up from 22%.

TABLE II
SUMMARY OF STUDENT PERFORMANCE STATISTICS

Metric	2021/2022	2022/2023
Number of students	182	188
Students who dropped out of the course (% over total)	60 (33%)	65 (35%)
Students who passed the course in the first opportunity (% over non-dropouts)	27 (22%)	39 (32%)
Students who failed the course in the first opportunity (% over non-dropouts)	95 (78%)	84 (68%)
Students who attended the second opportunity exam (% over failed)	29 (31%)	26 (31%)
Students who passed the second opportunity exam (% over attendees)	13 (45%)	13 (50%)

There is no conclusive evidence which clearly proves that a causation relationship exists between the change in teaching and assessment methodologies and the improved success rate: data from more academic years and further analysis would be required to accurately ascertain this. However, it could be hypothesized that many students may have struggled to adapt to the flipped classroom and intensive continuous assessment systems, requiring a high level of engagement from the very start of the course in order to perform well in the first few exams. This system, while favoring students who study in a regular manner throughout the semester, may have worked against others who underestimated the amount of work required during the initial stages of the course. It is important to keep in mind that, with this being a first year subject, many students may not have had any previous experience with the flipped classroom or an intensive continuous assessment system.

V. CONCLUSION

This study compared student behaviors in terms of interactions with digital course resources between two consecutive academic years: the first one implementing the flipped classroom and intensive continuous assessment systems, and the next one going back to traditional instruction and assessment methods. As it may have been expected, the use of resources associated with the flipped classroom system (videos and self-assessment activities) heavily decreased after the change in methodology, causing a drop in the overall level of student interaction with course resources on the institutional LMS. However, the drop in the amount of time that students typically spend interacting with course resources was much less significant. In terms of timing, a similar trend was identified in both academic years: interaction levels peak just before an exam takes place.

In terms of performance, there was a noticeable improvement in student success rate in 2022/2023 compared to 2021/2022. However, the observations in this paper are not enough to confirm how important the change in teaching and assessment methodologies was to this effect.

As a limitation of this study, it is important to point out that Moodle logs are not an exact representation of student activity in a university course. Any actions that are not

performed online, such as attending class, are not reflected in the logs. Moreover, students could potentially opt to download course resources instead of repeatedly viewing them on the LMS, therefore leaving those resource accesses unrecorded. Ultimately, while Moodle logs are extremely useful for the purposes of this study, they are not a perfect indication of the workload which students are subjected to.

Future work in this line of research would entail further data analysis in order to verify the trends observed in this study. This would require working with data from a wider range of academic years, representing the two different teaching methodologies that were covered in this paper. Furthermore, it would be interesting to take a deeper look into how student preferences towards specific categories of course resources could affect their overall performance. This follows a similar idea as the analysis of learning strategies by Jovanovic *et al.* [10].

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