QUEEN'S UNIVERSITY BELFAST

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Enhancing Assessment Practices

The use of Canvas formative quizzes to improve engagement and outcomes in first-year thermodynamics and fluid mechanics.

Cite as;

Description | What was done?

This case study describes the introduction of formative online assessment, through means of regular Canvas quizzes, in a stage one Thermodynamics and Fluid Mechanics module in the 2019/20 academic year with the aim of improving the levels of student engagement and self-regulated learning. High student engagement was found with the formative assessment, with an average of 96% engagement in each quiz. Many students were motivated to strive for higher marks in the quizzes, despite receiving no summative credit from them. Results in all summative assessments were improved compared to the previous year, and there was an increase in student satisfaction with the module. Feedback from student surveys was highly positive regarding the quizzes: "Regular, non-graded quizzes…help to identify an understanding/lack of understanding of the content being covered.". The experience with the new assessment format has offered opportunities for improved online delivery of the module in the 2020/21 academic year given the move to connected learning resulting from the Covid-19 pandemic.

Motivation and Aims

During stage one in the School of Mechanical and Aerospace Engineering, all students on the Mechanical Engineering, Aerospace Engineering and Product Design Engineering degree programmes study a core 20-CATS module in thermodynamics and fluid mechanics. There are typically 150+ students enrolled on the module, which has three hours per week timetabled contact time. This core module provides important foundational knowledge and skills that students require in several key subjects as they progress through their degree. However, students have historically found this module to be very challenging, often leading to high failure rates and low average grades, and there are difficulties in supporting students through the module due to limitations in the amount of direct one-to-one support that can be provided given the large class sizes.

It is a commonly noted issue that thermodynamics and fluid mechanics modules, frequently taught across a range of engineering disciplines, are often regarded by students as the most challenging subjects in their undergraduate programmes. Problems arise with the conceptual nature of the subjects, lack of prior study and the level of mathematical and analytical skills required [1–5]. Both subjects require a gradual construction of knowledge and lectures are usually strongly dependent on previous sessions, meaning that missing a few classes can have profound implications on the ability of students to progress through the course [6].

The introduction of Canvas as the new VLE for the university in the 2019/20 academic year gave opportunity to introduce measures to provide digitally enhanced teaching and learning strategies in the module to support the building of student knowledge and skills. It was of particular interest to ensure continuous engagement of students with the module and to encourage students to develop independent and self-motivated study skills.

This case study reports on our experience implementing regular online formative assessment in the first-year thermodynamics and fluid mechanics module in the 2019/20 academic year. The module was taught across the 24 weeks of semester 1 and 2 and there were 155 stage 1 students enrolled, plus 23 students enrolled on a resit basis.

Methodology

Following a review of the structure and assessment of the module, and considering indications in the literature that online quizzes were an effective way of increasing engagement and providing feedback [7–9], it was decided to introduce VLE-based formative assessment for the module. This was developed in the form of seven Canvas quizzes spread regularly across the year, each based on the previous two/three weeks of lectures. The quizzes were formative and provided no marks, but it was stipulated as a compulsory element of the module that all quizzes must be passed in order for a student to be eligible to pass the module.

Students were given two weeks to complete and achieve a pass mark (generally around 80%) in each quiz, with unlimited attempts. Rather than rely on multiple choice questions alone, the quizzes were set up with a variety of question styles and types to allow assessment of a wide range of levels of learning from simple recall of facts, to application of knowledge, to higher analytical skills.

Engagement with the quizzes was monitored throughout the year and the outcomes in summative assessments compared with the previous year. Fair comparison over a longer period was difficult due to a relatively large number of staffing and assessment changes in recent years. Some qualitative data was also gathered from students to assess their opinions of the quizzes and the module overall.

Literature Review

Literature Review.

Successes | Challenges | Lessons Learned

Overall, there was excellent student engagement with the quizzes with an average of 96% of the class passing each quiz. This was even the case for the final quiz which was completed during the first week of the Covid-19 shutdown, and still showed 93% engagement.

The quizzes appeared to pose varying levels of challenge for the students. For example, quiz 1 was the easiest for the students with 94% of students passing the quiz on the first attempt and the remaining students passing by attempt 2. Quiz 5, based on the first law of thermodynamics in closed and open systems, appeared to be the most challenging for students by some distance. It required 13 attempts before at least 90% of the class had reached the pass mark (see figure 1).

The results also showed that many students were motivated to try to improve even after achieving a pass mark. For example, fifty students took at least one extra attempt to improve

their score on quiz 1, while quiz 3 showed the highest level of students taking two and three extra attempts to improve their marks, and in quiz 5 only 17 students attempted a second time after a pass.

Summative assessment for the module comprised two class tests, one mid-semester 1 and one mid-semester 2, each worth 20% of the module mark, and a final exam worth 60%. The continuous formative quizzes appear to have contributed to improved assessment results. Figures 2 and 3 show the results from students taking each piece of assessment as a first sitting in 2018/19 compared with 2019/20, and it can be seen that the averages increased by 16%, 11% and 13%, and the percentage of the class who passed each assessment was 20%, 25% and 18% higher.

Caution should be taken however in drawing direct correlations, as the coursework was not identical in the two years (although it was very similar), and there was a staffing change on part of the module. For the final exam, the Covid-19 shutdown also necessitated an online open-book examination format in 2020 whereas the exam in 2019 was closed-book and under supervised conditions. However, the increase in the average exam mark was in line with the increases in the class tests, so it can be reasonably assumed that the increase on the exam was not solely due to the open-book format in 2020.

The quizzes have also increased engagement with the VLE for the module, as seen in figures 4 and 5, showing much higher page views and participation compared with the other core first-year modules.

Several positive comments have been received from students about the quizzes:

- *"Quizzes were quick and helpful; these should be assigned across all modules in the course in my opinion"*

- *"Online quizzes I think are a great way of just checking up on the knowledge from a module."*

- *"Regular, non-graded quizzes in Thermodynamics and Fluid Mechanics module helps to identify an understanding/ lack of understanding of the content being covered."*

The module evaluation questionnaire completed by students at the end of the year showed an increase in the overall satisfaction score from an average of 4.5 out of 5 in 2018/19 to 4.7 out of 5 in 2019/20.

While student engagement was expected to be relatively high given that passing all quizzes was a compulsory element of the module, it was especially remarkable that many students demonstrated high levels of self-motivation by continuing to attempt to increase their score even after a pass mark had been achieved.

The introduction of the formative quizzes into the module resulted in significantly more engagement with Canvas compared to the other first-year modules. Feedback indicates that online quizzes are positively received by students and assist them in self-assessment and self-regulation of their learning.

A notable increase in the scores for all three summative assessments was seen, and this was accompanied by an increased percentage of students achieving a pass in each assessment piece.

Feedback from students on the use of quizzes has been overwhelmingly positive.

Scalability and Transferability

The use of regular Canvas quizzes is easily scalable across other modules in a variety of disciplines. Staff now have a full year of experience in using Canvas and should be more confident in making use of additional features such as quizzes, and training is readily available.

The quizzes offer a means of quickly providing automatic feedback to students, which is particularly useful for large classes where providing individual feedback would otherwise be overly time intensive. It is also a useful way in which teaching staff can gather data relating to effectiveness of teaching and identify areas of concern. There is potential for the use of learning analytics data to identify students at risk at an early stage.

Implications for Online Learning and Assessment

The Covid-19 pandemic has necessitated a switch to a connected learning model for teaching during the academic year 2020/21. The positive experiences with the quiz format for formative assessment in 2019/20 have encouraged the trialing of the quizzes for combined formative/summative assessment in 2020/21. To date this has proven to be popular with students and provides an ongoing and effective way of assessing if students are engaging with and understanding the online pre-recorded material, as well as providing active learning activities.
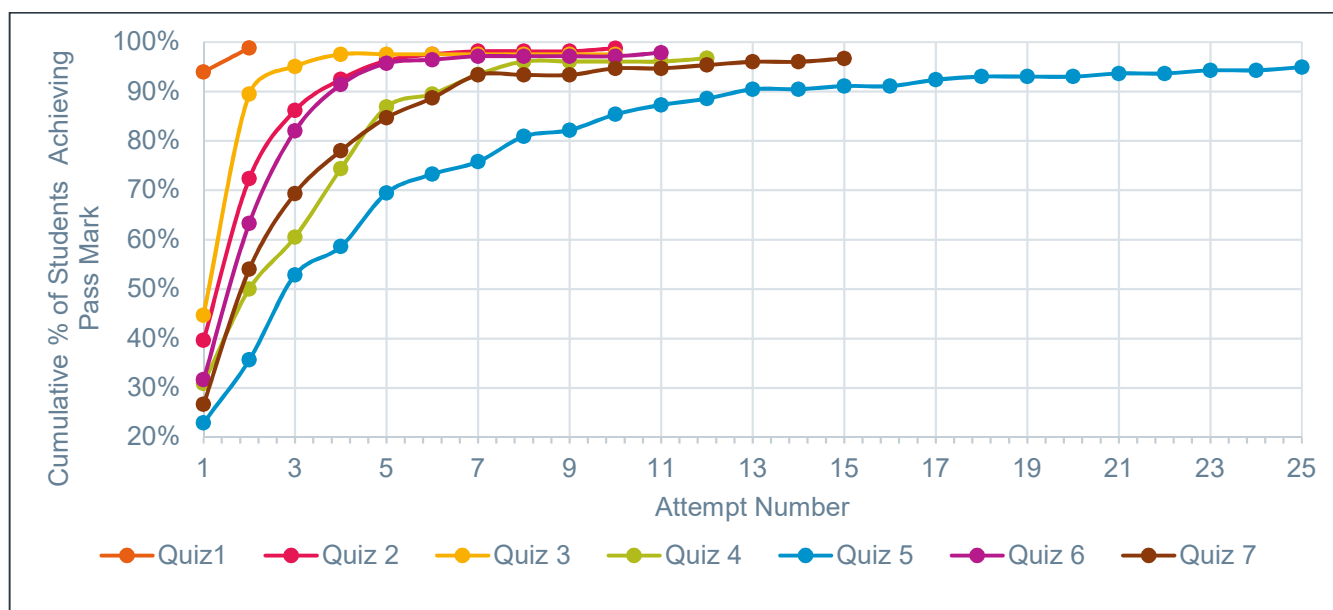
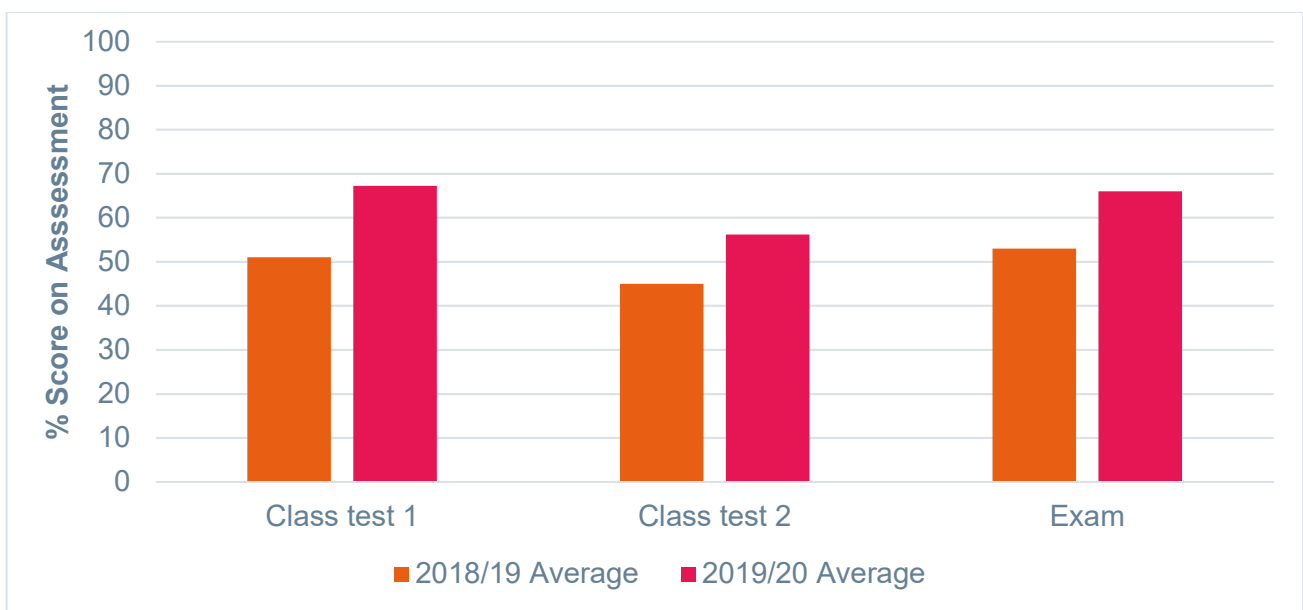Figure 1: Cumulative percentage of class passing each quiz

Figure 2. Comparison of average scores in the module's three assessments before and after the introduction of online formative quizzes
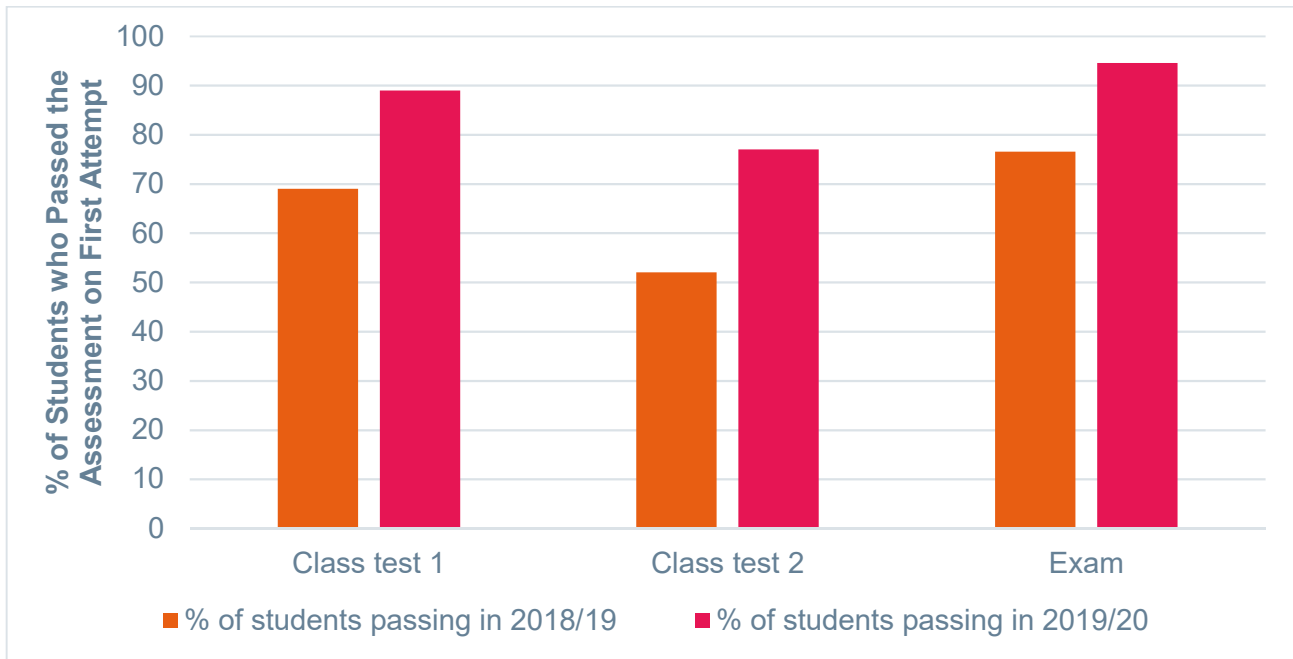
Figure 3. Comparison of percentage of class passing the module's three assessments before and after the introduction of online formative quizzes
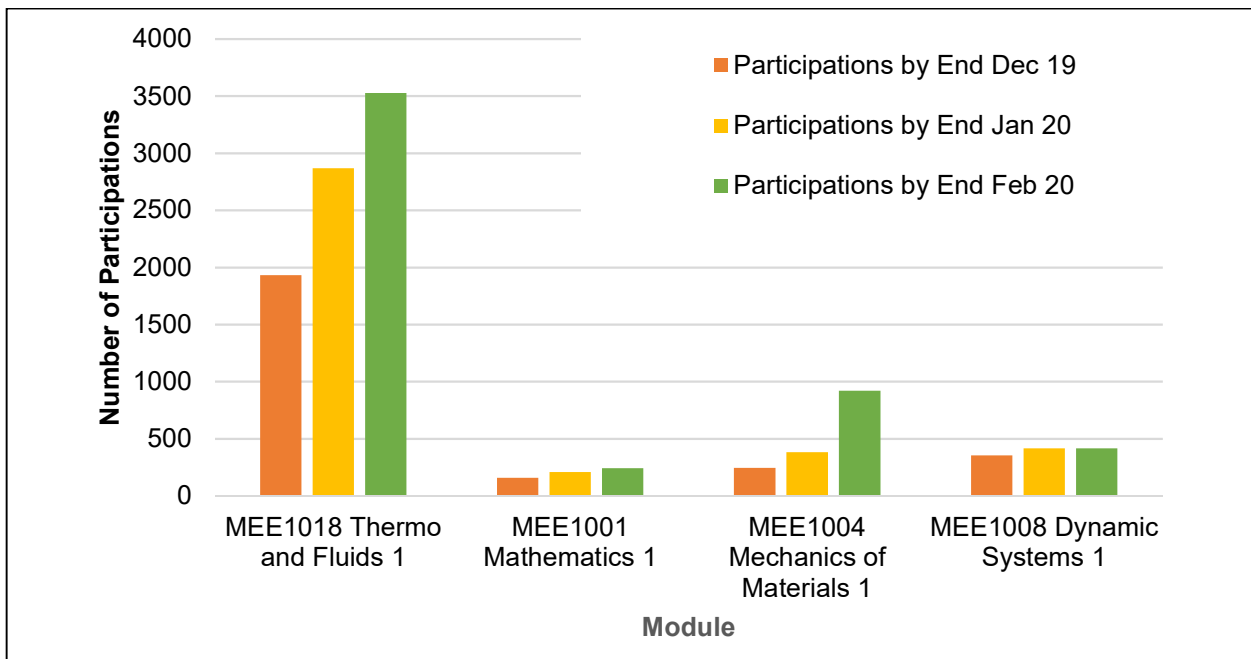

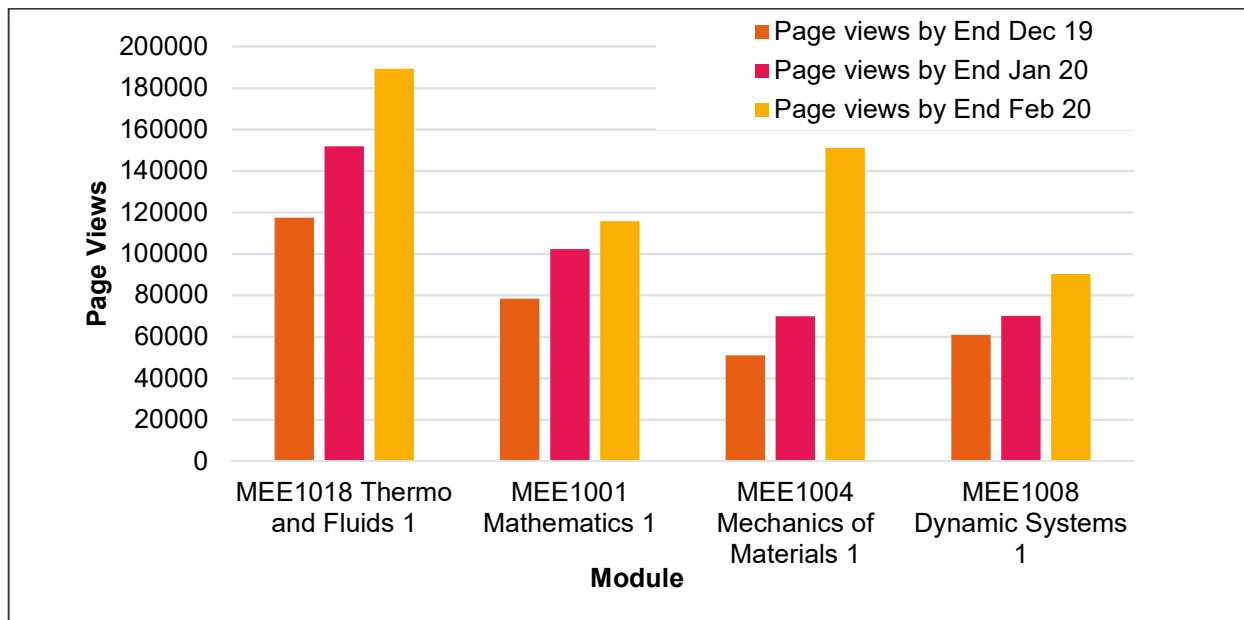Figure 4. Number of logged "participations" on the first-year Canvas courses

Figure 5. Number of logged "page views" on the first-year Canvas courses

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