

Project Title:

Assessment analytics of student engagement with, and performance on, S217 online quizzes

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Aims and scope of your project

The main aims of the project were to understand how students on S217 use the online quizzes and in what way these help (or not) students prepare for their formative assessment (the TMAs).

Specific goals were to use analytics information to assess when, and in what number, students accessed and completed each of the seven online quizzes. Then to carry out telephone interviews with a subset of students (those who volunteer to take part) to find out their motivations for the choices they made with regard to the timing and completion of the online quizzes.

Background

S217 Physics: from classical to quantum was launched in October 2015. It is the OU's core 60pt Level 2 physics module and is delivered entirely online as a series of 25 weekly Study Units. The module covers an introduction to mechanics, electromagnetism, gravity, special relativity, waves & optics, states of matter, thermodynamics, quantum physics, nuclear physics and particle physics. As a result, S217 largely covers the core concepts that are identified by the Institute of Physics as necessary for an accredited physics degree. The content hyperlinked and highly interactive, including video and audio tracks, screencasts of solutions to worked examples, interactive graphs and animations, online activities and experiments.

The assessment model uses a combination of summative and formative assessment. The summative assessment, referred to as the overall exam score (OES), has two parts. The first is an extended TMA04, submitted around the middle of the module and worth 25% of the OES. This assess a range of skills which it is not possible to assess in a conventional exam, and is based on a subset of 3 of the 25 Study Units. The remaining 75% of the OES is from a standard 3 hour unseen exam, sat at the end of the module, and based on the remaining Study Units that are not assessed in TMA04.

The formative assessment is based on five TMAs, (numbers 01, 02, 03, 05 & 06) each containing a series of structured problem-solving based questions, spaced throughout the study calendar. These assignments provide opportunity for significant formative tutor feedback. In addition, S217 includes a set of seven interactive online quizzes, whose questions are written using the OpenMark package. Each quiz comprises typically 6 to 10 individual questions requiring a mixture of calculation-based input, text input, drag-and-drop placement, and true/false selection, usually with multiple parts. Students are allowed three tries on each question before being presented with the answer, and receive automated targeted feedback after each try. Each question has multiple variants and students see up to three different versions on different attempts at the quiz. Quizzes may be started and revisited at any time, and previous progress is saved at each visit. Students are encouraged to repeat the questions, and indeed the entire quizzes, as often as they wish.

In order to persuade students to complete the formative assessment, a threshold score was placed on the five formative TMAs, such that students must score at least 40% on them overall in order to be allowed to qualify for a grade based on their OES. To encourage engagement with the quizzes, each (formative and summative) TMA included a final question, worth 10 marks for each TMA, which invited students to submit a screen-shot of their score from the most recent content-related quiz, and to briefly reflect on their learning from that quiz.

Activities

The overall approach in this project was a combination of accessing analytics information and telephone interviews with students on the 2015J presentation of S217.

The analytics evaluation was carried out by one of us (Norton) initially using Tableau Reader workbooks and latterly using the SAS-VA live system. The disadvantage of the Tableau Reader workbooks was that information therein was only updated infrequently (at best every few weeks, and at worst every few months). As the project developed, the updated SAS-VA system became available providing essentially real-time data on the student population which was updated overnight, every night. The key data product in the SAS-VA system allowing this research to be carried out was the "Tool use by module" report which allowed the week-by-week behaviour of students to be tracked for each online quiz, with respect to the associated TMA. The analytics work was begun in spring 2016 and completed after the module presentation ended in June 2016 when all data were complete.

The telephone interviews were carried out by one of us (Cayless) on a self-selecting cohort of students. An initial set of 100 students was contacted by CAMEL e-mail seeking volunteers to take part in the process. Following a disappointing response, a second set of 100 students was subsequently contacted. Eventually 11 volunteers were secured and they all signed consent forms to take part in the project. The interviews typically lasted half-an-hour or so and were carried out during May 2016. The questions put to each student were as follows:

Initial questions to confirm analytics data:

1. Which of the TMAs 1,2,3,4 did you submit? How did you score?
2. Which of the corresponding online Quizzes 1,2,3,4 did you attempt? How did you score?
3. When did you attempt each quiz (in relation to the TMA cutoff)?
4. How many attempts did you typically make on each quiz question?
5. Did you attempt multiple variants of the quiz questions?
6. Have you revisited any of the Quizzes since? Do you plan to do so in future?

Follow-up questions to understand engagement:

(If quizzes *were* attempted prior to submitting TMA)

7. Did you find the Quizzes improved your understanding of the topics they covered?
8. Did you find the Quizzes helped prepare you for the TMAs? In what way?
9. Did you do the Quizzes because of the reflective question in each TMA or would you have attempted the quizzes without the prompting of the reflective TMA question?
10. Was the reflective question in each TMA useful to you?

(If quizzes *were not* attempted prior to submitting TMA)

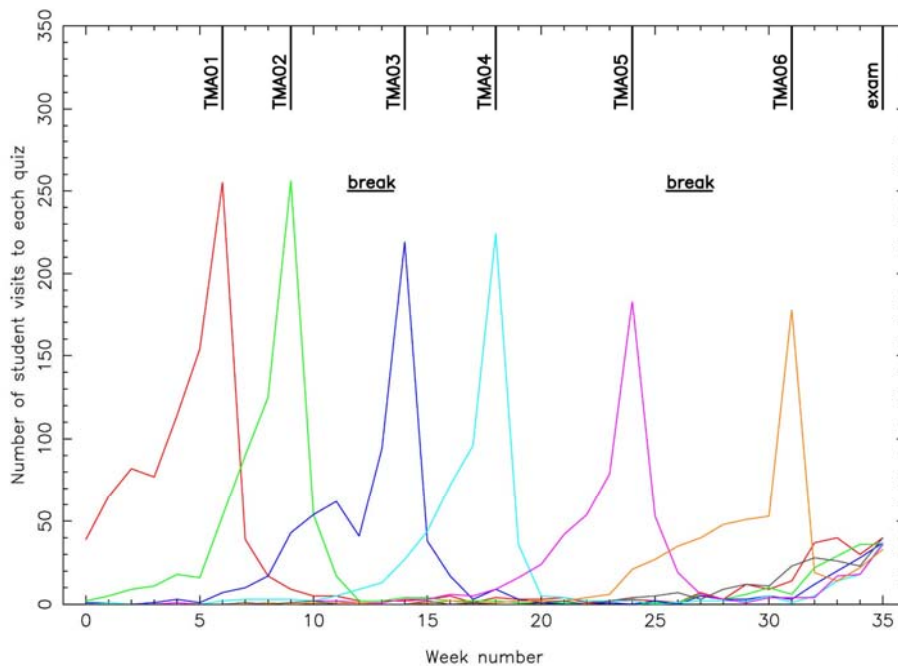
11. What stopped you from attempting the quizzes?
12. What might have prompted you to attempt the quizzes?

We had anticipated interviewing up to 20 students for this project, but had to alter this aspiration given the low response rate to the invitation.

Findings

The quantitative data concerning Quiz and TMA use is summarised in the following Table and the student behaviour regarding when, and in what numbers, they attempted each Quiz is summarised in the Figure below that.

Quiz / TMA number	Students completing each quiz	Students starting, but not completing, each quiz	Total students engaging with each quiz	Students submitting each TMA / sitting the exam	Mean TMA score / exam score
Quiz 1 TMA 01	330	72	402	382	78.2%
Quiz 2 TMA02	304	54	358	354	71.6%
Quiz 3 TMA03	284	62	346	338	74.9%
Quiz 4 TMA04	274	51	325	323	76.6%
Quiz 5 TMA05	241	52	293	285	70.7%
Quiz 6 TMA06	208	59	267	268	78.6%
Quiz 7 Exam	54	68	122	276	62.3%



Key: Quiz 1 = red, Quiz 2 = green, Quiz 3 = blue, Quiz 4 = turquoise, Quiz 5 = purple, Quiz 6 = orange, and Quiz 7 = grey. Breaks are for Christmas / New Year and for Easter.

From the Figure, It is apparent that only a small proportion of students visited each quiz in the several weeks during which they were working through the Study Units whose material was covered by that particular quiz. Instead, the majority of students visited the quiz during the week in which the TMA submission due date occurred. Downloading of each TMA itself also peaked during this week. The implication is that students only visited the quiz when they had to, in order to complete the self-reflection question at the end of each TMA.

Furthermore, Quiz 7, which was not referred to in a TMA, was only visited by a small proportion of students and did not show a significant peak in visits, like the other quizzes did. The only use of Quiz 7 occurred during the exam revision period, when a similar proportion of students also re-visited each of the earlier quizzes.

From the Table, it is apparent that the number of students who attempted (or completed) each of Quizzes 1 – 6 correlates closely with the number of students who submitted each of the corresponding TMAs 01 – 06. This indicates that students who submitted the TMAs *did* engage with the appropriate quiz, even if they left it late to do so. The number of students who submitted each TMA, and attempted each quiz, fell as the module progressed, as students dropped-out and de-registered from the module. Nonetheless, we also note that the mean scores on the TMAs were all very similar to each other, indicating a roughly constant level of academic engagement as the module progressed.

In the telephone interviews, most students said they had accessed the quizzes only shortly before the TMA submission due date (supporting the analytics results), and were prompted to do so by the need to respond to the final self-reflection question in the TMA. The students interviewed had typically completed all the quizzes and all the TMAs, and had scored reasonably well on each assignment. Many of them found the multiple tries at each question, and the multiple variants, very useful, and had attempted each quiz question several times. Some of the students said they planned to revisit the quizzes again as part of their end of module revision prior to the exam (although the analytics data showed that relatively few did so). However, one student interviewed had deliberately *not* attempted any of the quizzes at all, and intended to save their use solely for revision purposes towards the end of the module.

Students in general said they found the quizzes to be useful in improving their understanding of the topics covered, although they did not find the quizzes particularly helpful as preparation for answering the TMA questions. This was clearly at least in part because they mostly only attempted the quiz questions *after* completing the other TMA questions. Students mostly said that they would have done the quizzes anyway, even if not prompted to do so by the TMA (although judging by the few attempts at Quiz 7, this is not borne out by the analytics data), and cited their use in revision as the most likely reason to engage with them. Finally most students stated that the reflective TMA questions were in general not useful as an aid to learning.

Impact

There are two changes that we have made for the 2016J presentation of S217 as a result of the findings of this project.

1. In 2015J, students only attempted each quiz when prompted to do so by the TMA. In order to overcome this, and hopefully see a more appropriate pattern of use in terms of pacing and preparation, we have attempted to encourage students to engage with the quizzes earlier, and on a more regular basis. We have done this by “seeding” the online study calendar for 2016J with links to specific questions of each quiz in the same week as the relevant Study Unit. Students will

therefore have a weekly prompt to visit the appropriate quiz questions and so hopefully use them in the way we intended as preparation for their TMAs. This behaviour can easily be tracked using the SAS-VA tools and compared to the previous year's activity.

2. Students in 2015J did not find the self-reflection aspect of the final TMA questions to be useful. So we have altered these questions for 2016J to be more topic-specific. The self-reflection questions now ask: "In a few sentences, describe one thing that you learned from answering the questions in the Quiz that improved your understanding of XXX" where "XXX" is a topic of relevance to the remaining questions in the TMA.

We will continue to monitor student behaviour and see whether this differs from 2016J compared with 2015J. We hope the changes will have a positive impact on TMA scores and on retention.

List of deliverables

A paper has been submitted to the journal "Open Learning: The Journal of Open and Distance Learning" entitled "Carrots and Sticks in Physics Formative Assessment". This paper is currently under review.

Figures and tables

Table: The number of S217 students engaging with each online quiz and TMA, along with associated mean scores.

Figure: S217 student engagement with online quizzes throughout the study calendar in relation to TMA submission due dates.