BENEFITS OF CLASS TESTS AND CONTINUOUS ASSESSMENT IN HIGHER EDUCATION MATHEMATICS

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Abstract

There is a general interest in providing a wide range of forms of assessment in order to improve the performance on metrics such as the National Student Survey (NSS) and the Teaching Excellence Framework (TEF). Hence, there has been a growing pressure on staff to innovate on teaching and learning in general. This paper considers the option of continuous assessment and its impact on student's performance, attendance and workload based on a quantitative and qualitative analysis.

A study-case based on undergraduate students of Mathematical Sciences will be presented. In a two-semester module, we used the compulsory logbook component to change its assessment method for each semester, and compared continuous assessment throughout the second semester versus single-submission at the end of the first semester.

We analysed the correlation between exam results, logbook marks for each semester, class test and written assignments and student attendance, and we examined student views from a survey distributed at the end of the year. The results show that the weekly logbook helped students' revision and distributed their workload throughout the semester, whilst it made a significant positive difference in performance for students with high attendance.

Keywords: Continuous assessment, workload, attendance, coursework, teaching and learning.

1. Introduction and literature review

Thinking about assessment in higher education, there are mainly three viewpoints to consider: the students, the lecturers and the educational institutions. With an increasing pressure of expectations from lecturers, there is the need to improve the working conditions of teaching staff, like limiting the number of students per group, counting teaching hours comprehensively by including all preparation, etc. (Coll et al, 2007). This will ensure that the quality of university teaching increases and gets sustained.

There is no doubt that the implementation of continuous assessment brings additional workload for academics, due to the ongoing feedback to students involved (Trotter, 2006). However, this is an essential part of continuous assessment in the form of formative assessment, and it has been proven beneficial to support student learning (Hernandez, 2012). One of the reported benefits to lecturers, is that it informs their teaching, making it more adaptative to student's needs (Coll et al, 2007).

At the same time, learners have the opportunity to make an informed decision on what are the subject areas they need to work more on, in response to the feedback given. Hence, high student involvement is required and the amount of time dedicated to the subject ends up being higher than the average (Coll, 2004; Mawhinney et al, 1971). Thinking in particular about the study of Mathematics, it is accepted that continuous formative assessment improves student learning and helps to distribute the content more appropriately by making the learning more frequent and spaced (Loucks-Horsley, 1996; Myers and Myers, 2007). In addition, it is a good predictor of students' exam results, and students taking this kind of learning in Mathematics outperform students who do not (Shorter and Young, 2001).

Regarding the relationship between formative and summative assessment, some texts report that it is advisable to validate formative assessment with a summative one, in the form of an exam that would test student independence (Yorke, 2003; Soler et al, 2004). However, this second instance might bring the known difficulty of students giving more importance to marks rather than to the written feedback, and sometimes even ignoring the feedback altogether (Yorke, 2007, QAA, 2007).

Having all this in mind, our purpose with this paper is to come to an informed decision about what formats of assessment are more effective for the learning of our students of mathematics in higher education.

2. Background and motivation

The sample consisted of 21 students from a second-year undergraduate programme in Mathematics of a university in the United Kingdom. This study focuses in the results of formative and summative of one of the compulsory modules of the degree based on Linear Algebra and Mathematical Analysis which runs for 24 weeks – 12 weeks in the first semester and 12 weeks in the second semester. In each week, there are three consecutive teaching hours which are generally structured as 2 hours for lectures and one hour for a practical class.

The module is assessed using a wide range of forms:

Assessment in Semester 1

- Assignment 1 (10% of the final grade): set of exercises to be submitted within a given deadline, usually three weeks. Students have to work on their own.
- Logbook 1 (5% of the final grade): a logbook is understood as a compendium of evidence of the student's work throughout the semester. In this case, students had to submit a summary of all the material taught in the first semester by the end of the semester. There are no checks on whether the student does the work weekly.

Assessment in Semester 2

- Class test (10% of the final grade): this is an exam of the same format as the final exam containing only material of the first semester.
- Assignment 2 (10% of the final grade): set of exercises on the material taught during Semester 2 to be submitted within a given deadline, usually three weeks. Students have to work on their own.
- Logbook 2 (5% of the final grade): during the semester 2 and for the purpose of this study, we considered a different structure from Logbook 1. Each week the lecturer would ask for some homework and will check on the following week, in class. The lecturer checks whether the work has been completed, and provides verbal feedback to the answers. Students were encouraged to ask additional questions that the lecturer would solve on a one-to-one basis.

Final Exam (60% of the final grade): exam of two hours covering all the material of the module.

Given the different forms of assessments on this module, the authors pose the following questions:

1. Which form of assessment, and in particular which type of logbook helps students to perform better in the final exam?
2. Which form of assessment is preferred by students?
3. Which assessment components imply a larger workload for lecturers?

3. Quantitative analysis

In order to answer these questions, we will carry out a quantitative and qualitative analysis of the sample. The quantitative analysis will consist on analysing the results obtained in each of the assessments and measure the correlation with the final grade in the exam. We will choose the Spearman and Kendall's tau correlation coefficients as the most adequate statistic to measure the relationship between the grades of each of the assessment components due to the lack of normality in some of the cases. Although Spearman's rho is the popular measure on the literature, there is evidence that Kendall's tau is more statistically robust (Croux and Dehon, 2010). Furthermore, we will test the null hypothesis *there is not a significant correlation between assessment component A and assessment component B*.

Table 1. Non-parametric Spearman Correlations (n = 21).

	Assignment 1	Logbook 1	Logbook 2	Class Test	Assignment 2
Logbook 1	0.380				
Logbook 2	0.358	0.565**			
Class Test	0.597**	0.640**	0.358		
Assignment 2	0.234	-0.131	0.291	-0.099	
Exam	0.437*	0.602**	0.205	0.772***	-0.369

*p < .05, **p<.01, ***p<.001

Table 2. Non-parametric Kendall's tau Correlations (n = 21).

|	Assignment 1	Logbook 1	Logbook 2	Class Test	Assignment 2
Logbook 1	0.289				
Logbook 2	0.269	0.488**			
Class Test	0.450**	0.494**	0.289		
Assignment 2	0.127	-0.075	0.197	0.650	
Exam	0.302	0.448**	0.162	0.609***	-0.242

*p < .05, **p<.01, ***p<.001

With these results, we can provide an answer for questions 1 and 2. Regarding question 1, from Table X and Table X we can see that in both cases there exists a statistically significant positive correlation between Logbook 1 and Exam (Spearman's rho = 0.602, Kendall's tau = 0.448) what implies that students with higher marks in Logbook 1 also had higher marks in the final exam. The same can be deduced for the Class Test and the Exam with a p-value smaller than 0.001 for both Spearman's rho correlation's test and Kendall's tau correlation's test. The only difference between both correlations is the relationship between the Assignment 1 and the Exam. In this case, the correlation test happened to be significant for the Spearman's rho test but not for the Kendall's tau test. Therefore, further research is required and for this purpose, we plot a scatter plot with both variables.

From this scatterplot, we can notice the appearance of two apparent outliers at the very right-hand side of the diagram. Should we neglect the two points the data appears to be structure on a vertical column for which there is not a clear line of best fit. Therefore, it is not possible to conclude that there is clear evidence on the relationship between the performance on the Assignment 1 and the Exam. Both outliers correspond to students that performed well in both. From the remaining group of students, some of them could have well pushed to study more during the second semester and improve the results from the previous semester.

Consequently, we can conclude from the data analysis that the Class Test and the Logbook 1 were the forms of assessment that significantly contributed towards the exam grade.

Figure 1. Scatter Plot (n = 21).
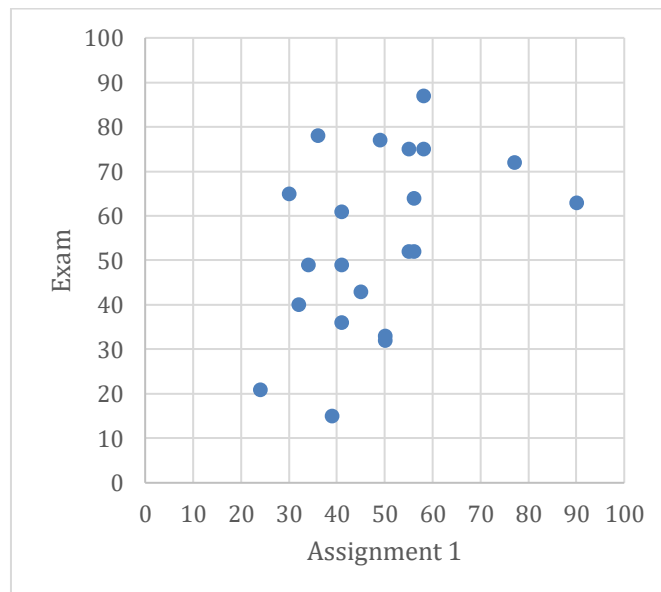
4. Qualitative analysis

A simple survey was run to understand student preferences and perceptions of the different forms of logbook. The response rate was 6 out of 21 students, 29%, therefore, it is important to be cautious about the generalisation of this qualitative analysis. The survey consisted of the 4 following questions:

1. Did the Logbook 2 help you to revise weekly?
2. During the last two weeks of semester two (when the logbook was not due anymore). Did you still solve the exercise sheets after each lecture?
3. Did you prefer Logbook 2 over Logbook 1?
4. Why? In your opinion, what are the advantages and disadvantages of a weekly logbook versus an end of semester logbook?

Students strongly agree that the Logbook 2 helped their revision. Some comment that it makes their workload more manageable in general, except when it clashes with assignments from other modules. Regarding what logbook format they preferred there are mixed opinions, but they lean towards the weekly one. One comment mentions that the assessment of the logbooks did not reward the individual effort.

From a lecturer perspective, checking weekly entails spending some of the practical time checking whether students have done the corresponding tasks whereas submitting a big chunk at the end entails not spending time on lectures but adding extra time on marking for the lecturer. In both cases, both lecturers agree that there are often situations of plagiarism with assignments and logbooks. If the lecturer checks the work weekly, then, it is hard to spot plagiarism in detail whereas with an assignment submission the lecturer has more time to detect this sort of issues, resulting, however, in more time of workload for lecturers.

With the increasing pressure for having an excellent student experience, high position on university rankings and the fierce student market competition, student feedback is thoroughly considered. This is where there are usually issues with clashing deadlines regarding the nature of the assignments.

There is not an easy win in the choice of the assessment format. Nevertheless, from the quantitative study, it seems that class tests contribute towards a better performance in exams. Furthermore, the use of logbooks helps revising weekly, although it causes clashes and sometimes burden for lecturers. Therefore, it makes sense to consider a mixture of both methods such as a series of class tests with the following characteristics:

- one class test every certain number of weeks,
- every class test will contain all the material of the module up to the date,
- if a student improves the grade on a later class test, then that test overrides previous tests.

This format of continuous assessment has been tested for the first time in a different module with similar teaching hours in order to improve the results and the retention of the students. The cohort consisted of 40 students, the results from the first two class tests showed that the average grade improved from 51 marks to 61 preserving a similar standard deviation of 30.5. Moreover, 70% of the students improved their grade. These are the results from the first semester and further research will continue to analyse this assessment format in depth.

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