

Student Expectation and Usage of On-line Quizzes in First Year Undergraduate Mathematics Courses.

Sandra Britton and Jenny Henderson
(S.Britton@maths.usyd.edu.au, J.Henderson@maths.usyd.edu.au)
School of Mathematics and Statistics
University of Sydney
NSW 2006 Australia.

Abstract

This paper investigates the perceptions and expectations of students with respect to integrated web-based formative assessment offered as part of undergraduate mathematics and statistics courses. In particular, we report on student opinion and usage of interactive web quizzes which are integrated into the course material provided for five different first year courses. Data on usage has been obtained by counting the number of times the quizzes have been accessed on a daily basis throughout semester. Student opinions have been canvassed via email surveys, to which over 200 students responded. The following questions are addressed:

- do students use the material in the way that academics expect?
- do students find the material useful to their learning?
- what factors inhibit student usage of web-based mathematical material?
- what differences are there in student perceptions and usage of multiple choice questions as opposed to questions requiring student input of numerical answers?

1 Introduction

The expectations university students have regarding the use of technology in their studies has certainly changed over the past decades. In Australia, such changes have been documented in findings from large national studies, commissioned by the Australian government. (See Krause et al.[1] and McInnes et al.[2].) These studies indicate an increase in the proportion of students who access on-line course resources from 75% in 1999 to 95% in

2004, and an increase in the percentage of users who found information and communication technologies (ICTs) useful from 64% in 1999 to 80% in 2004.

It is not only students who expect that ICTs will be a natural and significant part of their learning experience. Increasingly, tertiary institutions expect academic staff to provide materials for e-learning as part of their courses. The University of Sydney, despite providing a predominantly campus-based student learning experience, has a strategic commitment to embedding e-learning appropriately in that learning experience. In 2005, the Higher Education Funding Council for England developed a strategy for “supporting higher education institutions to develop and embed e-learning over the next 10 years”. [3]

It is now routine, of course, for academics to provide course information and course materials on-line and it is increasingly common for course websites to include interactive quizzes. More often than not, these quizzes consist largely of multiple choice questions. While many academics may have serious reservations about multiple choice questions, most would probably agree with the following: “Students derive great benefit from attempting questions and getting immediate feedback on their answers Practically the only way that this can be delivered on a large scale in higher education today is through the use of computer-aided assessment.” (Lawson [4])

In a recent small study of science students at the University of Sydney (Ellis et al. [5]) the students were asked what type of ICTs best supported their learning. 50% of the students responded “quizzes for formative self testing”.

In the School of Mathematics and Statistics at the University of Sydney we have been developing interactive web quizzes for our first year mathematics courses since 2001. Currently, the teaching and learning of thirteen different first year courses is supported by interactive web quizzes. For each course there are 120 questions, divided into 12 quizzes of 10 questions each. Each 10-question quiz covers material presented in one week of the course. The majority of the questions are multiple choice, but there are also questions requiring the input of a numerical answer.

The quizzes are for formative assessment only. Students are advised that there exists a quiz covering each week’s material, and are encouraged to try the relevant quiz on a weekly basis.

Over the past two years we have collected data on student use of the quizzes (by counting hits on the websites), and we have surveyed (by email) students in five of the courses. The survey was emailed to approximately 1100 students taking both a calculus and a statistics course, to 150 students taking both an advanced calculus and an advanced statistics course, and to 500 students taking a linear algebra course. The survey asked the following questions:

1. If you tried the on-line quizzes:
 - (a) How often?
 - (b) Did you find them useful?
2. If you didn't try the on-line quizzes:
 - (a) Why not?
 - (b) Do you intend doing them before the exam?
3. Any other comments?

More than 200 students have responded to the email surveys. Their responses, plus the hit data, have given us a reasonably clear idea of how students use the quizzes.

2 How students use the material

Of the 233 students who responded to the email survey, 197 (or 85%) said that they had tried the quizzes at least once. (It should be noted, however, that since the survey was sent to approximately 1750 students, it is likely that the overall percentage of students who used the quizzes was lower than 85%.)

About 40 students reported doing the quizzes on a weekly or fortnightly basis throughout the semester. These students appear to be using the quizzes in the way that we had hoped they would – that is, as a way of consolidating their learning each week, or at the end of a particular topic. The following comments were typical of these students:

“I tried them every week when I had completed my tutorial sheet and wanted some extra work.”

“I used the quizzes quite often, usually at the end of each section.”

It was not surprising, however, that the vast majority of students reported using the quizzes only for revision immediately before an assessment task, or

before the final exam. This is borne out by the hit data. For example, in one particular course, with an enrolment of 500 students, the hit data shows an average of around 20 hits per day throughout a week in which there was no assessment task, but an average of about 100 hits per day for the three days before a test was held. In the three days before the final exam, almost 800 hits were counted.

3 Do students find the material useful to their learning?

179 students responded to the question that asked whether the quizzes were useful. 157 of those answered “yes”, 14 answered “no” and 8 were non-committal.

Some students were remarkably enthusiastic. One student wrote:

“I think the online quizzes were actually the best learning resource that the entire course had to offer. They consolidated the material taught each week with comprehensive and detailed answers.”

Several students explained why they found them useful, and a number of students made comments similar to the following:

“As i approached the exam these web quizzes became an essential part fo [sic] my study. I made as much use of them as i could. The hints became highly appreciated, because it [sic] developed my thinking pattern and allowed me to surface my own unique way of solving rpoblems [sic]”

“... they were very useful in reviewing all the fundamentals and giving me crucial tips.”

“I found them very useful as drill type exercises to solidify understanding and skill.”

The 14 students who said that the quizzes were not useful invariably gave as their reason that the questions were too different from exam questions. In contrast to the students quoted above, the sole focus of these students appears to be on passing the exam.

4 What factors inhibit student usage of web-based mathematical material?

There were 49 students who had not tried the quizzes at all at the time they responded to the survey. (Several of these intended, however, to do them before the exam.) The reasons they gave for not trying them included the following.

- Lack of time. (21 students)
- Dislike working on-line. (7 students)
- Unnecessary. Other course material provided was sufficient. (15 students)
- Laziness. (2 students)
- Too different from exam questions. (3 students)
- Didn't know the quizzes existed. (10 students)
(Note that some students gave more than one reason.)

The number of students reporting a dislike of working on-line was surprisingly small, and it was pleasing to note that only one or two students reported technical difficulties in using the quizzes. Access to computer facilities is not a problem for our students. Computers for student use are readily available on campus, and most students have computer facilities at home. Our data shows that approximately 75% of the hits on the quiz websites come from home computers.

5 Student perceptions and usage of MCQ and CRQ

A follow-up survey was conducted after the main survey in one of the five courses in order to obtain more information on exactly how students worked through the quiz problems. In particular, we wanted to investigate preference and usage of multiple choice questions (MCQ) as opposed to questions requiring the input of a numerical answer (constructed response questions, CRQ).

Previous studies using information obtained in the context of non-formative assessment suggest that a majority of students prefer MCQ over CRQ. Bridgeman [6] tested 364 volunteers (all of whom had recently completed the U.S. Graduate Record Examination (GRE)) on a set of timed computer-based CRQ related to the GRE. Subsequently, more than 80% reported that they preferred MCQ to CRQ. In a small study of 29 high school mathematics student volunteers, Hamilton [7] reported that 20 preferred MCQ to CRQ. In this study, students attempting the CRQ were also required to explain verbally how their answers were obtained. Engelbrecht and Harding [8] compared tertiary student examination performance using on-line MCQ and on-line CRQ and found that better results were obtained on MCQ than on CRQ. It is not altogether surprising that students might prefer a format in which they are more successful.

The follow-up survey began with a short preamble which reminded students about the two different styles of questions (MCQ and CRQ) they had encountered in the web quizzes and also the fact that in each style of question an incorrect response generates a hint. It then asked these questions:

1. Which style (MCQ or CRQ) do you prefer, and why?
2. When answering MCQ, do you generally
 - (a) do your own calculation before checking any of the options,
 - (b) do no calculation, read all the options and choose the most likely one,
 - (c) do no calculation, tick ALL the options one by one to see which is correct.
3. For both MCQ and CRQ, how often do you check all the options or enter a random numerical answer for the purpose of seeing all possible feedback provided?
 - (a) always
 - (b) sometimes
 - (c) never.

Results and Discussion

There were 22 responses to the follow-up survey.

1. MCQ 15, CRQ 6, no preference 1.
2. (a) 13, (b) 1, (c) 0. Eight other students gave mixed responses.
3. (a) 8, (b) 10, (c) 3.

The sample is small and no claim is made that it is representative. However, in answering question 1 the majority preferring MCQ over CRQ is substantial. Of those who preferred MCQ (a total of 15 out of 22), the most common reasons were:

- MCQ are quicker and easier to do and provide certainty that one of the options is the correct answer,
- students could attempt the question even when uncertain of the correct procedure,
- students felt satisfaction when their calculated answer matched one of the options,
- students appreciated the ability to identify the format and type of answer required from the list of options, and hence to obtain some (visual) assistance with the problem,
- a wrong initial choice highlights a misunderstanding and gives an opportunity to fix it.

Some of the 15 students said that while they preferred MCQ overall (especially when their understanding of the material was still developing), they recognised the value of CRQ when they had become familiar with the work by the end of semester and more confident of their ability. Some others mentioned their awareness of the mood of caution and alertness induced by MCQ: there is value in seeing plausible but wrong answers.

Of those who preferred CRQ (6 out of 22), the most common reason was the recognition that having to work right through a problem themselves was a positive learning experience. “CRQ prevented me from guessing – I had to prove I understood completely” and “if wrong, it ensures you go back

over your working instead of just choosing another option”. Two students commented that the MCQ distracters had the potential to confuse.

Procedures (a), (b), (c) in question 2 correspond to different levels of confidence when starting questions. The 8 students who did not choose one of (a), (b), (c), stated that they used all three methods depending on how sure they were of what they were doing.

For question 3, a large majority (18) of the respondents either sometimes or always make a point of seeing all possible feedback, even that relating to incorrect answers. This majority includes those who know how to do the questions and whose answer has been marked as correct. This reinforces the view of students as “information gatherers”, constantly seeking access to more problems, more answers, more explanations.

6 Conclusion

In all the first year courses for which students were surveyed for this study, the summative assessment tasks are entirely paper-based and involve both CRQ, MCQ and extended response items. However the on-line quizzes are completely separate from the summative assessment tasks; their use is entirely voluntary, unmonitored (except for hit counts), untimed, and with the possibility of unlimited re-sits. It was hoped, therefore, that the survey responses would reflect genuine opinions free of the stress associated with immediate summative assessment.

The survey results suggest that only a small minority of students use the web quizzes in a way the designers hoped, as a weekly reinforcement of the current lecture and tutorial topics. Indeed, the hit counts show that their use is almost entirely driven by the summative assessment timetable. Nevertheless, the students who responded appear to genuinely appreciate the quizzes as a valuable extra resource. There was a marked preference for MCQ over CRQ in the small sample who responded to the follow-up survey. The need for feedback on progress has long been identified as an important factor in student satisfaction with mathematics courses. Marking of written assignments has usually been the mechanism for providing such feedback, but there is often a substantial time between submission and return. The immediate feedback possible in the web quizzes, although impersonal, is a valuable con-

tribution to the overall mix and appreciated by students. It is our view that extra resources such as on-line web quizzes should definitely be retained.

References

- [1] K. Krause, R. Hartley, R. James, and C. McInnes. *The first year experience in Australian universities: Findings from a decade of national studies*. Canberra: AGPS, 2005.
- [2] C. McInnes, R. James, and R. Hartley. *Trends in the first year experience in Australian universities*. Canberra: AGPS, 2000.
- [3] Higher Education Funding Council for England. *HEFCE strategy for e-learning*. HEFCE, 2005.
- [4] D. Lawson. Computer-aided assessment in mathematics: Panacea or propaganda? 2001. Available from the world wide web at: <http://science.uniserve.edu.au/pubs/callab/vol19/lawson.html>.
- [5] R. Ellis, T. Hubble, A. Applebee, and M. Peat. Perspectives of stakeholders on e-learning in science education at university. In *Proceedings of the 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*, Sydney, Australia, 2006. Sydney University Press.
- [6] B. Bridgeman. *A Comparison of Quantitative Questions in Open-Ended and Multiple-Choice Formats*. *Journal of Educational Measurement*, Vol. 29, No. 3, 1992, pp 253-271.
- [7] L.S. Hamilton. *An Investigation of Students' Affective Responses to Alternative Assessment Formats*. Presented at the Annual Meeting of the National Council on Measurement in Education (New Orleans, LA, April 1994.)
- [8] J. Engelbrecht and A. Harding. *Online Assessment in Mathematics: Multiple Assessment Formats*. *New Zealand Journal of Mathematics* Vol. 32, Supplementary Issue, November 2003, pp 57-65.