

# Online Weekly Quizzes in a Numeracy Unit Within a University Preparation Course

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**Abstract:** Edith Cowan University (Perth, Western Australia) offers a University Preparation Course to provide entry to degree programs to school leavers and mature age students who do not fulfil traditional entry requirements. The Course contains a Numeracy unit which involves over 300 students, spread over four campuses, and coordinated and taught entirely by sessional staff. In this paper a discussion is provided of the advantages and disadvantages the author experienced with integrating online weekly quizzes into the Numeracy unit. The quizzes are administered by Blackboard, a Learning Management System that allows students to access material and quizzes anytime via the internet. The Numeracy unit is comprised of eleven modules and each has an associated quiz to provide incentive for students to “keep up to date” with their work. The quizzes are also made available to students in the week prior to their final exam for revision purposes. Answers are not provided to weekly quizzes but are included with the revision quizzes. This paper outlines the design of the quizzes and technical issues involved with their implementation using the Blackboard platform. In addition, the author realises that students may guess or have help completing the quizzes, so the author looks at the reliability of the within term quiz results by comparing them with the final exam mark associated with similar multiple choice questions.

## 1. Background

The University Preparation Course (UPC) at Edith Cowan University (ECU) prepares students for study at university by teaching required skills necessary for academic success with emphasis on students becoming independent learners. The course is designed for school leavers, recent school graduates under 20 years of age and mature age students. Completion of the course meets ECU’s minimum entry requirements and successful UPC students may apply to a degree program at ECU at a future date. Applicants entering ECU through UPC are not guaranteed entry into all courses. Restrictions such as quotas and the level of competition apply to degrees, unless the student takes the full-fee paying option. Special conditions apply to some courses and successful applicants may be required to complete further bridging units.

The numeracy unit provides a foundation for students to demonstrate numeracy skills and processes required for study at ECU in courses that do not require specific mathematics prerequisites. Basic numeracy skills are essential for students to achieve independence and succeed in life (Zelenski, 2001). Adults who do not have an understanding of number concepts and simple computational skills face numerous problems. The numeracy unit comprises 11 modules that cover topics including number concepts and computations, linear functions, algebra, problem solving, financial problems, probability and statistics. The mathematical ability of the students enrolled in this unit varies considerably. Most of the students require a great deal of repetition to grasp basic maths skills.

The author faced a challenge of teaching students of varying age, from different backgrounds, and with varying English and mathematical skills. There was a noticeable number of students where English was their second language and terms and expressions often needed to be explained in more

depth. The author discovered that cultural and language differences sometimes created problems, for instance, one cannot take for granted that all students understand what a pack of playing cards is comprised of. Having students with different skill levels makes it challenging to keep brighter students engaged while ensuring others gain understanding of basic concepts.

Many mature aged students, and a handful of younger school leavers, have not done mathematics for a number of years. These students came to the unit very apprehensive, lacking confidence in their mathematical ability and questioning the need and usefulness of studying mathematics. There are also those students that have not enjoyed an earlier experience in learning mathematics who enter the unit as unwilling learners.

Many of these students do not have good study habits and require continuous feedback throughout the semester. As noted by Norton and Ovens (2005), the better students tend to disengage from the unit in the first couple of weeks when the majority of the material being covered is reviewing material already covered by these students. The students become complacent and often overlook areas in which they don't really have a good understanding of the material.

Students are supposed to attend a two-hour lecture and a one hour tutorial each week. With large student numbers, many students find their tutorial is three or four hours after their lecture time and do not want to "hang around" campus so they skip their tutorial. In the past students handed in tutorial questions each week and would have them marked and returned the following week. Due to the number of students, only a handful of exercises were actually marked, so students did not get feedback to all the problems. Students who did not attend the tutorials would get another student to hand their exercises in for them. Because many students did not attend regularly, many marked exercises were never collected and these students had no way of knowing how they were progressing in the unit. The teaching staff members are all sessional and most do not have an office on the campus where they are teaching, so students who missed a class had no way of collecting material or handing in work outside a lecture or tutorial. Most students only have access to their tutor through email.

Introducing online quizzes was seen as a means to help overcome these problems as well as reduce the amount of paperwork to keep track of and marking for tutors. Weekly online quizzes assist students to "keep up to date" with the material in the modules by containing a range of questions that cover the content of the module, and similar questions can be asked in different ways to assess a student's understanding. A student may answer a question correctly when in a true/false format but incorrectly when it is asked as a multiple choice question. One then postulates that the student has guessed the answer or does not understand the concept.

Online quizzes allow students flexibility as to where and when they attempt the quiz and they get immediate feedback with a score. Students were encouraged to wait till after their related tutorial before attempting the quiz as the questions were based on tutorial questions that they worked on in their tutorial and which had solutions available. This also gave the students time to ask for help with problems they had trouble with. To encourage students to do the quiz themselves they are told that the final exam contains a multiple choice section with questions based on the quiz questions.

## 2. Implementation

The quizzes were implemented using Blackboard version 6 (Bb), a learning management system. A general purpose maths and science notation tool (WebEQ equation editor) with the Blackboard Learning System allows users to use mathematical and scientific notation. The equation editor symbols are based on MathML, a markup language for mathematics on the Web. MathML is a subset of XML and WebEQ requires installation of the MRJPlug-in for Netscape 6 and Mozilla.

Each week had an associated quiz that related to the tutorial questions and lecture material for that week. The Numeracy unit was offered on four campuses, so four quizzes were made available each week and students selected the quiz associated to their campus. This enabled students from a particular campus to be easily identified in the gradebook, a spreadsheet that handles all the student marks. The quiz marks for each campus were grouped together resulting in a rather large spreadsheet, but with large student numbers it helped the coordinator identify students from any given campus. Students were able to view their marks for each quiz but these were not automatically added to their final grade as this was calculated on their best 6 marks and then added to the gradebook under a separate heading at the end of the semester.

The quizzes were created within the Test Manager and questions were selected from question pools within the Pool Manager. The quizzes were located under weekly folders within a Unit Resources folder. There was a separate folder for each module. Numerous settings can be applied to a test. The options that were applied to the quizzes included the following:

- Forcing completion which made the students complete the test the first time it was launched.
- Setting the timer so students had 30 minutes to complete the test and the completion time is recorded. A student that took longer than 30 minutes is identified within the gradebook by an exclamation mark instead of a score and the coordinator submits a mark later.
- Display the time interval (after/until) that the quiz is available.
- Passwords were required to access the tests – each campus had a different quiz and password associated with it.
- The feedback mode was set to “Score only” so students only received a final score. When the quizzes were used as revision the “Detailed Results” mode was selected so students were informed if an answer was correct, the final score was presented, but the correct answers were not given.
- The presentation mode was set to “One at a Time” so one question is presented at a time. The “Prohibit backtracking” box was selected to prevent students changing answers to questions that had already been submitted.
- Selecting “Randomise Questions” ensured each test attempt had similar questions appearing at different times. In case students were doing the quiz at the same time, there was less chance of them answering the same type of question.

Initially quizzes were developed for the first ten modules and students were urged to have a go at all of them, although only the best six contributed to their final quiz mark that was worth 20% of their final overall unit mark. This enabled students to miss or fail a couple of quizzes and still receive a satisfactory mark. Quizzes for a module were made available for two weeks following a module’s lecture. This was because some students had tutorials timetabled prior to a lecture and some afterwards, so the tutorials were run a week later to the lecture to be fair to all students. This also gave the students a week to look at material before attending a tutorial where they were expected to

have attempted exercises and ask questions. Any problems they had could be addressed and they still had a week to do the quiz. Students who felt confident with a modules content could always attempt the associated quiz prior to attending the related tutorial. Most students tended to wait till after their lecture.

### **3. Quiz Design**

Blackboard offered a number of question formats and the author experimented with ordering, true/false, multiple choice, fill in the blank and multiple answer questions. Due to a time restraint to get the quizzes up and running, the author restricted questions to true/false and multiple choice formats after the first couple of quizzes were set up. The quizzes were designed to give students a grade on completion, so formats such as short answers were not used as these would have required some manual marking. Fill in the blank questions were trialled in the first couple of quizzes. These worked well but all possible answer variations must be identified in advance. For example, if the solution to a problem is 3000, the variations 3,000 and 3 000 would also need to be given as possible solutions.

Ordering questions, such as:

Arrange in ascending order: 0.605, 0.0655, 0.065, 0.0605

worked well but a partially correct answer results in a partial mark. If one number was correct the student received a mark of 0.25 and if two numbers were correct the student received half a mark.

True/False questions are quick to set up although students guessed an answer when they didn't know or were unsure of the correct answer.

Multiple choice questions have one correct answer associated with them, while multiple answer questions can have two or more correct answers. All correct answers must be selected in a multiple answer question for a mark to be awarded. Questions can be worded in such a way that students have to think carefully before selecting an answer. These can take a little longer to set up but they challenge the students more than the simple true/false question and the probability of selecting a correct answer when guessing is reduced.

Quiz questions were written in five ways:

1. Entering text only.
2. Entering text and editing the source code for special characters, for example,  $\pi$  ( $\pi$ ).
3. Using only the Bb equation editor.
4. Combining text and the Bb equation editor.
5. Writing the equation in Word using Mathtype and inserting it in picture format, such as a bitmap, where it was displayed.

### **4. Advantages and disadvantages**

Restricting access to the quizzes by using passwords ensured students only accessed the quiz for their campus, ensuring their grade was located in the correct column in the gradebook. A problem arose when a student needed extra time and the password needed to be changed to accommodate this. A solution to this is to allow more flexibility in the time the quiz is available and not allowing any further extensions. Including a maximum number of marks, say 80% of the total marks

available, means a student is not required to answer all questions in order to achieve a maximum overall quiz mark.

The Numeracy students enjoyed doing most of the quizzes. Students were given instructions to email the unit coordinator if they experienced any difficulties. There was the odd student who had problems – for one reason or another their quiz crashed, but generally resetting the quiz once was sufficient to enable the student to complete the quiz. A student that experience a difficulty was instructed to use the computers in the megalabs at the university instead of their home computer and was sometimes granted a time extension using a new password. Students did tend to leave doing the test till the last day, so if they experienced problems it often eventuated in the student requiring an extension.

Unfortunately, due to technical problems encountered with the Bb platform, the quizzes did not always perform properly, creating a major headache with two of the quizzes half way through the semester. There were two quizzes that relied heavily on the equation editor to display the questions. These problems are not new, as they have also been experienced by WebCT users (Varsavsky, 2004). The first time one of the quizzes crashed, the students emailed the coordinator and the quiz was reset, but unfortunately the quizzes continued crashing. The questions were then emailed individually to the students, who in return emailed the answers back, and the coordinator entered the marks directly into the gradebook. This was a rather slow and tedious solution to the problem, especially as it occurred over the Easter holiday break and many students were not on campus and not checking emails regularly. Students were given an extension on these quizzes and the number of quizzes that counted towards the final quiz mark was also reduced.

Initial talks with the Blackboard support team indicated that the problem might be due to the Java plug-in that the quizzes rely on but this is to be investigated further. The university has since upgraded to Blackboard 7 and all computers in the university megalabs have had software updated, so hopefully the equation editor will function better and these problems will not arise again. The author has rewritten most of the questions that experienced difficulties in alternative formats though to ensure this does not happen again. As found by Varsavsky (2004) the author found the most reliable method for creating questions was by inserting mathematical expressions in a picture format.

Some students would attempt a quiz immediately after a lecture and prior to attending their tutorial or attempting tutorial questions. With the exception of a few above average students, these students generally did not do as well in these quizzes.

## **5. Analysis**

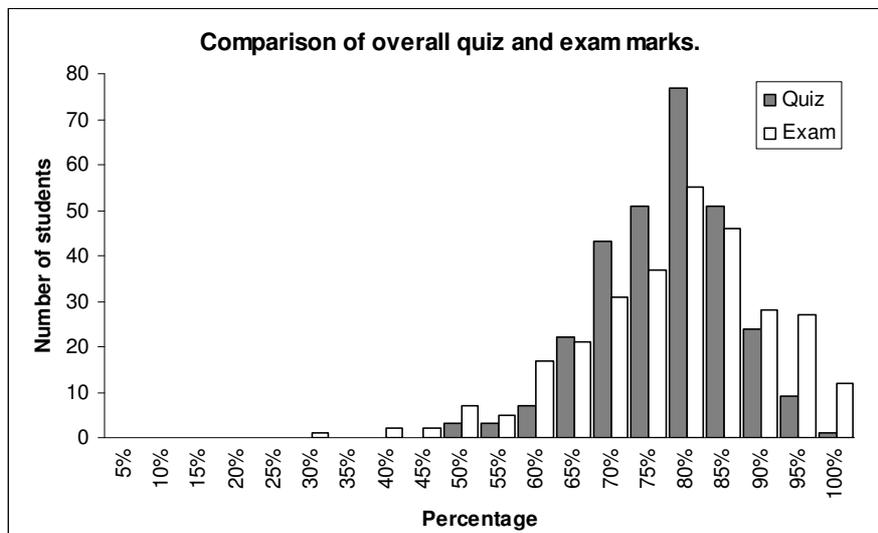
The final exam consisted of a multiple choice section containing 70 questions. The quiz mark was calculated using a student's best six quiz marks. Prior to the exam students were given access to the quizzes. They could attempt these as many times as they wished and correct answers were displayed when a student selected or gave an incorrect answer. Only about half the students used these quizzes for revision.

The grades from 291 students enrolled at the two metropolitan campuses were compared as the author had access to individual quiz and exam marks for these students. The exam papers from the

two regional campuses were not available when this analysis was done. The marks, represented as percentages, are summarised in Table 1 and displayed graphically in Figure 1. The majority of students are seen to have scored between 75 and 80 percent and the distribution for both sets of marks is normally distributed. There is a greater variation in exam marks than quiz marks.

**Table 1:** Descriptive statistics for 291 overall quiz and exam marks.

| (n = 291) | Mean   | St dev | Minimum | Maximum | Median |
|-----------|--------|--------|---------|---------|--------|
| Quiz      | 75.84% | 8.87%  | 48.0%   | 97.0%   | 77.0%  |
| Exam      | 75.77% | 12.81% | 26.2%   | 100%    | 76.9%  |



**Figure 1:** Comparison of overall quiz and exam marks.

A sample of 10 quiz questions that were very similar to ten final exam questions was selected and examined. The ten questions came from three quizzes. A total of 175 students were found to have attempted these ten quiz questions and their quiz and exam marks were compared. The selected quiz questions were all written as true/false questions with the exception of question 50 which was a multiple choice question. All the corresponding exam questions were multiple choice questions. As seen in Table 1 and Figure 2 students generally did better with the quiz question rather than the corresponding exam question. There is a significant difference in the number of correct answers for question 53. Students did not do well using the multiple choice format.

The two forms of the question were:

An example from the quiz question pool:

8, 4, 2, 8, 4, 5, 3, 3

The relative frequency of the score 3 is  $\frac{1}{4}$ .

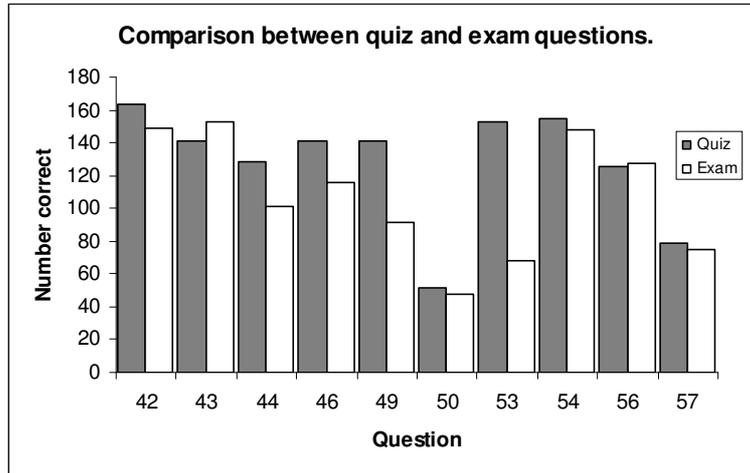
Exam question 53:

The relative frequency of 7 in the scores 4, 7, 8, 7, 7, 9, 6, 1, 7, 4 is:

(a) 0.3 (b) 0.4 (c) 3 (d) 4

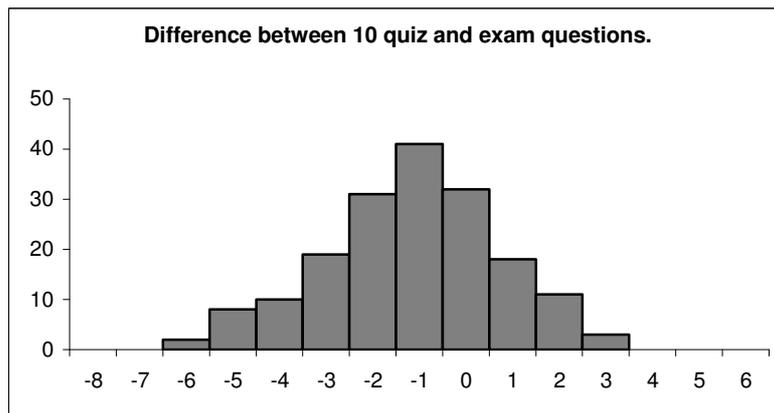
**Table 2:** Descriptive statistics for 175 overall quiz and exam marks.

| (n = 175) | Mean  | St dev | Minimum | Maximum | Median |
|-----------|-------|--------|---------|---------|--------|
| Quiz      | 73.1% | 14.9%  | 20.0%   | 100%    | 70.0%  |
| Exam      | 61.5% | 18.5%  | 10.0%   | 90.0%   | 60.0%  |

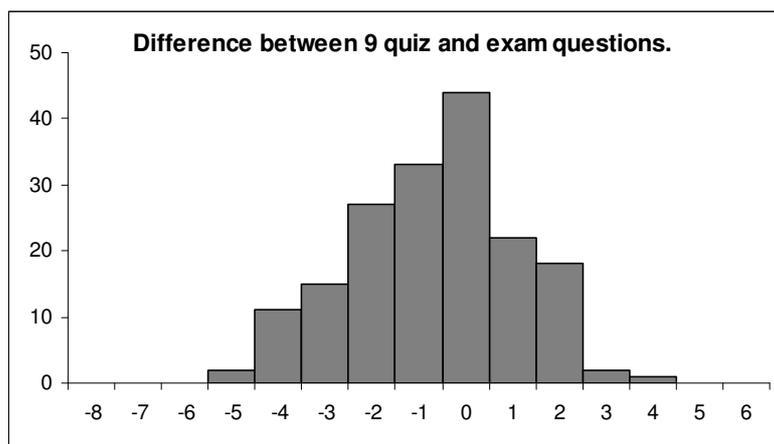


**Figure 2:** Comparison of ten quiz and exam questions for 175 students.

The multiple choice format of the exam questions did make the question harder, and as expected, many of these students selected (d) instead of (b). The difference between the number of correct exam and quiz questions was calculated (quiz - exam) and this is illustrated in Figure 3. The majority of students achieved one less correct exam question. If we remove question 53 we notice (Figure 4) the majority of these students had equal quiz and exam marks.



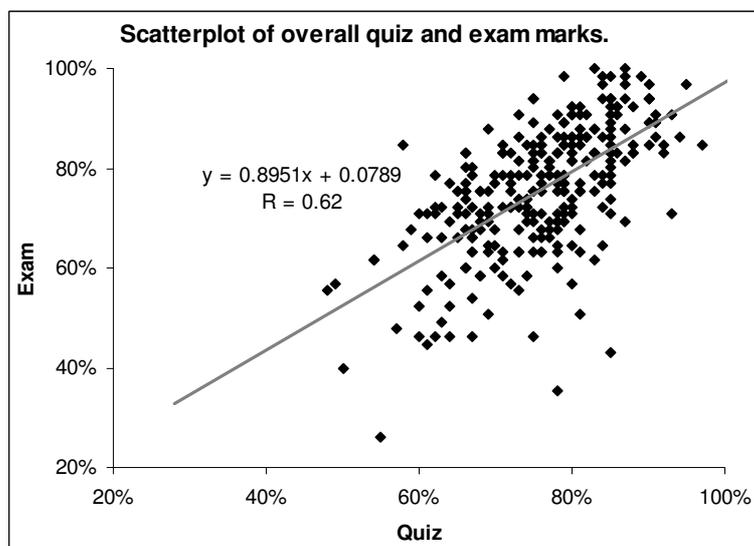
**Figure 3:** Difference between the number of 175 correct exam and quiz questions for 10 questions.



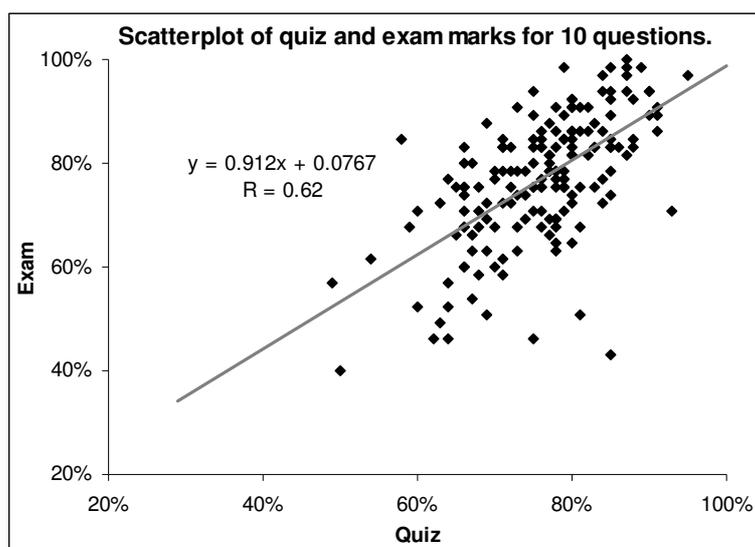
**Figure 4:** Difference between the number of 175 correct exam and quiz questions for 9 questions.

Figure 5 shows there is a positive relationship between the overall quiz and exam marks for 292 students with 38.34% variation in exam marks explained by the linear relationship with quiz marks.

Figure 6 shows the relationship for the sample of 10 questions is almost identical.



**Figure 5:** Scatterplot of overall quiz and exam marks.



**Figure 6:** Scatterplot of quiz and exam marks for 10 questions.

## 6. Conclusion

Online quizzes have the potential to be a useful tool to use in addition to lectures and tutorials. There are a number of technical problems with Blackboard that need to be overcome to ensure the quizzes do not crash as students get very frustrated and annoyed when this happens. To overcome the occurrence of students not understanding mathematical concepts well enough, the database of questions will be expanded so as to provide a greater variety of question formats.

## 7. References

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