Using online Moodle quizzes to support the teaching of mathematics to foundation engineering students

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ABSTRACT
Some first year engineering students lack basic knowledge of, and have a lack of engagement with the topics of foundation mathematics. This was clearly reflected on their low level of in-class interaction with the face-to-face lectures, and low marks in their final exams. The aim of this paper is to investigate the usefulness of online Moodle quizzes in improving and enhancing the teaching of mathematics to foundation engineering students. For this purpose, online Moodle quizzes with multiple-choice questions were developed and used to support the teaching and learning of foundation mathematics, help students during their exam revision, and improve their engagement with the topics of mathematics. The students had the opportunity to customize the online quizzes to their needs, control the topics and level of difficulty they want to study, and control their own pace and time of study during their revision before final exams.

The preliminary results from this research revealed an improvement of students’ exam results compared to last year’s results. More than 90% of the students felt positively about and commended the use of online Moodle quizzes, thought that online quizzes helped them learn mathematics, and prepared them during revision for their final exams.
RESEARCH QUESTION
Some foundation engineering students lack basic knowledge of mathematics, with lack of engagement with face-to-face lectures. This was reflected in their low level of in-class interaction and low marks in the exams. For the academic year 2012/13, the average pass mark in the final exam was 40%, and the pass rate was 68%.

Weekly online Moodle quizzes with multiple choice questions are developed to help improve and enhance the teaching of foundation mathematics, and help students during their revision for their final exams (summative) of the module.

RESEARCH METHODOLOGY
Tuttle\textsuperscript{1} recommends that online quizzes focus on the critical lower-level thinking learning for the students, and listed ten reasons to use online quizzes; I quote four reasons from his lists which are related to my online Moodle quizzes:

1. Students do not have to wonder if their answer is correct or not. They get immediate feedback to their answer.
2. Students can answer without feeling badly about having a wrong answer as can happen in a face-to-face class.
3. Students can read the teacher-provided strategy for improvement for each wrong answer. They improve through formative assessment.
4. Teachers can quickly analyze in what areas students are successful and in what areas they have demonstrated learning gaps. The teacher can use the online quiz’s graphing analysis to see if any learning gaps are class wide. Such real time data improves the formative assessment process.

Table 1. Example of a Schedule Plan for the Online Quizzes

<table>
<thead>
<tr>
<th>Week</th>
<th>Quiz Number/Title</th>
<th>No. of Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quiz 1: Vectors Operations</td>
<td>Attempts: 13</td>
</tr>
<tr>
<td>1</td>
<td>Quiz 2: Vector operations</td>
<td>Attempts: 14</td>
</tr>
<tr>
<td>2</td>
<td>Quiz 3: Vector product</td>
<td>Attempts: 6</td>
</tr>
<tr>
<td>2</td>
<td>Quiz 4: Differentiation</td>
<td>Attempts: 14</td>
</tr>
<tr>
<td>3</td>
<td>Quiz 5: DIFFERENTIATIONS</td>
<td>Attempts: 13</td>
</tr>
<tr>
<td>3</td>
<td>Quiz 6: Gradient of a function</td>
<td>Attempts: 7</td>
</tr>
<tr>
<td>4</td>
<td>Quiz 7: Differentiation using Product Rule</td>
<td>Attempts: 5</td>
</tr>
<tr>
<td>4</td>
<td>Quiz 8: Maxima and Minima of a Function</td>
<td>Attempts: 6</td>
</tr>
<tr>
<td>5</td>
<td>Quiz 9: indefinite integrals</td>
<td>Attempts: 6</td>
</tr>
<tr>
<td>5</td>
<td>Quiz 10: Mock Test Question 2: Vectors operation</td>
<td>Attempts: 10</td>
</tr>
<tr>
<td>6</td>
<td>Quiz 11: Definite Integral</td>
<td>Attempts: 13</td>
</tr>
<tr>
<td>6</td>
<td>Quiz 12: Definite Integral 2</td>
<td>Attempts: 5</td>
</tr>
<tr>
<td>7</td>
<td>Quiz 13: Integration of fraction</td>
<td>Attempts: 5</td>
</tr>
<tr>
<td>7</td>
<td>Quiz 14: Max &amp; Min of a Function</td>
<td>Attempts: 6</td>
</tr>
<tr>
<td>8</td>
<td>Quiz 15: Chain Rule Derivation</td>
<td>Attempts: 7</td>
</tr>
<tr>
<td>8</td>
<td>Quiz 16: Finding Area under a curve</td>
<td>Attempts: 5</td>
</tr>
<tr>
<td>9</td>
<td>Quiz 17: Area between two curves</td>
<td>Attempts: 4</td>
</tr>
<tr>
<td>10</td>
<td>Quiz 18: Statistics</td>
<td>Attempts: 4</td>
</tr>
</tbody>
</table>

Figure 1. Example of an online Moodle quiz: Definite integral of a function.
Johnson and Kiviniemi\textsuperscript{2} have found that the use of online quizzes motivates students to participate in class discussion, and improve performance on exams for materials covered both in class and on the quizzes. Online Moodle quizzes with multiple-choice questions are developed and used to support the teaching and learning of foundation mathematics, help students during their exam revision, and improve their engagement with the topics of mathematics. The students will have the opportunity to customize the online quizzes to their needs, control the topics and level of difficulty they want to study, and control their own pace and time of study during their revision before in-class assessments.

The E-learning Moodle system\textsuperscript{3} has a quiz activity, which can be incorporated in the module with an option for a reporting system for summarising quiz results, number of students who attempted the quiz, and a diagnostic feedback option for the student at the end of the quiz session to view their progression.

![Figure 2. Example of a Quiz results showing number of attempts and grade for each student (Names of students omitted for personal data protection).](image)

![Figure 3. “The online Moodle quizzes were clear and accurate”.](image)
PLANNING STAGE OF THE RESEARCH

The first step in this research was to monitor and keep track of what my students were doing, and to collect data about the current situation of my students vis à vis their learning and interaction with the topic of mathematics. The information used to collect data about the current situation were:

- Students attendance register
- Students activities and interaction during lectures and tutorial sessions
- Students’ mid-term exam results
- Students’ interaction with the Moodle website of the module, and with online quizzes.

Thirty-one online Moodle quizzes were developed, which were divided into six different categories according to the topics studied at each week (see Table 1):

- Vectors operations;
- Differentiations;
- Indefinite Integrations;
- Definite Integrations;
- Statistics; and
- Probabilities.

The weekly online quizzes were arranged from easy to difficult ones. An example of a typical online quiz to find the definite integral of a function is shown in Figure 1.

Figure 2 shows the quiz results such as: number of students who attempted the quiz, time taken to do the quiz, number of attempts, student grade, and any feedback.

RESULTS FROM ONLINE QUESTIONNAIRE

An anonymous online questionnaire based on the Likert scale and open questions were used to obtain quantitative data and feedback about students’ satisfaction and usefulness of online Moodle quizzes to support their leaning and revision of mathematics. A total of 18 students from 25 completed the questionnaires. Some of the students’ feedback are shown in Figures 3, 4, 5, and 6.

Figure 4. “I find online Moodle quizzes to be helpful to my learning of mathematics”.

Figure 5. “I would recommend that online Moodle quizzes to be included in other modules”.
Sample of students’ responses to the question:
“If you felt that online quizzes were useful, list three things about them you felt were particularly helpful in your learning”:
“The instant feedback”, “Interactive and detailed”, “Easy to access by Internet”, “It was helpful to my learning and exams”, “It was structured well”, “They helped me to practice for my exams”
“Kept me focused in class”, “Found them to be useful”, “Finding the right workout answer”, “Easy to understand the question”, “Help me to revise”.

CONCLUSION
The preliminary results from this ongoing academic research revealed an improvement of students’ results in the final exam compared to last year’s results. More than 90% of students felt positively about, and commended the use of online Moodle quizzes, and think that online quizzes helped them engage with and learn mathematics, and prepared them during revision for their final exams. The average exam mark was 46%, which is a slight improvement compared to last year results (40%).

This research is considered as a first step for a long term project, in which more data collection is planned in future to build a clear picture of the usefulness and practicality of using online Moodle quizzes to enhance the learning process and engagement of students with the topic of mathematics. The comments from students’ survey were constructive, and some of the students’ suggestions will be incorporated to improve the quality of online Moodle quizzes, and make them more practical and enjoyable.

REFERENCES