

Online Mathematics Learning in Tertiary Education: A Study on Students' Behavior

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ABSTRACT

Learning mathematics requires extensive understanding and practical, which makes it a challenge to many students. Traditional face-to-face session with "chalk-and-talk" is still required for many students, who need extra guidance and step-to-step explanation on the subject. However, the advancement of digital technology today enable the teaching and learning on mathematics to be carried out through internet with less limitation in time and space. In this study, volunteered students were requested to take part in online mathematics learning activities. The students' feedback indicated that with the blending of online approaches, improvement was achieved in learning the subject. In conclusion, students showed positive responses to the online mathematics study.

Keywords: Mathematics education, blended learning, tertiary education

INTRODUCTION

Mathematics is a subject that requires extensive understanding and many practical, thus unfavored by many students. Mathematics teachers always face the challenge of getting their students to understand the concepts as well as the application in the subject. In order to help the students to score in this subject, dedicated teachers spend extra time to guide their students with face-to-face consultation, which might not be effective, especially when the number of students is large.

In order to solve the problem in guiding their students, many teachers relied on the usage of technology in their teaching (Ayub, Sembok, & Luan, 2008; Fukuda & Kakihana, 2009; Nguyen & Kulm, 2005; Razali et al., 2011; Sanchis, 2001; N. Tawil et al., 2010). Some of them are using the offline technology such as Microsoft Word or Microsoft PowerPoint to enhance students' understanding, while some have started to teach mathematics through online approaches. Facebook, Youtube, and Blogger are among the popular platforms for these online approaches.

In teaching mathematics subject, a few teachers found that blending the online mode into the class was helpful (Nguyen et al., 2006). However, there are disagreements as well. Smith and Ferguson (2005) gave different view on this as they found that the attrition rate for online mathematics subject is higher compared to other online subject, caused by difficult-to-use mathematical symbols in online environment. Tawil et al. (2012) have also found that engineering students prefer traditional face-to-face lecturing for mathematics, due to the same reason.

In this paper, we report an initiative in teaching mathematics with a blend of online and offline modes in order to enhance students' understanding on the subject. The feedback from the students collected through questionnaires to study the students perspective about the online approaches used.

METHODOLOGY

Overall Design

Face-to-face lectures were carried out as normal for the whole semester (14 weeks), with additional online discussion carried out on Facebook and ready-made interactive online assessment tool provided by Pearson (2014). At the end of the learning process, survey was conducted through questionnaire. Students' participation on the face-to-face lectures was compulsory, while online discussion was optional. Mathematics questions can be formulated in many ways. There is no one unique site which can be used to cover all types of mathematical questions. Nevertheless, we have chosen two approaches: Facebook and online assessments provided by Pearson.

Facebook

Facebook was used to convey the questions involved discussions and did not require specific symbols. A Facebook Group was created for the subject and the students were invited to become the members of the group. Five questions that required short answers or discussion were posted on the Facebook Group thorough the semester. Group members were free to share their answers, to guide their friends through discussion, and to share their calculation steps within a period of time. The answers given by the students were checked and feedback was provided by the teacher from time to time throughout the discussions.

Pearson Online Assessment

Online assessment provided by Pearson (2012) was used to formulate objective questions, structural questions, and questions which involved graphs and extensive mathematical symbols. In order to access to the online assessment, specific login permission, which only came with the purchase of Pearson text book was required. Students were required to try out the online assessments provided by Pearson (2012). Students were able to key in mathematical symbols with the palette available on the website itself.

The question provided by Pearson allowed students to search for help by clicking on "Help Me Solve This" or "View an Example" buttons, in order to reveal the steps to solve the problem. If they were still unable to understand the working steps, they may choose to click on "Ask My Instructor" to direct their questions to their instructor through the system. Questions printing option was also available in the system. Pearson online assessments were prepared for all the chapters taught.

The Survey

A survey was carried out at the end of the semester using questionnaires. The questions surveying students' perspective on the online approaches were measured with Likert scales (from 1 represents strong disagreement to 5 represents strong agreement). Questions were designed to collect information regarding general information about the online assessment taken, opinions about mathematics, and the perspective of those who have participated in online assessment and discussion.

Data Analysis

The results from the survey were analyzed to test on the hypotheses listed below with significant value $\alpha = 0.05$.

H0: Online participating students show no increase of interest in Mathematics (mean = 3)

Ha: Online participating students show an increase of interest in Mathematics (mean > 3)

H0: Online participating students show no increase of understanding in Mathematics (mean = 3)

Ha: Online participating students show increase of understanding in Mathematics (mean > 3)

H0: Online participating students show no increase of confidence in Mathematics (mean = 3)

Ha: Online participating students show increase of confidence in Mathematics (mean > 3)

RESULTS AND DISCUSSION

Out of 47 students, 41 students participated in at least one of the learning activity. The results were analyzed in two parts: Part 1 analyzes the background of the students, i.e. general opinions about mathematics, which involved all 47 students. Whilst part 2 analyzes on students' perception towards online learning, which consists of participating students only.

Results of part 1 are stated in Table 1. We found that majority of students (mean = 3.5, standard deviation = ± 1.1) stated that mathematics was one of their favorite subjects. Perhaps, the likeness of the subject was related to the teaching approaches used, which could be more or less reflected from the active participation of students (mean = 3.6, standard deviation = ± 1.0). As this survey was taken at the end of the semester, students' positive perception towards the subject was well-anticipated due to the usage of online approaches. However, still they worried about this subject, with a rate of 4.1 and standard deviation of ± 1.2 .

Table 1. Result for students' general opinions about mathematics

No.	Statements	Mean	Standard Deviation
1	Mathematics is one of my favorite subjects.	3.5	± 1.1
2	I always participate actively in my mathematics classes.	3.6	± 1.0
3	I always worry about my mathematics subject.	4.1	± 1.2

The statistical analysis showed no correlation between favorability of the subject and the anxiousness of the subject (Table 2), with correlation coefficient, $r = - 0.07$, likewise for anxiousness towards the subject and being active in class ($r = 0.01$). There is only moderate positive correlation ($r = 0.41$) between the favor to the subject and being active in class participation. It was interestingly showed the contradiction in students' worry about the subject despite their active participation and their increasing "love" to it. The "fear" to mathematics might cause by the performance of the subject in their previous education (Hembree, 1990; Russell, 2012). Nonetheless, the students who liked mathematics tended to be more active in the class with $r = 0.41$.

Table 2. Correlation between students' general opinions about mathematics

	<i>Favorite</i>	<i>Worry</i>	<i>Active</i>
Favorite	1		
Worry	-0.07	1	
Active	0.41	0.01	1

Students' perception towards learning mathematics online was measured in the second part of the survey (Table 3). From the survey, we found that the students responded positively towards learning mathematics online. They reflected that the online learning had increased their interest in the subject and has enhanced their understanding in the subject, with both items scored 3.5 and p-value less than 0.05 respectively. The students reflected that they felt more confident in the subject after taking online assessment with the score of 3.6 and p-value less than 0.05.

Table 3. Correlation between online participants' perceptions in learning mathematics online

	<i>Interest</i>	<i>Understanding</i>	<i>Confidence</i>
Interest	1		
Understanding	0.54	1	
Confidence	0.39	0.39	1

Bursal et al. (2006) reported that the confidence could reduce the anxiety towards mathematics. Anxiety affects the performance of students (Maloney et al., 2010; Wu et al. 2012), thus more online activities should be integrated into the subject in future.

CONCLUSION

Teaching mathematics is always a challenge in tertiary education. Blending online learning into traditional face-to-face session is facilitated by many approaches. In this study, we found that the students showed more positive attitudes towards mathematics after using Facebook for the questions that required simple discussion, while Pearson Online Assessment was used for the questions that required complicated mathematical symbols. Through the combination of two approaches, students reflected that they gained more interest, understanding and confidence on the subject. These findings may help to encourage the students to pursuit a better results in mathematics.

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