Students' and Lecturers' Perception on the Use of Introductory Engineering Mathematics PutraMOOC

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Makhfudzah Mokhtar*, Wan Azizun Wan Adnan, Ahmad Salahuddin Mohd Harithuddin, Diyana Jamaludin, Zuraidah Zan and Faisul Arif Ahmad

Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

** fudzah@upm.edu.my*

Abstract

This paper presents the perceptions of lecturers and students on the use of the Introductory Engineering Mathematics PutraMOOC as a medium of learning and teaching for first year engineering students. The objectives of the study include respondents' perceptions of the characteristics of the PutraMOOC and its impact on the implementation of OBE. To measure the findings based on the respondents' experience on using the PutraMOOC, questionnaires which was also linked to students' scores, as well as interviews with lecturers were conducted. The results of this study show a positive impact and perception of the use of the PutraMOOC. However, based on the findings, there are also some improvements that need to be made in helping the effectiveness of the PutraMOOC in the future use.

Keywords: Assessment for Learning (AfL), Massive Open Online Course (MOOC), Outcome Based Education (OBE), e-learning, Introductory Engineering Mathematics.

Introduction

Research Background

With the advancement of online learning, MOOCs (Massive Open Online Courses) which have been introduced in 2008 embarks the world class teaching and educational resources beyond geographical and social boundaries. Despite of many models of MOOCs, the blended MOOC (bMOOC) model converges the cMOOC (i.e. focus on knowledge creation and generation) and xMOOC (i.e. focus on knowledge duplication) and hybrids both MOOC and face-to-face learning. It has been much more popular as it promotes more personalized and scaffold learning. Among the criteria that would fulfill the effectiveness of MOOC listed by Yousef et al. (2015) are blended learning, flexibility, high quality Content Instructional Design and Learning methodologies, life-long learning, network learning, openness, and student-centred learning. Meanwhile, Marks et al. (2005) have suggested that there are three main aspects of online learning need to be taken into consideration which are instructor-student interaction, student-student interaction, and student-content interaction.

The Introductory Engineering Mathematics PutraMOOC has been offered in the Faculty of Engineering, Universiti Putra Malaysia in 2017 and has undergone two cohorts of students, comprising around 600 students to year 2019. This course is very crucial as it is a basic course to mastering engineering fields, and it has been developed on the Massive Open Online Course (MOOC) environment in blended mode - bMOOC with the purpose that the course could be considered in the credit transfer system in future once it is fully a MOOC. The course was designed to suit with the Outcome Based Education model when it is run on the PutraMOOC. Using appropriate and effective assessment is one of the important aspects to be considered in this course so that the learning objectives can be achieved on bMOOC environment. Traditionally, assessment methods focus much on summative assessments where students' performance is assessed solely through tests and examinations. It was found that by applying the assessment based on summative assessment alone, it was quite challenging for instructors to recognize the shortcomings of the students at early stage and accordingly, very little remedial activity could be done. Since the summative assessments only could not help shaping the progress of a student, formative assessment or known as 'assessment for learning (AfL)' was also highlighted in this work.

Assessment for learning (AfL) is a type of assessment that is observed during the students' learning process. During the process, lecturers identify the weaknesses and learning needs of students and take appropriate actions so that the students have better preparation for summative assessment afterwards. Numerous cases reported the effectiveness of AfL (William, 2007). Behind its implementation, students need to know and understand the following before learning can take place: what is the aim of the learning? why do they need to learn it? where are they

in terms of achieving the aim? and how can they achieve the aim? This indicates how critical it is to the students' attention to their learning progress, and to show the need for teachers to inspire such attention as much as possible. Kesianye (2015) also agreed that assessments which are focused during the process of learning and progress made by students could help the AfL becomes more effective. Effective teaching is usually assisted by five teaching strategies which are clarifying and sharing goals for learning and criteria for success with learners; conducting effective classroom discussions, questions, activities, and tasks that show evidence of students' learning; providing feedback that moves learning forward; activating students as owners of their own learning; and activating student as learning resources for one another (William, 2007).

Influenced by constructivism learning theory which emphasizes on the role of students in achieving higher level of thinking, authentic assessment for learning becomes an interest of this study. There are ten characteristics of assessment activities that have been identified by Reeves et. al. (2002) in which the authentic activities are seamlessly integrated with assessment. The authentic assessment provides a platform for students to solve real-world, ill-defined, and complex problem while collaborating with other parties, applying multi-, cross- or even trans-disciplinary knowledge or skills, and prepare the students to become creative and innovative. An extended study of authentic assessment by Herrington et al. (2004) argues that as the development of technology grows very fast, the value of authentic activity is not constrained to learning in classroom or face-to-face manner, but the benefits of authentic activity can also be realized through careful design of e-learning environments.

Although there have been many studies that have outlined ways of effective online course or even MOOC (Zulkifli, Hamzah & Bashah, (2020), the perceptions among respondents would be different based on the ways the course was offered. Therefore, more investigations on examining challenges or perceptions need to be done on upgrading the course efficiency for the Introductory Engineering Mathematics PutraMOOC. Among the aspects to be considered are based on i) the features of PutraMOOC, ii) the use of PutraMOOC for Outcome Base Education model, ii) the impact of the use of PutraMOOC towards students' achievement and iv) the potential of PutraMOOC as a credit transfer course. Therefore, this work is intended to see any possibilities of resolving the issues by formulating the following research objectives; to what extent do students and lecturers perceive the use of the Introductory Engineering Mathematics PutraMOOC? and to what extent do PutraMOOC tells the differences in students' tests performance?

Research Framework

The overall research framework of this study is shown in Figure 1. It focuses on blended MOOC (bMOOC) and refers to the perceptions and performance of engineering students who take the Introductory Engineering Mathematics PutraMOOC course. The study also involves lecturers in obtaining their perceptions on the use of the platform and its potential towards a credit transfer course. The form of assessments carried out are inspired by the learning of constructivism which assigns students to produce an explanatory video on mathematical applications in engineering, as well as behaviourism learning theory via quizzes. The findings are expected to contribute for the upgrading of the Introductory Engineering Mathematics PutraMOOC for future use.

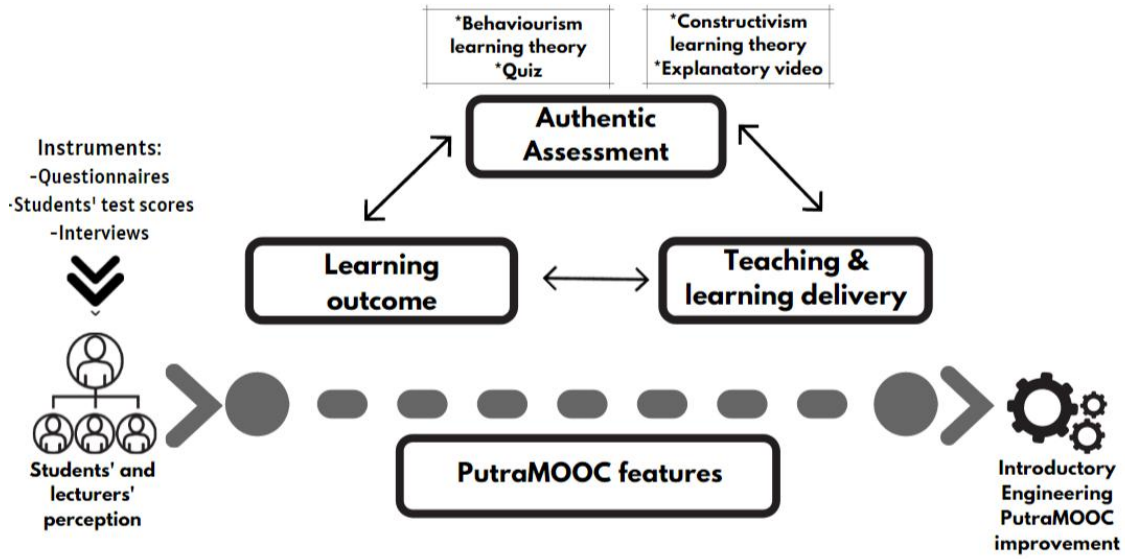

Figure 1. Research framework

Methodology

Development of assessment instruments

The types of assessment are multiple choice questions (optional for students for self-assessment) and video assignment (compulsory). The assessments were developed by considering the course content and outcomes that requires students to apply and explain the use of mathematics in solving engineering problems. In a group of three students, students were given a task create a short video (3-5 minutes) and explain a big idea of 'function' in real life. The explanatory video could be in any form (such as animation, talking head, documentary, and dramatic reconstruction) and using dynamic visual medium (such as diagrams, simulations, physical demonstrations etc.) rather than explaining in front of a whiteboard. The videos are assessed according to the teamwork, content, and creativity criteria. Since there are 8 groups of students from different programs in this PutraMOOC, each lecturer who conduct his/her group would assign any relevant topics or issues to students. One of the triggers given is depicted in Figure 2.

Development of questionnaires

The main objectives of the questionnaires are to examine the perception of students on the use of The Introductory Engineering Mathematic PutraMOOC. The Likert scale was used as the perception indication with the range of 1 to 5 (1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, Agree and 5: Strongly agree). A few open-ended questions were also included as parts of qualitative data. The first questionnaires were distributed to a small number of students in looking for the views on any parts that they like or dislike about the Introductory Engineering Mathematics PutraMOOC features and specific opinion about the course. Their perception was also mapped to individual's test score in finding relationship between students' perception and their test scores. The second questionnaires were given to bigger number of students in finding their detailed perception on the implementation of AfL in the PutraMOOC.

Interviews with lecturers

Individual interviews were held after the semester ended once lecturers have completely done the course activity and grading. The questions were asked based on their teaching and learning implementation using the Introductory Engineering Mathematics PutraMOOC and their perceptions regarding the usage of PutraMOOC with relation to authentic assessment, recommendation to the course improvement, and opinions on the challenges using this MOOC as a credit transfer course.

Data collection and analysis

There were 3 lecturers involved in the interviews: one male and two female lecturers. Meanwhile, 16 students involved for the first questionnaires and 263 students took part for second survey, consisting of engineering students from various engineering programs such as computer and communication systems engineering, electric and electronics engineering, civil engineering, and chemical engineering. The data were collected and analysed based on recording from the interviews, statistical parameters of mean and variance from the questionnaires, as well as views from the respondents.

Results and Discussion

Students' perception on the Introductory Engineering Mathematics PutraMOOC features and its impact towards the summative assessment

A questionnaire to identify whether students favour the use of PutraMOOC in assessing their understanding was done after they took the test in the middle of the semester. There were 16 students involved in this study. They were given the option of expressing their preference as well as the reason for supporting their respective standings. The pie chart (in Figure 3) shows the characteristics that have been categorized according to the student's response.

Figure 2. An example of trigger for video assignment

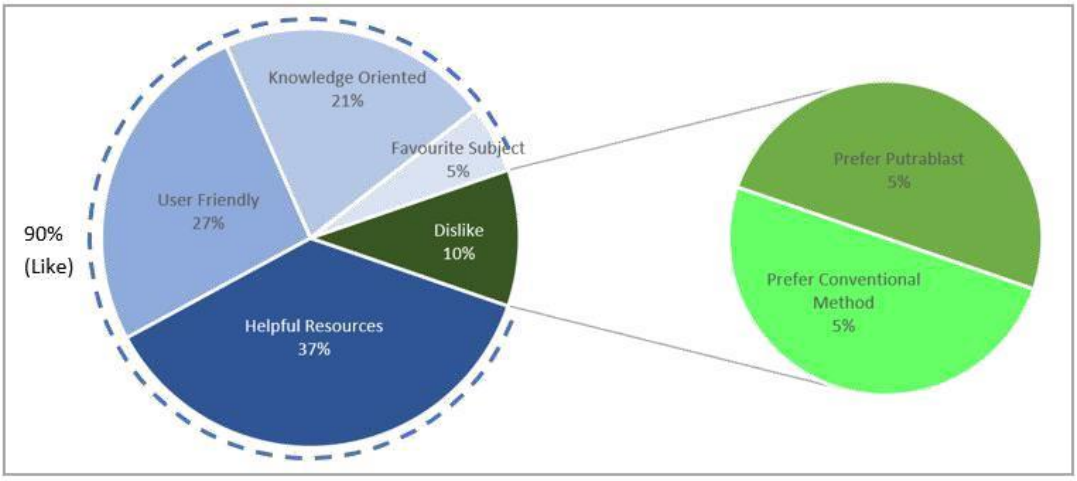

Figure 3. Perception of students about the Introductory Engineering Mathematics PutraMOOC

The findings show that 90% are likely to prefer the PutraMOOC use. Among the 90% of students who prefer PutraMOOC; 37% of students feel that PutrMOOC provides helpful resources, 27% stated that PutraMOOC is a user-friendly platform, 21% found that PutraMOOC is knowledge oriented while 5% like this course as a favorite subject. Meanwhile, among the 10% who do not prefer PutraMOOC, 5% prefer the use of PutraBlast which is the common learning management system at the University and 5% prefer the conventional lecture. The main challenge identified from the questionnaire is related to a server connection where some students recommend that server connection must be improved.

The questionnaire was also aimed to find out whether there is a link between the preference of the student to PutraMOOC and their achievement in the test. In order to look at these relationships, the 'like' perception was evaluated to scale 5 while the 'dislike' was assessed to scale 1.

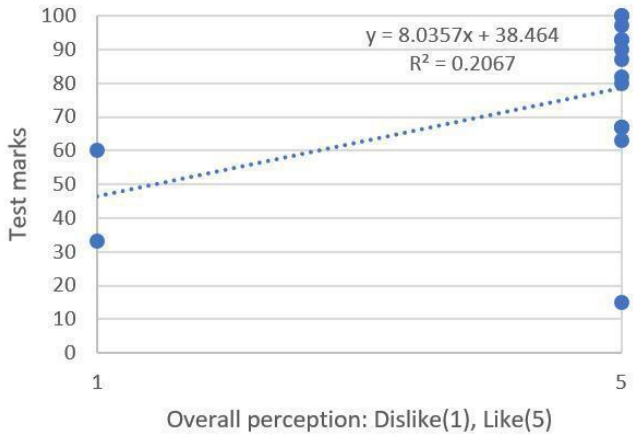

Figure 4. Overall perception with relation to test marks

Scores of students according to their preference are shown in Figure 4. It can be noted that there is a positive correlation where most students who love PutraMOOC perform better than those who do not like. This observation indicates a positive response towards the use of PutraMOOC as a platform for attaining learning outcomes among students.

Students' perception on the usage of the Introductory Engineering Mathematics PutraMOOC in Outcome Based Education implementation

At the end of the semester, a total of 263 students participated in a detailed questionnaire of students' perceptions on three main categories of Outcome Based Education via PutraMOOC. The overall results are shown in Table 1.

In general, this finding clearly shows that there is a good acceptance among students in using PutraMOOC as platform for them to attain learning outcomes based on assessments and teaching and learning delivery, and have good interaction with both lecturers and peers. Majority of students showed a uniform response with a small variance value (<1.00) for each question item. Nevertheless, the aspects that need to be addressed are the ways lecturers give feedback to students on their assessment, and the extensive contents of the teaching and learning materials.

Lecturers' perception on the usage of the Introductory Engineering Mathematics PutraMOOC

Based on the interviews with three lecturers, it is found that they used PutraMOOC in supporting their teaching and learning activities.

Assessment for Learning (AfL) strategies

One of interesting assessment methods that they used was video assignment. It is observed the ways lecturers ran the assignment fulfils effective learning strategies as summarized in Table 2. This had opened opportunities for both lecturer and students to involve in active learning approach.

Table 1. Students' perceptions on three main categories of Outcome Based Education via the Introductory Mathematics PutraMOOC.

No	Question	Category	Mean	Variance
1	The online content are well structured and easy to follow	Course structure	3.93	0.84
2	The materials from the video assignment which are shared online from my peers help me to increase my understanding of the topics	Assessment-Learning Outcomes	3.91	0.78
3	The video assignment given in this course stimulates my thinking	Assessment-Learning Outcomes	4.03	0.68
4	Additional online questions (such as multiple questions) given in this course stimulate my thinking	Assessment-Learning Outcomes	3.99	0.68
5	Additional online questions (such as multiple questions) given to me is appropriate with the learning outcomes	Assessment-Learning Outcomes	4.05	0.63
6	The feedback from the lecturer help to increase my understanding	Assessment-Teaching and Learning Delivery	4.19	0.72
7	**The lecturer gives online feedback for my assignment**	**Assessment-Teaching and Learning Delivery**	**3.92**	**0.90**
8	The video assignment given to me is appropriate with the learning outcomes	Assessment-Learning Outcomes	4.04	0.68
9	Most of the contents delivered help me to understand the topic effectively	Teaching and Learning Delivery-Learning Outcomes	4.01	0.82
10	Most of the contents delivered attract my interest in mathematics	Teaching and Learning Delivery (Contents)	3.92	0.92
11	**There are sufficient examples explained in the contents**	**Teaching and Learning Delivery (Contents)**	**3.80**	**1.00**
12	I am satisfied with the online interaction I had with my lecturer	Teaching and Learning Delivery (Interaction with Lecturer)	3.96	0.86
13	I am satisfied with the online interaction I had with students in this course	Teaching and Learning Delivery (Interaction with Peers)	3.97	0.86
14	Learning outcome are stated clearly at the beginning of each topic	Learning Outcomes	4.21	0.65
15	Summary of the lesson is given at the end of each topic	Learning Outcomes	4.04	0.88

Table 2. Video assignment strategies

Clarifying learning objectives	Conducting classroom discussion	Providing feedback	Activating students as owners of their own learning	Activating student as learning resources for as one another
Lecturers mentioned the learning objectives in class and PutraMOOC	Lecturers motivated students to discuss via chat room/ forum	Lecturers gave feedback in class and PutraMOOC	Students gave comments in PutraMOOC and contributed their works with open access to other lecturers and students	Students learnt among themselves by sharing their works in PutraMOOC

Benefits and Recommendation for the Introductory Mathematics PutraMOOC

There is positive feedback from lecturers in their views on the benefits of this course when it is run in bMOOC environment. The aspects that they appreciate are more on the cross-department visibility, additional supports on the teaching and learning materials, involvement of big number of students and it offers flexibility for lecturers to do asynchronous lecture mode. The summary of their views is shown in Table 3.

Meanwhile, in terms of their thoughts on making improvement to the PutraMOOC, they prefer to improve the contents, system interface and their skill in using the platform. More trainings are needed so that they can fully utilize the features offered by the PutraMOOC platform. Detailed recommendation can be found in Table 4.

Considerations of the Introductory Mathematics PutraMOOC as a credit transfer course

Another important aspect is in seeking views from lecturers about the consideration of the Introductory Engineering PutraMOOC as a credits transfer course. Their concerns are mainly based on the contents and the effective assessments strategies that can be monitored by lecturers, as mentioned in Table 5.

Table 3. Opinions by lecturers on the benefits of the Introductory Mathematics PutraMOOC

Lecturer	Benefits
#1	- Lecturers can provide additional notes and teaching video to students - Unlimited participants.
#2	- Students can join between classes of different department. - Lecturers can upload teaching video and set time for student to do the assignment outside class when lecturer not available to attend lecture. - Student can choose to learn Maths freely.
#3	- Lecturers can upload teaching video to students for self-learning. - Unlimited number of students is possible.

Table 4. Recommendations by lecturers on the improvement of the Introductory Mathematics PutraMOOC

Lecturer	Recommendation
#1	- Modules need to be improved - Need a lot of self-assessment problem for student in PutraMOOC, a lot more functions and better user-friendly quiz interface - Need more training for system features full utilization. Some features are not fully learnt yet.
#2	- Need more training for system features full utilization.
#3	- Provide training for lecturers - Avoid materials uploaded by students to be private - Create an apps integrated with messaging feature.

Table 5. Feedback by lecturers regarding the consideration of the Introductory Engineering PutraMOOC as a credits transfer course

Lecturer	Feedback
#1	Can be considered if there are proper modules that fulfil criteria according to standard requirements for Maths related subject.
#2	Course module must be complete first (e.g. notes, assessment, syllabus, course content). The main issue would be based on monitoring the student progress because the student can access the system everywhere without others to monitor. There is a probability that student's work is not genuine.
#3	There is a possibility to be implemented if the course module is complete and have standard passing mark for credit transfer. However, the challenge is due to difficulty to monitor students who has poor attitude and lack of practice.

Conclusion

Overall, this work observed perception from both students and lecturers about the use of Introductory Engineering Mathematics PutraMOOC in its initial implementation. Majority of students liked the use of PutraMOOC although there were constraints in terms of internet access. It can be noted that there is a positive correlation between the preference of using PutraMOOC with students' performance in their test. The results show that there is a good acceptance among students in using PutraMOOC as their learning platform. More attentions need to be addressed on the lecturers' feedback and the course contents. Meanwhile, the recommendations made by lecturers are useful for upgrading the PutraMOOC in terms of its contents and features. More studies on effective assessment monitoring need to be done on realizing this course for credit transfer in future.

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