STUDENTS' PERCEPTIONS ON LEARNING ORDINARY DIFFERENTIAL EQUATIONS (ODEs) USING MOOCs

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ABSTRACT

In traditional Mathematics classes, the lecturer lectures and gives some examples related to the new concepts that have been taught. In order to get students more engaged and invested in their own learning, educators in UiTM Perak implemented the MOOC platform of Ordinary Differential Equations (MAT300) for teaching and learning of Ordinary Differential Equations. Students were assigned selected portions of learning materials in the MOOC platform before class. In this way, students were better prepared for class and class time was better utilized for discussions. Online learning here was used as a complement to and an extension of traditional classroom learning. MOOC make learning available to anyone anywhere at any time. This will also fulfills the education ministry's requirement of life-long learning for all. This study aims to investigate learner's perception in term of usefulness, understanding, effort, excitement and confident towards MOOC for Ordinary Differential Equations (ODE). This study involved 36 respondents from Diploma in Mathematical Sciences (CS143) students, who took MAT300 during the March- July 2017 semester. This study revealed that most of the students put in much effort accessing the online material, enjoyed learning through videos, preferred accessing MOOC on campus and had better understanding in MAT300 after using the MOOC platform. Overall, MOOC increased the level of confidence of students in learning MAT300.

Keywords: ODEs; MOOCs; Teaching and Learning; Perceptions

1. INTRODUCTION

Technology has continued to transform traditional education especially in online medium [1]. Recently online learning has been trending toward open source of massive open online courses (MOOCs) in educational institutions [2]. The aims of MOOCs are i) promoting educational innovation [3], [4]; ii) stimulating reflection on the use of technology in the classroom and with the students; and iii) the creation of a community of practice and sharing. It has driven academicians from the whole world to grab this opportunity to implement MOOCs in various disciplines.

Innovation in education has changed rapidly the concept of delivery of knowledge to open educational resources [2]. This new learning format, enabled students to use social media and mobile technologies in order to learn anywhere and at any time. The other benefits of using MOOCs are creating new learning scenarios [5] and enhancing various interactive learning activities [6]. The promises behind MOOCs stand for free and open to the public that offer huge numbers of learners worldwide, as well as training a large criterion of students [7]. The obvious advantages are overcoming geographic and economic barriers to education, enabling students to access various learning opportunities, offering lifelong learning, and enhancing face-to-face and traditional education in new ways [8].

MOOCs are a new trend in online learning that provide a new business model of innovation strategies in educational institutions [9].

For the ODE course, learners' participation in MOOC is encouraged by their lecturers. Their voluntary participation depends on their interests, motivation and needs [10] of the MOOC itself. Some of them chose MOOC for the joy of learning and gaining more knowledge. However, they were not obligated to complete the learning activities. This study aims to investigate learner's perception towards MOOC for Ordinary Differential Equations (ODE). This study also investigated students' perception of the usefulness of MOOC, level of understanding and the excitement level to take a MOOCs [11].

Many researchers have been studied about learners in MOOC in terms of their characteristics, perception and outcomes ([11] – [13]). According to [14], the numbers of students who completed the course was low due to lack of interest or motivation for completion of MOOC.

Other research look at the factors for learners to use MOOC for example flexibility of the course schedule, credibility of the lecturer, and quality of the materials. Besides that, hands-on nature was the most helpful aspect in the MOOCs [11].

3. ORDINARY DIFFERENTIAL EQUATIONS

Differential equations (DEs) have an essential role in mathematics and is a branch of Calculus. DEs are used in many fields to solve problems involving velocities, chemical reactions, thermodynamic changes, population growth, electric circuits and others. DEs are actually is about function and its derivatives [15]. In the late 17th century Sir Isaac Newton, used DEs to seek information about the motion of planets indirectly through the analysis of rate of change equations [16]. Dawkins described ordinary differential equations (ODEs) as equations where the unknown function depends on a single independent variable and partial differential equations (PDEs) as those where the unknown functions depend on more than one independent variable [17]. Teaching and learning of differential equations is a difficult part in any mathematics course, particularly at pre-university level [18]. Ordinary Differential Equations (ODE) is one of the core subjects taken by students majoring in the mathematics, science or engineering programs in Universiti Teknologi MARA (UiTM). It is one of the most essential parts of the curriculum for science and mathematics students. In UiTM Perak (Tapah campus), this course is undertaken by part five students of the Diploma in Mathematical Sciences (CS143) program as stipulated in the Study Plan. MAT 300 consists of five chapters that cover 16 sub-topics as shown in Table 1.

Table 1. Chapter and subtopics covered in MAT300

Chapter	Subtopic
1	Terms such as order, degree, linearity, dependent and independent variables.
2	Separable first order DEs, homogeneous first order DEs, exact first order DEs, linear first order DEs and Bernoulli equations.
3	Application of first order DEs – growth/decay problems, Newton's Law of cooling and mixture problems.
4	The Wronskian and linear independence, homogeneous second order DEs with constant coefficients, reduction of order and finding second solutions, non-homogeneous DEs using the method of undetermined coefficients, and non-homogeneous DEs using variation of parameters.
5	Applications of second order DEs - spring/mass systems and LRC circuits.

3. METHODOLOGY

The survey was conducted online using google forms that allowed the students to answer the questions at the end of the March – July 2017 semester. The responses from a total of 36 students from the Diploma in Mathematical Sciences (CS143) program was analyzed using descriptive Statistics using Statistical Package for Social Science version 22 (SPSS 22) and Microsoft Office Excel 2018 to obtain the results and present the findings in line with the objectives of the study. The variables considered in this study such as usefulness, understanding, effort, excitement and confident toward MOOCs. The descriptive statistics explain the score min and distribution of respondents in terms of frequency and percentage of the responses collected. Descriptive statistics are useful for describing the basic features of data, for example, the summary statistics for the scale variables and measures of the data. In a research study, descriptive statistics may help us to manage the data and present it via various types of chart.

4. ANALYSIS AND RESULTS

Based on Table 2 most of students agreed that lecturer notes and videos in MOOC provided a set of practice questions for each chapter for better understanding in order to do well in their assessments. They also agreed that they had enough time to complete the ODEs course. However, they still needed the lecturer's input as instructor to guide them.

Table 2. Students' Perception of Usefulness of Learning Resources in MOOC

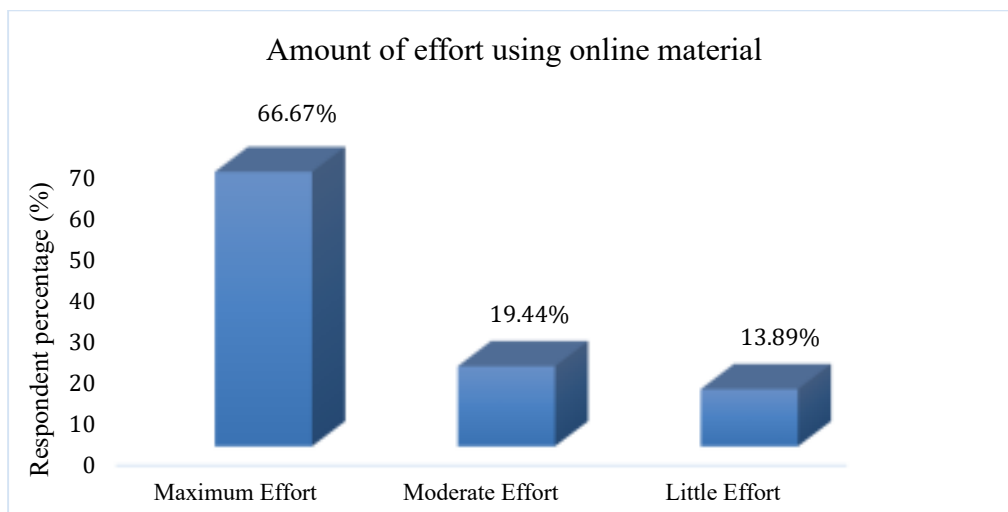|	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Score min
a) Lecture notes and videos were easy to understand.	10	16	4	4	2	3.78
b) Lecture notes and videos prepared me for the practice questions.	11	17	3	3	2	3.89
c) Practice questions helped me prepare for the end of module assessment.	10	15	6	3	2	3.78
d) I never felt that I needed an instructor to guide me through the material.	5	11	17	3	0	3.50
e) The amount of time necessary to complete the course was reasonable.	9	14	8	4	1	3.72

Fig.1. Amount of effort expended in accessing online materials outside class

Based on Figure 1, the bar chart indicates that most of the respondents (66.67%) put in maximum effort in accessing online materials outside class. 19.44% of the students put in moderate effort while 13.89% put in little effort in accessing online material.
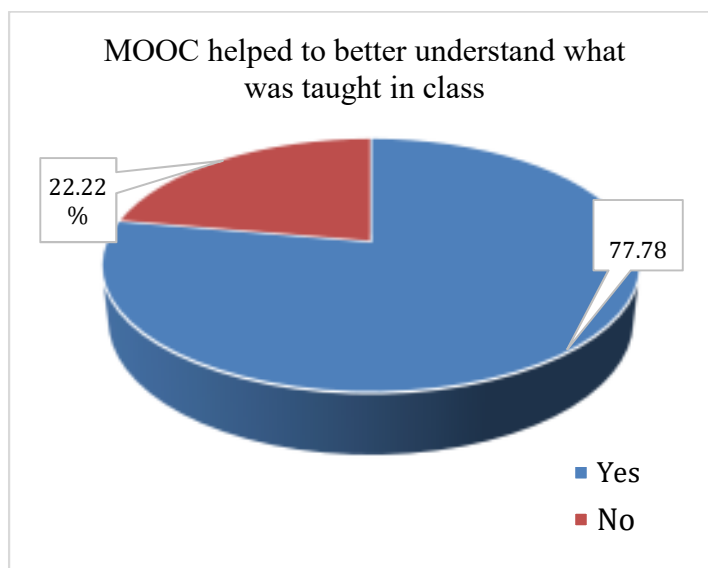

Fig.2. Understanding Enhanced Using MOOC

Based on Figure 2, the pie chart shows that the majority of the students (77.78%), agreed that MOOC helped them to better understand what was taught in class. However, about 22.22% stated that it did not help to better understand what was taught in class.
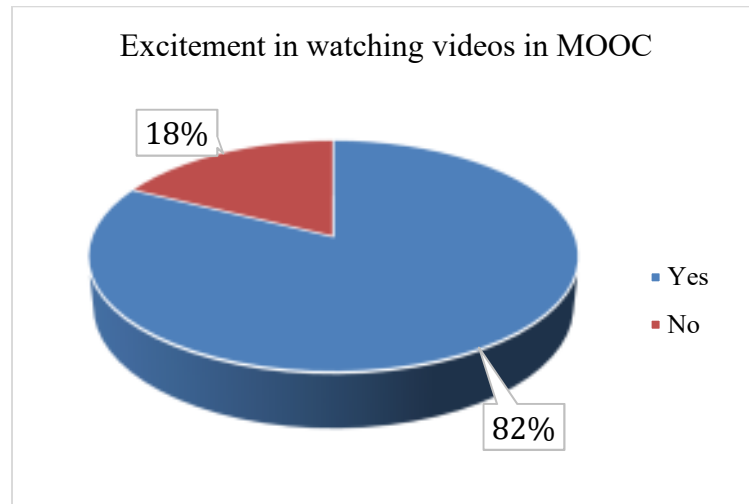
Fig.3. Excitement in watching videos in MOOC

Based on Figure 3, the bar chart shows that the majority of the students (82%) stated that they enjoyed learning through videos featured in MOOC to increase understanding in MAT300. However, only 18% stated that they did not enjoy watching those videos.
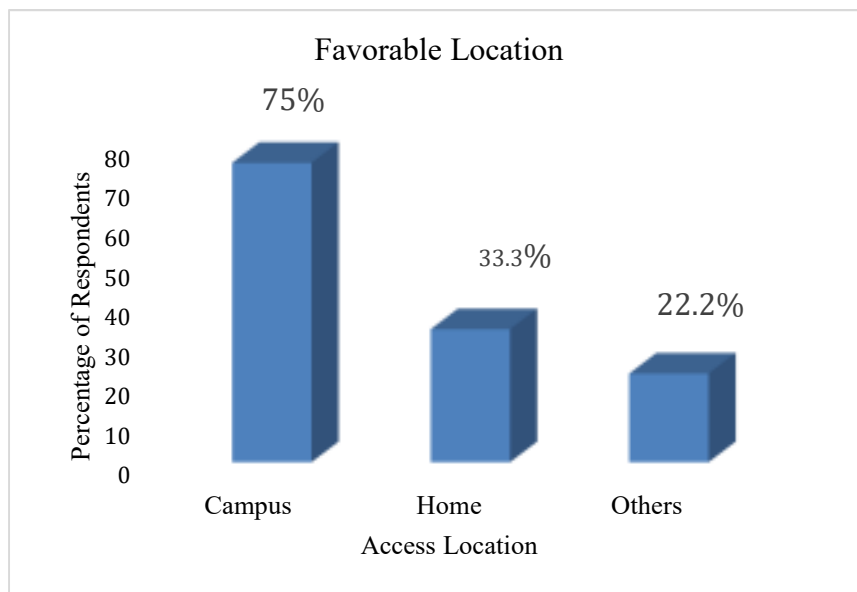

Fig.4. Favorable spots for accessing MOOC online

Based on Figure 4, the bar chart shows that 75% of respondents favor accessing MOOC in campus followed by 33.33% of respondents who preferred accessing MOOC at home and 22.2% who preferred accessing MOOC in public areas such as cafés and cybercafés.
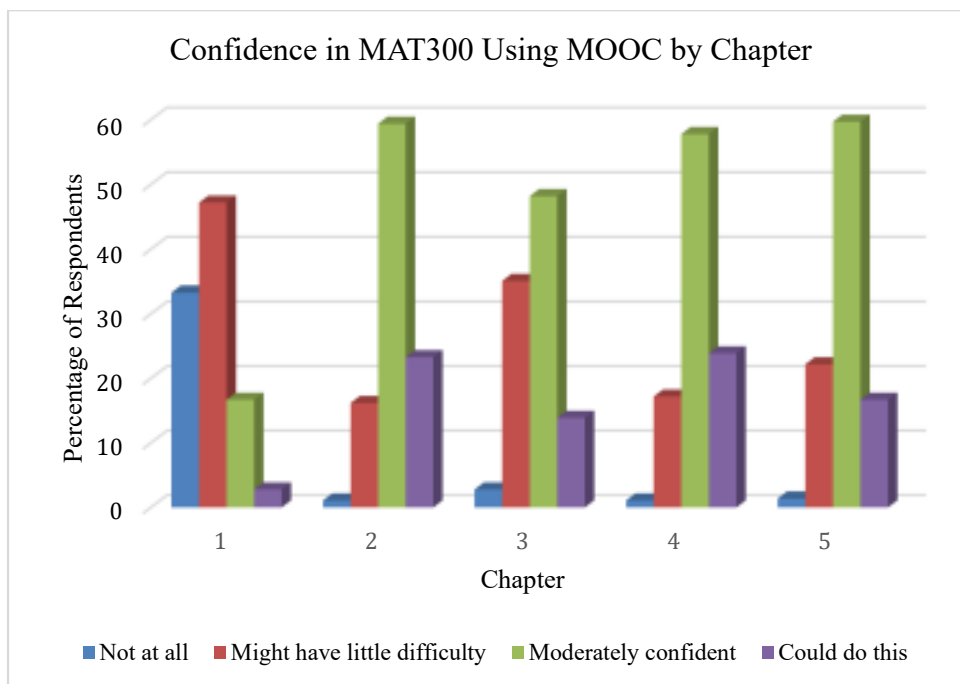
Fig.5. Students' confidence towards chapters in MAT300 using MOOC

Figure 5 indicates that they were moderately confident in Chapters 2, 3, 4 and 5 with percentage of 59.4%, 48.2%, 57.8% and 59.7% respectively. However, 47.2% of the students stated that they have a little difficulty with Chapter 1.
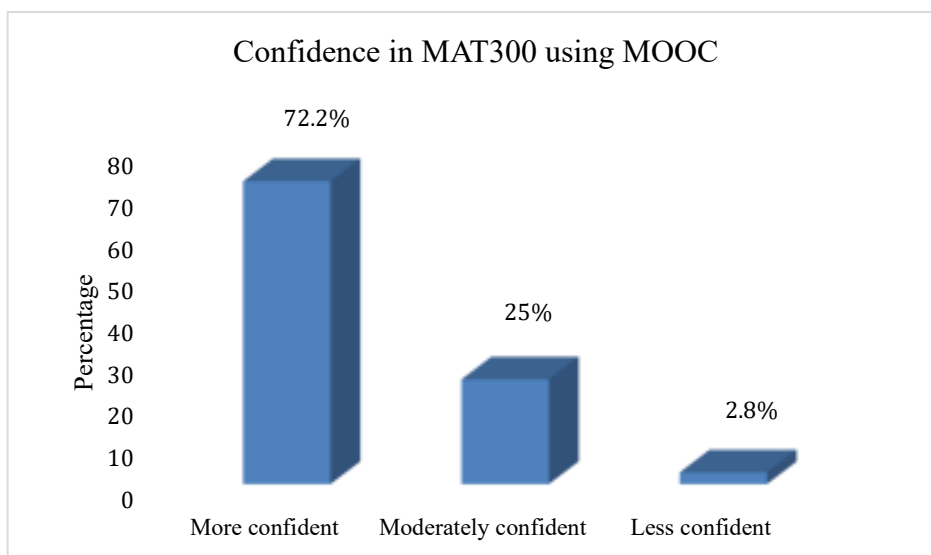

Fig.6. Confidence in MAT300 using MOOC

According to Figure 6, the majority of students (72.2%) said they were more confident studying MAT300 using MOOC, while 25% were moderately confident and 2.8% were less confident.

5. CONLUSION

In conclusion more than 50% of the students said that the MOOC absolutely helped them to better understand the classroom sessions. Most of the students put in maximum effort in accessing the MOOC hence, increasing students' perception about the content and usefulness of the MOOC itself. The MOOC also helped to build up self-confidence of students in the course material and also provided the content that fulfilled students' needs. It is hoped that as the MOOC is further refined and improved, it will influence more students to enroll in this course. The authors hope that students will benefit from MOOC for ODE and this in turn will increase the value of the MOOC.

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