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Implementing Flipped Learning Method in Programming Course: A Case Study at UTeM

Ahmad Shaarizan Shaarani[1], Norasiken Bakar[1], Aida Nasirah Abdullah[2], Wan Sazli Nasaruddin Saifudin[1], Maslita Abd Aziz[3]

[1]Department of Interactive Media, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia
[2]Faculty of Defence Studies and Management, National Defence University of Malaysia, Sungai Besi Camp, 57000 Kuala Lumpur, Malaysia
[3]Department of Software Engineering, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia

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ABSTRACT

This paper describes the enhancement of engagement model where the new model is adapted and reconstructed from a 'Model of engaging online students organized around SDT and instructional design elements'. The new suggested model is designed by adding educational theory elements. In addition, we also added two more channel of communication inside the 'Interaction' menu which are 'students-lecturer' and 'lecture students'. Those interactions are suggested by previous research who originally created this engagement model. The enhancement model is based on a case study conducted at Universiti Teknikal Malaysia Melaka (UTeM), Malaysia for Programming Technique (using C++ language) subject. The study was conducted for two groups of students, which are ICT and Engineering courses students. For the interaction between students-lecturer and lecturer-students, aside from the forum and activities inside MOOC, the interaction is conducted through social media such as WhatsApp and Facebook.
KEYWORDS: Blended Learning, Flipped Learning, Massive Open Online Courses, Technical Education.

INTRODUCTION

With the use of tools in education that has been increased and the spread of networking technologies transform the e-Learning practice to evolve significantly. The term 'e-Learning' may be defined as learning facilitated and supported through the use of Information and Communication Technology (ICT). These include a number of activities from the use of the technology to support the learning process as part of an approach called 'blended learning' as in [1]. The term 'e-Learning', therefore, covers the use of computers and technology as the main tools for knowledge exchange within teaching and learning.

Blended learning is a great step for teaching approach which means the students will be exposing with not just face-to-face (F2F) interactions but using the medium like video, forum, activities, animated slide and discussion online as in [2]. E-Learning also provides the use of technology to support a wide range of educational activity as in [3].

With the development and growth of e-Learning, we cannot escape but to develop the materials needed for the e-Learning such as online videos and flipped learning approach for teaching purpose as in [4]. These materials that can be classified as e-Content, which also vital in the growth of the local learning system.

One of the important elements in blended learning and flipped learning approach is students' engagement. Researchers have come out with a few models of student engagement through blended learning. This study applies flipped learning approach through Massive Open Online Course (MOOC) in Programming Technique subject. The test was conducted for ICT and Engineering students. The result from this study is being used to enhance the Engagement Model.

LITERATURE REVIEW

Flipped Learning Approach

Once the e-Content developed and reached the specification required by the educators, the educators are able to turn the learning process around which is called Flipped Learning. In Flipped Learning, the content of the subject matters are given to the students earlier before the class. The students can learn the course content prior and after the school sessions as in [5].

Corresponding Author: Ahmad Shaarizan Shaarani, Department of Interactive Media, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia. E-mail: shaarizan@utem.edu.my

Inside the classroom, students participate in a variety of assignments and activities that seem appropriate for them and related to the subject matter as in [6-7]. This class activity is for the reinforcement of the subject as well as for the instructor to check and balance level of students' understanding for any particular topic. Students are free to share and discuss their ideas with their peers and also with the lecturer. Flipped Learning helps the students to learn on their own and the lectures will act as a facilitator to assist them in gaining the right information during the class session or through online interaction.

The usage of e-Learning, e-Content, Learning Management System (LMS) and the implementation of flipped learning play an important role in the implementation of the MOOC as in [8]. Those aspects are the backbones that help MOOC to operate and widely used, current student especially the Generation Y (Gen-Y) students are able to learn from the comfort of their own. MOOC has not only improved students' learning but also they are able to communicate with others who enrol the course either local or abroad. MOOC has also opened the window of opportunity for the students to learn new knowledge and enrol in different courses which are not available in their own university.

Massive Open Online Course

A massive open online course (MOOC) is a model for delivering and learning content online to any person who wants to take a course, with no limit on attendance. Traditional online courses charge tuition, carry credit and limit enrolment to a few dozen to ensure interaction with instructors. The MOOC on the other hand is usually free, credit-less and massive too. MOOCs have been around for a few years as collaborative techie learning events, but the year 2012 was the year when "everyone wants in" as in [9].

MOOCs allow learners from diverse backgrounds to learn on a centralized learning platform and collaborate with a massive number of students on a global scale. Research on MOOCs has focused on various disciplines ranging from computer sciences to social sciences, as well as engineering to medicine as in [8].

In Malaysia's education system, MOOCs initiative has attracted a massive number of learners since it was introduced and being developed by many higher public institutions. In [10] shows around 55,000 students enrolled in the first four MOOCs subject offered. This indicates a huge potential in teaching and learning, where a large number of students locally as well as globally are gathered in a centralized hub to learn about a certain subject matter as in [11].

AN ENGAGEMENT MODEL FOR ENGAGING MEANINGFUL MOOC LEARNING USING FLIPPED LEARNING APPROACH

Collaborative Learning Platform to Support FL

In [12] shows the paper stated that in order to support the improved flipped classroom learning model, the learning platform should include at least the following basic functions:

- various types of resources such as video tutorials
- learning materials and students' works, etc.
- blogs for self-reflection and learning summary
- FAQs for raising questions in the process of learning
- e-portfolios for helping learners view learning curves and providing data support for evaluation
- learning evaluations for supporting the formative evaluations and the outcome evaluations

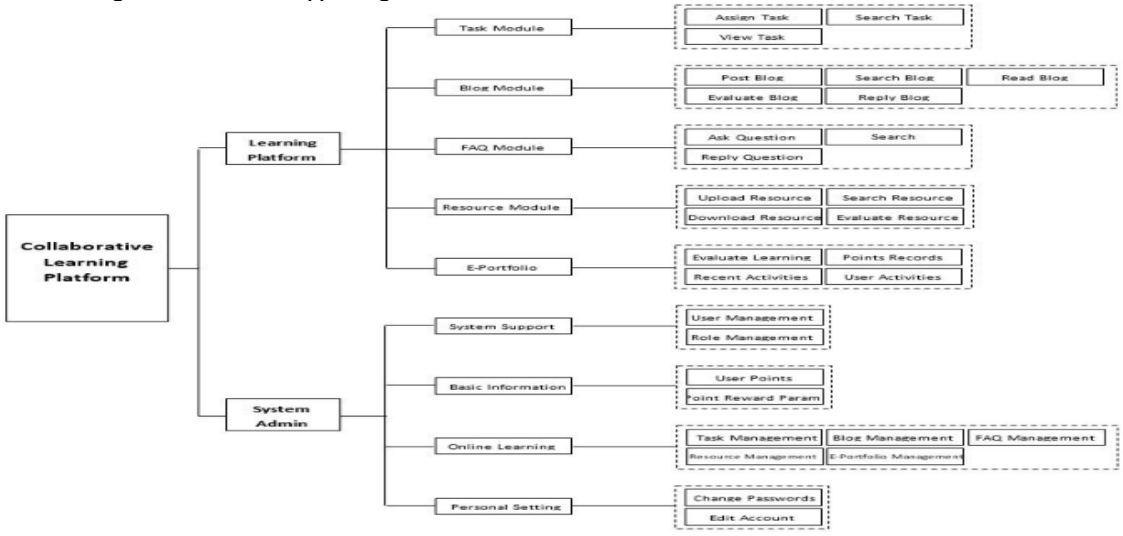

Figure 1: The function module architecture of collaborative learning platform

This model architecture as shown in Figure 1 is adapting an object-oriented approach to guide development of the platform, the model object is built first and the business operation is written-method according to the model, the down-up and the up-down method to implement software development are combined at the end as in [12].

Model of Student Engagement

A model of student engagement organized around self-determination theory (SDT) by [13] research on Towards a Model of Engaging Online Students: Lessons from MOOCs and Four Policy Documents. In [13] shows stated that autonomy refers to the need for freedom or perceived choice over one's action. Previous studies have found that students with a greater sense of autonomy show greater levels of engagement. Relatedness refers to the need for an individual to connect or interact with other people, while competence refers to the need for a person to master one's pursuits or learning. This model by [13] depicts graphically how the three psychological needs posited by SDT may influence the three aspects of engagement as shown in Figure 2.

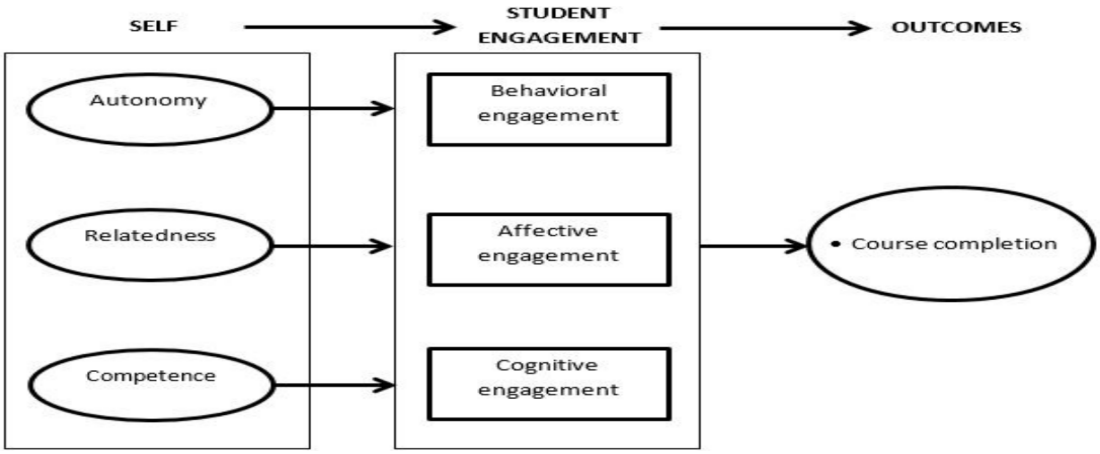

Figure 2: A model of student engagement organized around SDT

The project model is a new model which was adapted and constructed from a "Model of engaging online students organized around SDT and instructional design elements" as in [13].

The project model has been added with educational theory elements, affective learning domains, the interaction between the lecturers and also students. The enhanced model is as shown in Figure 3.

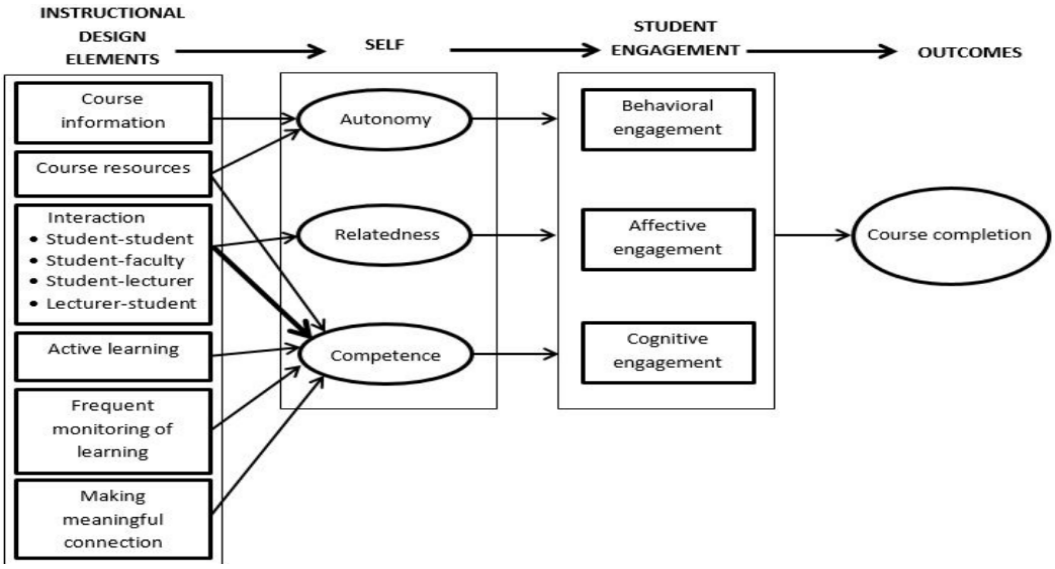

Figure 3: A new engagement model for flipped learning approach in MOOC

Each menu has stated their goal in enhancing the effectiveness of flipped learning. Menus available in models that have been designed for this project are the 1) course information, 2) course resources, 3) interaction, 4) active learning, 5) frequent monitoring of learning, and 6) making meaningful connection. In the previous

model, there are only student-student and student-faculty connection inside 'interaction' menu. But, as suggested as in [13], we have added two more connections inside this menu which are 'student-lecturer' and 'lecturer-student'.

- Course information-Course information has been described as the objective of the subject, the period of the subject, total workload of the subject, mediation language to be used in R&D and also the reasons why the syllabus was chosen.
- Courseresources-Courseresources provides a video that describes the contents of each topic every week. This video included all important contents delivered briefly in only 5 to 7 minutes. This video is a resource for students so it needs to grab their attention and is enjoyable for students.
- Interaction-This is the part where the interaction between lecturer-student-faculty takes place. Any interaction that occurred was considered very important in the development of flipped learning because without interaction, communication and response flipped learning would have not taken place successfully. The interactions had occurred as designed in ID model: Student-student interaction, student-faculty interaction, student-lecturer interaction and lecturer-student interaction. The last two types of interaction are those that we add into the suggested model.
- Active learning-Active learning adapts active learning strategies such as small projects, online games and also self-assessment activities.
- Frequent monitoring of learning-Frequent monitoring of learning is used to evaluate grades on a weekly basis and provide trainings related to the weekly topics. Student-student interaction, student-faculty interaction, student-lecturer interaction and lecturer-students interaction.
- Making meaningful connection-Making meaningful connection provides illustrative examples or case studies. This comprises the assignment and activities for the students. In this study, we also include the communication through social media between students and lecture and vice versa.

RESULTS AND DISCUSSION

This research began by recognizing the difficult subjects for students to understand among other subjects available in each of the courses of the ICT faculty at Universiti Teknikal Malaysia Melaka (UTeM), Malaysia. The aim was to identify the most difficult subject in Teaching and Learning (T&L) [14]. In this particular study, we had acknowledged the subjects with low rates of performance from previous semester. The results were taken from the grades of the students of each course. Most of the subjects found were the ones with programming language. There were five subjects that were found to be incredibly low in success. One of them that had the lowest performance was an Introduction to Basic Programming (C++).

The grade achievement of each subject was analyzed in order to gather the number of students who achieved the lowest grade in each subject. The grades that had been focused on were D, D+ and E. The data collected can be viewed as shown in Table 1.

Table 1:Grade achievement of five subjects in semester 1 2014/2015

Subjects	Grade Achievement (%)		
	D	D+	E
1. Introduction to Basic Programming	3.13	2.43	1.74
2. Computer Organization and Architecture	0.66	1.99	0.99
3. Multimedia System	0.35	-	-
4. Discrete Mathematics and Linear Algebra	1.59	0.95	0.63
5. Games Programming I	4.0	-	-

A study on preliminary analysis was conducted to investigate the most difficult topic in an Introduction to Basic Programming (BITP 1113) subject or famously known as C++. The study was carried out through an online survey generated by Google sheets via Google doc. The subject was a basic programming technique using C++ language and it was a compulsory subject to all ICT students for the first semester of their study.

The online survey had focused on two groups of respondents which were both the lecturers and the students. The reason behind this was to know and understand the level of difficulty of each chapter from both perspectives of the respondents. The lectures were those who have taught this subject in the previous years until to date, whereas the students were those who took this subject from previous semester until present. The respondents were selected using purposive sampling. The groups of lecturers however were selected from four technical based universities in Malaysia such as Universiti Malaysia Perlis (UniMAP), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Tun Hussein Onn Malaysia (UTHM) and Universiti Malaysia Pahang (UMP). These universities have similar purposes and goals in Higher Learning under MTUN (Malaysian Technical University Network). MTUN was introduced in 2006 and was formerly known as Technical University College Network of Malaysia (TUCN Malaysia).

The survey title used for gaining the students responses was “Students' Perception on C++ Subject's Topics Difficulty”, whereas the lecturers’ online survey entitled “Perception of Lecturers Who Teach C++ Subject”. Respondents were required to fill in their name, faculty, IPTA and rate the difficulty of each chapter in C++ which was displayed in a radio button form. The 4 point Likert Scale (1 = Easy, 2 = Moderate, 3 = Difficult, 4 = Very Difficult) was used to determine the difficulty level of each chapter of this subject.

The Mean and Standard Deviation (SD) value of each construct was then analyzed using SPSS. The data gathered was used to help the course developer and the university to upgrade and enhance the content design, presentation and the effectiveness of the course. This procedure covered several aspects of learning and teaching elements such as infrastructure, pedagogy and also curriculum, which will be applied with flipped learning technique. The data gathered are shown in Table 2.

Table 2: Mean and standard deviation of perception of lecturers and students on the difficulty level of Programming Technique (C++)

Chapter Title	Students (n = 60)		Lecturer (n = 13)	
	Mean	SD	Mean	SD
Lecture 1: Introduction to Computer and Programming Language 1. Introduction to Computer and its application area, computer components, hardware and software 2. Introduction to programming language: Machine Language, Assembly Language, High Level Language 3. How does a computer run a program 4. Write, edit, compile and link a program	1.88	0.70	1.33	0 .61
Lecture 2: Problem Solving 1. Introduction to problem solving 2. Basic techniques of problem solving: Pseudo Code, Flow Chart 3. Introduction to function 4. Develop algorithm	2.07	0.78	2.46	1.06
Lecture 3: Basic Elements of C++ 1. Basic elements of C++ language 2. Character set, Token: keyword, identifiers, operator and punctuation, input, output 3. Data type and its declaration & statement 4. Operator-assignment operator, arithmetic operators, relational operators and logical operators 5. Formatting Input /Output	2.01	0.70	2.06	0.88
Lecture 4: Function (Part 1) 1. Types of function 2. Prototype and function declaration 3. Function call and returning value 4. Local and global variables	2.16	0.77	3.33	0.81
Lecture 5: Function (Part 2) 1. Pass by value function 2. Pass by reference function 3. Standard library functions	2.19	0.80	3.46	0.83
Lecture 6: Selection Control Structure 1. The control structure 2. The selection structure : if 3. The selection structure: if…else 4. The selection structure: nested if…else 5. The selection structure: switch-case	2.31	0.78	2.80	0.94
Lecture 7: Repetition Control Structure 1. The while, do…while, for control structure 2. Nested loops 3. continue and break statements	2.32	0.80	3.06	0.79
Lecture 8: Array (Part 1) 1. Introduction to array. 2. One dimensional array, two dimensional array, multidimensional array. 3. Declaration, Assignment, Initialization, Operation on array	2.56	0.83	3.20	0.94
Lecture 9: Array (Part 2) 1. Array and functions 2. Pass by reference, value and pointer 3. Pass the whole array 4. Pass the individual elements of array	2.83	0.86	3.33	0.89
Lecture10: String and File 1. String input and output 2. String manipulation functions 3. Array of strings 4. Introduction to file 5. External file as input or output	2.83	0.79	3.06	0.70
Lecture11: Structured Data 1. Introduction 2. Declaration, initialization, assignment and data manipulation of struct 3. enum, typedef and union 4. Array of struct	2.88	0.80	3.40	0.73
Lecture12: Pointer 1. Introduction 2. Declaration, initialization and assignment 3. Operation of pointers 4. Pointers and function 5. Pointers and array 6. Arrays of pointers	2.94	0.90	3.60	0.63

The outcome of this statistical analysis showed that the mean for lecture week 12 was the highest among the other chapters with 2.94, and this indicated that most of the students agreed that lecture content for week 12 which covered the pointer topic was the most difficult topic in this particular subject. Furthermore, this statement was confirmed by the results gained from the lecturers' perspective where large number of lecturers chose lecture week 12 as the most difficult topic in C++ with the highest mean of 3.6.

CONCLUSION

The usage of e-Learning, e-Content, Learning Management system (LMS) and the implementation of technology in education such as flipped learning play an important role in the implementation of the MOOC. The trend will change the way educators deliver their knowledge to the students. This approach allows learners from diverse backgrounds to learn on a centralized learning platform and collaborate with a massive number of students on a global scale.

One of the important elements in blended learning and flipped learning approach is students' engagement. Many researchers have come out with a few model of student engagement through blended learning. This study applied flipped learning approach through MOOC in Programming Technique subject. The test was conducted for ICT and Engineering students. The result from this study is being used to enhance the Engagement Model. The new model was suggested by adding an educational theory element as well as two interactive channels like forum, activities inside MOOC and social media like Facebook and WhatsApp.

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