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Comparison of Students' Academic Performance and Resources Requirement between MOOCs and Traditional Lecture

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Abstract:- This study compares the academic performance and resource requirement between MOOCs and modules conducted in the traditional approach at Taylor's University. Data such as the number of students, means and standard deviations were obtained from Examination reports of two cohorts of students undertaking the two general study modules. Each module consisted of more than 1000 students. Pooled means and pooled standard deviations were derived and computed from various classes of students from the two modules using a JAVA function. The passing rate of the two cohorts of students was calculated from the examination reports. The number of lecturers, classroom requirements and timetable for the two semesters were obtained from the university timetabling department. This provides a descriptive statistic on the resource requirement associated with both approaches of content delivery. Results from the Two-sample T-test suggested that academic achievement declined, however, the passing rate for the MOOCs students was raised slightly. Results from the analysis on the number of lecturers and classrooms requirement suggested a 50% reduction of lecturers and minimize the usage of physical resources to 1 lecture hall in the 1st week of the semester only. This provides useful evidence of cost reduction in the adoption of MOOCs. The research findings provide a positive impact for institutes of higher learning to sustain their education business with cost reduction and increase in revenue, and yet allow the students to be able to tap into the best education experience and maintain excellent academic performance with the implementation of credit-bearing MOOCs.

Keywords*: Academic Performance, Cost reduction, Massive Open Online Course (MOOC), Traditional lecture mode.*

1. Introduction

Online learning can be termed into different categories according to the percentage of E-Learning involved in a particular module. Basically, many researchers have suggested that classes with more than 80% of e-Learning are considered as fully online modules.

Online education existed in two phases, the first phase occurs prior to 1980 where, the "online" education took place in the form of distance learning via correspondence, radio broadcast, television as well as telephone based. The second phase involves more sophisticated technology and ICT, which has been gaining popularity since 1990 via the Internet. The most significant development of online education took place in 2012 whereby the Udacity and EdX, have opened and offered hundreds of university-level Massive Open Online Courses known as MOOCs.

MOOCs are increasingly gaining its popularity worldwide in the last few years. Many universities in the world have embarked and invested in this specific education landscape for various reasons. A search on Class Central's MOOC report 2018 (a search engine for online courses) has indicated that 11400 modules were offered in MOOCs

[3]. Class Central also reported that there are 20 million new learners signed up for at least one MOOC in 2018, which made the number of learners to a total of 101 million since 2012.

Taylor's University categorized online learning based on the percentage of e-Learning proportion in a module. Taylor's "e-Learning policy" adopts the following practical taxonomy for online learning as shown in Table 1:

Table 1: ***The E-Learning Categories Based On Proportion of E-Learning Activities***

Proportion of E-Learning Activities Based On Student-Learning Time	Types of E-Learning	Typical Description
0%	Traditional or face-to-face	Module with fully face-to-face or traditional approach
0%<E-Learning<30%	Web-aided	Module facilitated with web-based teaching and used Learning Management System (LMS) or web pages to post its syllabus and assignments.
30%< E-Learning <80%	Blended/hybrid learning	A module that blends the use of technology and face-to-face delivery. A substantial proportion of the content is delivered with the use of technology combined with face-to-face interaction.
E-Learning >= 80%	Online Learning	A module where most or all the content is delivered through the use of Information Communication Technology (ICT).

Although a huge number of peer-review publications on online education and courses had been published in the past two decades, it was not until the emergence of MOOCs that had truly taken flight in 2012. Majority of the peer-reviewed publications on MOOC began appearing following the most significant development of two massive online education websites who had opened and offered hundreds of university-level MOOCs (Massive Open Online Courses) the online education by the Udacity and EdX. The main reasons for adoption of credit bearing MOOCs at Taylor's University were to increase profit margin by lowering the cost, increasing revenues as well as improving educational outcome.

Problem statement

Taylor's university has set its' goal to be top ranked and prefer university for students, staff, employers, and business partners. For a Private University to achieve this goal, it needs to be profit-oriented to sustain their education business and yet allow the students to be able to tap into best education experience and maintain excellent academic performance. Reducing unnecessary costs, both tangible and intangible as well as engaging and improving lecturers and students' teaching and learning experience and satisfaction is one of the aspects to achieve the goal.

However, with increasing enrolment of students each year, the university faced the challenges of assigning lecturers and classrooms to the huge number of students in its two "general studies modules" as required by Ministry of Higher Education in Malaysia, particularly time tabling problem due to clashes with other core and elective modules conducted in different programs/ schools in the university. Lecturers teaching these two general studies modules were overwhelmed by the high workload, long teaching hours until classes scheduled at night and on weekends. Students also suffered from long periods of waiting to attend the class which may be scheduled at night or during weekends. This had led to a negative impact on learning and teaching experience for both lecturers and students. From the economic perspective, it incurs higher cost for university to conduct these two modules, both tangible and intangible. From the educational outcome perspective, it may affect students' motivation and learning, and this situation is not limited to these two modules only.

In response to these problems, this research proposes to compare the students' academic Performance and Resources Requirement for these two general studies modules between two cohorts of students who undertake the modules conducted in traditional face to face lecture approach and 100% MOOC approach.

Purpose of study

In view of the literature based on different reports of study on the MOOC initiatives in various universities, there was lack of evidence on the cost reduction and its effect on academic performance after the implementation of MOOC. The objective of this research was to compare the academic performance and cost reduction from the aspects of Resources Requirement for general studies modules between two cohorts of students, one cohort studying the modules in traditional face to face lecture approach and the other undertaking the MOOC. Two research questions were developed to guide this research:

RQ 1. Does implementation of Credit bearing MOOCs improve educational outcomes for MOOC learners as compared to traditional face to face approach? and

RQ 2. Does implementation of Credit bearing MOOCs improve University economics by lowering costs through reduction in usage of resources?

Fig. 1 shows the proposed research model of this study which compares the academic outcome and Institution Economics in modules conducted in traditional lecture approach and MOOCs.

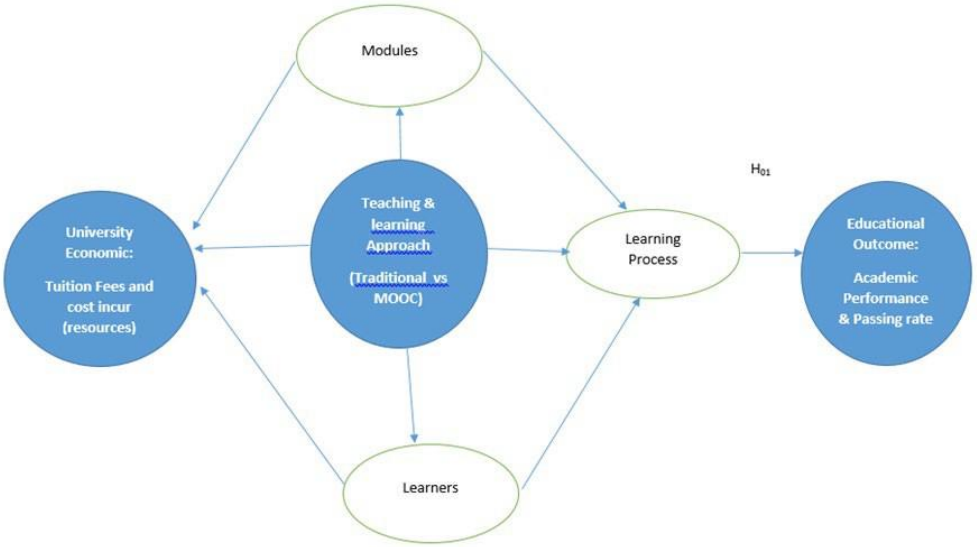

Fig. 1: ***Proposed Research Model to Investigate Impact of Credit Bearing MOOCs on Educational Outcomes of MOOCs Learner and Institution Economics***

Conceptual definitions

The variables in the proposed research model are defined as follows:

Educational outcomes in this research are the combination of academic outcomes and the passing rate of the course.

Academic outcomes refer to students' final scores which include continuous assessment and final examination.

Passing rate refers to the percentage of students scoring the minimum marks set by the university.

University economics in this research refers to the state of cost reduction in terms of human and physical resources or increase revenue from tuition fees in a microscopic view after the adoption of MOOCs.

2. Research Methodology

Research Design

This study adopted Quasi-experimental research with the post-test only design to test the causal hypothesis. This study aimed to compare the academic performance and cost reduction from the aspects of resources required for general studies modules between two cohorts of students. The control group was the cohort of students studying

the modules in traditional face-to-face lecture approach and the treatment group was the cohort of students who followed the 100% MOOC approach.

Sample

The convenient sample of students from the two cohorts of students was studied to investigate the impact of Credit-bearing MOOCs on educational outcomes of MOOCs learner and institution economics at Taylor's University. The control groups comprised of 2435 students studying the two modules in traditional face to face approach in August 2018 semester. They were 1305 students taking Hubungan Etnik (Ethic Relation) and 1130 students taking Tamadun Islam Dan Tamadun Asia, TITAS (Asia and Islamic Civilization). The treatment group comprised of 2193 students studying the same two modules in MOOC approach in August 2019 Semester. They were 1022 students taking Hubungan Etnik and 1171 students taking TITAS. There was no random assignment, but the two groups of students were required to complete the two modules during their studentship in the university. They have almost the same characteristics as both groups comprised of combination of students from various majors of study and have an age range between 20 to 22 years old.

Procedure

TITAS and Hubungan Etnik modules conducted in traditional approach at Taylor's University

In the traditional lecture mode, which was practiced prior to MOOCs implementation in August 2019, a student will require to attend 2 hours of lecture and 2 hours of tutorial per week in the lecture room or classroom. The lecturer will conduct the quizzes, give the assignments and assign group project or individual project with a total mark allocation of 60% throughout the semester. Students were required to sit for a proctored final examination constitute of 40% at the end of the semester.

TITAS and Hubungan Etnik modules conducted via MOOC at Taylor's University

In August semester, 2019, Taylor's university replaced the traditional lecture approach for the two general studies modules with 100% e-learning and offered in MOOCs. Under Taylor's private MOOCs, a student was required to attend 2 hours of face-to-face briefing session in the first week of the semester. This briefing session allowed students to gain a thorough understanding of MOOCs.

Students were required to participate in online learning via MOOC platform on a weekly basis. They were responsible for completing the exercises, watching the videos and conducting self-study on weekly basis. The weekly activities (checkpoints) were treated as the attendance for these virtual classes. It was mandatory for students to complete 100% of attendance. All students were required to sit for the proctored final examination at the end of the semester.

TITAS and Hubungan Etnik are specifically offered to Taylor's students in the form of private credit-bearing MOOCs with proctored final exam and synchronous live sessions of discussion forum. There are various reasons and goals for universities to adopt MOOCs, this study investigates the following goals: 1. MOOCs increase the profit margin of university economics by lowering costs and increasing revenue, and 2. It improve educational outcomes for MOOC learners through comparison of data between traditional face to face approach in August 2018 semester and the MOOCs approach in August 2019 semester.

Quantitative analysis of inferential statistics and descriptive data was adopted to test the hypothesis and describe the association between the constructs to answer the two research questions. Data for the inferential statistics were obtained from the examination reports of the two modules which were published after the Board of Examination in December 2018 (for Traditional approach) and Dec 2019 (For MOOCs approach). Means and standard deviations as well as number of students from various classes for both modules were obtained from examination reports. This data were used to compute the combined means and combined standard deviations using a JAVA function for pooled means and standard deviations. The passing rate for the two cohorts of students taking the two modules were calculated from the examination reports as well. T-tests using the combined means and combined standard deviations were run using NCSS software to test the hypothesis derived from the research question RQ1. The number of lecturers as well as classrooms requirements and timetable for the two semesters were obtained

from the university time tabling department. This provides descriptive data on the resource's requirement associated to both approaches of content delivery, which provided evidence to answer the second research question, RQ2.

3. Results

MOOCs and Educational Outcomes

RQ 1. Does implementation of Credit bearing MOOCs improve educational outcomes for MOOC learners as compared to traditional face to face approach?

A hypothesis and its subsidiary hypotheses were developed and tested to answer the first research question, RQ1.

H_{01} : There is no significant difference between the traditional lecture and MOOC approaches with regards to educational outcome.

H_{01a} : There is no significant difference between the traditional lecture and MOOC approaches with regards to Passing rate.

H_{01b} : There is no significant difference between the traditional lecture and MOOC approaches with regards to pooled Mean score for Hubungan Etnik and TITAS.

Table 2 shows the academic outcome computed from the examination reports for the two cohorts of students, it can be observed that there was an increase in the passing rate for both modules conducted in MOOCs. However, there was a drop in the pooled means of the examination score for students following MOOCs.

Table 2: ***Academic Performance of Two Cohorts of Students in General Study Modules***

Academic Performance	Hubungan Etnik conducted in traditional lecture approach (August 2018 Semester)	Hubungan Etnik conducted via MOOC approach (August 2019 Semester)	TITAS conducted in traditional lecture approach (August 2018 Semester)	TITAS conducted via MOOC approach (August 2019 Semester)
Number of learners	1305	1022	1130	1171
Passing Rate	97.01	97.65	95.58	96.41
Pooled means	70.87	69.55	66.86	65.69
Pooled SD	9.61	9.37	8.69	8.09

Z-test for proportion of the Passing Rate and Two samples T-test with the number of students, pooled means and pooled standard deviations using NCSS was conducted to compare passing rate and examination scores of students learning Hubungan Etnik and TITAS conducted in traditional lecture approach and MOOC approach as shown in table 3.

Testing of Null Hypothesis, H_{01}

H_{01} : There is no significant difference between the traditional lecture and MOOC approaches with regards to educational outcome.

H_{01a} : There is no significant difference between the traditional lecture and MOOC approaches with regards to Passing rate.

H_{01b} : There is no significant difference between the traditional lecture and MOOC approaches with regards to pooled Mean score for Hubungan Etnik and TITAS

Table 3: ***Results of Testing of subsidiary hypotheses with z- test and T-test***

There is no significant difference between the traditional lecture and MOOC approaches with regards to Passing rate.	There is no significant difference between the traditional lecture and MOOC approaches with regards to pooled Mean score for Hubungan Etnik and TITAS
Z-Test Results for Passing Rates of: Hubungan Etnik TITAS Z-Statistic: -0.944 Z-Statistic: -1.016 P-Value: 0.345 P-Value: 0.310 as P. value for both modules are more than 0.005, thus fail to reject the null hypothesis, The results indicate that there is no significant difference in passing rates between the traditional lecture approach and the MOOC approach. This indicates that there is no statistically significant difference in the passing rates for both "Hubungan Etnik" and "TITAS" between the traditional lecture approach and the MOOC approach.	• Two samples T-test with the Number of students, pooled means and pooled standard deviation using NCSS was • Results showed that • There was a significant difference in the examination scores for students taking Hubungan Ethink in traditional approach (M=70.87, SD=9.61) and MOOC approach (M=69.55, SD=9.37); t (2325) =3.3246, p = 0.001. • There was a significant difference in the examination scores for students taking TITAS in traditional approach (M=66.86, SD=8.69) and MOOC approach (M=65.69, SD=8.03); t (2299) =3.3559, p = 0.001. The t-tests confirm that the differences in pooled means for both modules between the traditional lecture approach and the MOOC approach are statistically significant.

The z-tests for proportions indicate that there is no statistically significant difference in the passing rates for both "Hubungan Etnik" and "TITAS" between the traditional lecture approach and the MOOC approach. This means that the slight increases in passing rates observed with the MOOC approach are not statistically significant.

The t-tests confirm that the differences in pooled means for both "Hubungan Etnik" and "TITAS" between the traditional lecture approach and the MOOC approach are statistically significant. Despite the slight increases in passing rates with the MOOC approach, the decrease in pooled means is significant for both subjects.

As it failed to reject subsidiary hypotheses H_{01a} while H_{01b} were rejected in favor of the alternative hypotheses, it followed that when students studying the general study modules via MOOC, there is no significant difference in the passing rate, however, their academic achievement in terms of final exam score declined.

MOOCs and University economics

Table 4 shows the number of lecturers (Human resources) and classrooms (Physical resources) required to conduct the two general studies modules in the August 2018 semester (traditional approach) and in the August 2019 semester (MOOC approach). A significant reduction in tangible resources, such as human resources (number of lecturers) and physical resources (number of classrooms) can be observed.

A 50% reduction of lecturers and a tremendous reduction of lecture rooms had indicated a large proportion of cost reduction in terms of tangible cost reduction. The intangible cost reduction constituted the cost saving from electricity and maintenance as well as timetabling effort for classroom allocation and car park for students and lecturers. As these two modules were credit-bearing modules and students were required to sit for proctored final examination, standard tuition fees were charged for the credit-bearing MOOCs, thus the reduction in cost was converted into the profit gain of the university.

Table 4: ***Comparison of Resources Requirement to Conduct the Two General Study Modules In Traditional and MOOC Approach***

Resources Required	No of Staff	No of Students Per class	Lecturer Workload	Number of Classroom Needed
For HE & TITAS In Traditional Approach	8	60-70	16 Hours; 4 classes /lecturer	16 rooms, Mon to Sat for the whole semester
For HE and TITAS in MOOC approach	4	500-700	16 Hours; 1 class /lecturer	1 big lecture hall, for the 1st week of semester

4. Discussion

The two research questions developed to guide this research were addressed and the section below provides the answers to the research questions.

RQ 1. Does implementation of Credit bearing MOOCs improve educational outcomes for MOOC learners as compared to traditional face to face approach?

The answer to the first research question, RQ1 can be addressed from two perspectives.

Firstly, the educational outcome in this study refers to students' academic performance (which is recorded as total examination score) and passing rate. The total examination score constitutes of 20 % of midterm test, 40 % of assignment and group project, and 40 % of final examination for both approaches. Despite the many research which indicated an improvement of students' academic achievement in MOOCs, this study had shown a minor decline in students' average score in MOOCs (less than 2 marks), which had been tested in the two subsidiary hypotheses. However, a rise in the passing rate had been recorded with the implementation of Credit bearing MOOCs. There are many factors which may cause this slight decline of average score in MOOCs. Among these factors, drastic implementation leads to the decline of exam scores.

The MOOCs initiative of replacing the two general studies modules from traditional approach happened at a very drastic manner with short notice. According to the lecturers involved in this MOOCs initiative, they spent about two months to transform all the course contents and design all the necessary material, including videos and online assessments into the respective MOOCs with the assistance of staff from Taylor's University e-Learning department prior to the full implementation and adoption in August 2019 Semester. As the MOOCs were created and designed from scratch at a short period of time, and lecturers were not well prepared and lack of well-equipped MOOC environment, this had affected the perfect delivery of the course to the students. Meanwhile, the sudden change from traditional face to face approach to MOOCs have caused a lack of social interaction among lecturers and students as well as among students and their peers, this may potentially affect the learning activities and performance in their group assignment. This situation will also develop study anxiety to some students which may cause a decline in the learners' academic achievement. According to Knox, mass participation of many participants in MOOCs has developed anxiety and burdensome in learning [5]. Vitasari et al., found that there is a significant correlation between study anxiety and academic performance [8]. Students who have high level anxiety achieve low academic performance, Besides, Sena et al., and Luigi et al., also reported that high level of anxiety brings about lower academic performance [6], [7].

Another factor that contributes to the slight drop in exam score and slight rise in passing rate has to do with the students' perception of these two general studies modules. As students realized that these two general studies modules are offered as credit-bearing MOOCs, however, the grade will not be considered for grade point average (GPA) computation. As such, many students have the same mentality of putting minimum effort in these two modules to merely pass the modules and reserved more time to do well in other modules to boast up their GPA and CGPA (Cumulative grade point average).

Pertaining to the first factor, the situation can be improved in the subsequent semester to reuse and improve in the MOOCs contents and material, providing substantial training to the lecturers and provide a well-equipped and conducive environment for MOOCs.

RQ 2. Does implementation of Credit bearing MOOCs improve University economics by lowering costs through reduction of requirement of resources.

A significant reduction in tangible human resources and physical resources has been observed with the implementation and adoption of the two credit-bearing general studies modules. Almost half of the manpower can be spared to perform other jobs or transfer to another department. Staff who were teaching the two modules and decided to leave the university due to better offer elsewhere did not need to be replaced. Two staff from the department have decided to participate in the voluntary separation scheme (VSS). In terms of human resources, there was a 50 % cost or expenditure reduction following the implementation of credit-bearing MOOCs. Reducing the number of staff also means a reduction in the cost of staff training and development as well as other benefits provided to the staff.

A minimal usage of the physical resources, such as the lecture hall and car park for students has been recorded with the implementation of the credit-bearing modules. In the traditional approach for the two modules prior to MOOCs implementation, the students' finance and Timetabling (SFTT) department had to work very hard to secure the lecture theaters and classrooms for all the classes. Due to the large student number of the two modules, approximately 1200 students per module, the classes were spread from early morning to late evening, from Monday to Saturday. This arrangement was required as it needed to compete with large number of modules offer in each semester for total population of Taylor's university. This has led to a high workload of lecturers, working long hours and staying in campus for long hours to wait to conduct classes. To schedule classes, SFTT needs to prioritize or avoid clashes in the students' timetable, which may lead to long interval between two adjacent classes, both for students and lecturers. With the implementation and adoption of MOOCs, this problem is solved. Moreover, the reduction in the usage of large number of classrooms and lecture theaters with MOOCs has led to cost saving in electricity, and manpower to perform cleaning as well as helping to protect environment by reducing the use of air conditioner and cars.

5. Conclusion

Previous study had reported the improvement of academic performance of students in MOOCs as compared to the traditional face to face approach [1], [2], [4]. The present study documented an interesting phenomenon of academic performance. A slight raise in the passing rate for MOOCs have been observed, however, a slight decline of overall examination score had been observed. The main reason for the slight decline of overall examination score is due to drastic change during the transformation with lack of well-equipped MOOCs environment and proper training for lecturers. With the reuse and improvise of the MOOCs content material in the subsequent semesters, together with better training and more seasoned and experienced lecturers to facilitate the credit bearing MOOCs, a better academic performance can be predicted. Further research is therefore necessary to justify this prediction.

Previous study also demonstrated that significant evidence of the high costs of development and delivery of MOOCs had been reported. There was no evidence on cost saving by implementing MOOCs initiative. In view of the credit bearing feature, and proctored exam requirement for the two MOOCs, Taylor's University had imposed the same standard fees structure as the traditional approach to the two MOOCs, and the data obtained from the administrative office of Taylor's University had provided strong evidence of cost saving in reducing 50

% of lecturers and minimize the usage of classrooms and lecture theaters to 1 lecture hall in the first week only with the adoption of MOOCs.

The move to implement MOOCs at Taylor's University will provide a positive impact to sustain their education business and yet allow the students to be able to tap into best education experience and maintain excellent academic performance.

6. Future Research

The overall examination scores of MOOCs constitute of 40 % of individual and group assignments, 20 % of midterm test and 40 % of final exam, future research can compare each of these components between traditional approach and MOOCs during initial implementation and latest cohort of students (after several rounds of using MOOCs). Learning analytics for MOOC is therefore the future direction to gauge the academic performance of MOOC learners. This will enable the university to decide on transforming more face-to-face modules into MOOCs and making more profits to further enhance the quality of education.

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