Ameliorate the shortcoming: A quantitative inquiry on How Engineering Educator Can Improve Students Self-Learning trough MOOC

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Abstract: With regards to the ninth shift in Malaysia Higher Education Blue Print 2015-2020 which is Global Online Learning, the Massive Open Online Courses (MOOC) initiation has become central attention to Higher Learning Institution (HLI) in innovating the teaching delivery. With training support given by the academic office, more than 300 courses are now offered in UiTM MOOC. The presented paper has applied flipped classroom approach combine with the use of MOOC in its course for three consecutive semesters. It is off interest to know now how well the designed MOOC for the course is helping the students in their learning and what is the suggested improvement base on the students' preference. From the factor analysis conducted using Rasch analysis, it is found that the students having no difficulties to agree on the educator's clarity of using the MOOC. However, their level of agreement differs when it comes to their perceptions on the use of MOOC. Hence, suggestion of improvement informed by students from the open-ended section of the survey were frame, based on corresponding students on the specific item related to MOOC. The results will serve as an evidence base for the engineering educator in the improvement of MOOC teaching practice.

Keywords: *Engineering Education, flipped classroom, MOOC, thermodynamics*

INTRODUCTION

With the advancement of technology nowadays, it's inevitable to embed online learning with teaching practice. If educators well equipped with specific training, teaching trough online learning platform does come in handy. Among other progressive steps taken by a higher learning institution (HLI) is Massive Open Online Learning (MOOC). In developing the MOOC content, the educator experiences a parallel process shift; learning to create the content and adjusting their delivery from physically present in the classroom to virtual existent. These processes could lead to educator shortcoming in ensuring the learner's acceptance. It's argued that with the supposed training support given by HLI's academic office such shortcoming can be addressed early. However, the process of creating MOOC content is strenuous especially to those educators who are not familiar with teaching and learning theory. Thus, this quantitative paper examines the specific shortcoming of MOOC content delivery informed by the learners and their suggested improvement that researcher deem as preference which could enhance educator's teaching delivery trough MOOC.

BACKGROUND OF STUDY

Thermodynamics is part of the fundamental subject in Mechanical Engineering programme. It is an unfavourable course to students as they perceive it as a tough subject with a record of high failure rate. This issue has been going on for years. From the observation and experience in teaching the course for students in diploma programme, it is found that students have difficulties in understanding the concept in Thermodynamics. The work of Balmer has highlighted this poor grasp of thermodynamics concept results from its jargon used in explaining the concepts derived from Greek words (Balmer & Spallholz, 2006). Even though the textbook used in teaching thermodynamics able to describe the Greek term into English, the set of students in this research context are non-native English speaker thus, it looks like two times of 'memorization' to understand the concept.

This unaddressed issue is then further, causing hitches for the students in solving the problems in Thermodynamics. On the other hand, for the educator to cater the difficulties in understanding the concepts at students'

pace is somewhat wearing. The face two face (F2F) contact hours allocated will be insufficient, pushing the educator to keep up with the content instead. It could at some point become tedious especially when there are four groups of class to teach for the semester. Thus, the teaching delivery method comes in question, how can it be improvised?

To overcome the two identified limitation namely the poor conceptual grasp among the students and the insufficient face two face class session, the flipped classroom approach has been implemented. It is an adoption from presented various published work (Lo, 2018; Nouri, 2016; Roehl, Reddy, & Shannon, 2013). The approach offers sufficient time for the educator to focus on students' capability of problem-solving during F2F class and allocate times for the students to grasp conceptual understanding trough content uploaded via MOOC platform; which in turn promotes students self-learning and fully utilize the students learning time (SLT) designated for the course. Since the approach employed has been going on for three consecutive semesters, it is of interest to gain the students insight on two things, their acceptance towards the flipping approach and the preference of content uploaded in the MOOC. However, this paper will only cover the findings on students' MOOC preference.

METHODOLOGY

3.1. Context of Study

The study was conducted for three consecutive semesters among second year Diploma in Mechanical Engineering students' who enrol in Thermodynamics course. The course is delivered over 14-week semester, covering six chapter. The first three chapter is on Thermodynamics concepts e.g. energy balance, First and Second Law of Thermodynamics, close and open system and type of working fluid. The remaining three is on the applied part of these concepts namely; Steam Power Plant (vapor power cycle), Gas Turbine Plant and Internal Combustion Engine (gas power cycle). However base on educators' past experience, it is observed that students having difficulties in distinguish between closed and open system, thus in the MOOC content, the topic are separated into two, one for '1st Law

Applied in Closed System' and the other is '1st Law Applied in Open System'. Hence making the overall content for MOOC consist of 8 topics.

3.2. Course delivery

The contact hours for this course are four hours per week, where three hours is spent for F2F class and remaining one hour is for self-learn via MOOC platform. The students will be assigned prior to class to watch the video uploaded in MOOC according to topics that they will solve in the next following F2F class. Since part of the motivation of this teaching approach is to shift the responsibility towards learning to the students thus, there is no specific monitoring system impose on them during their self-learn session. However, in order to get them to engaged in the learning process especially on the topics that contribute to high failure rate, the educator will ask them to list at least three questions from the watched video. It's either directly listed in the forum or comment section or sometimes they need to bring it into F2F class discussion. This in turn not only informed the educator the level of understanding as the students watch the video but it also indirectly monitored the used of their self-learning time. The flowchart in Fig. 1 summarizes the teaching delivery activity.

3.3. Instrument use

The registered Thermodynamics MOOC course is developed using UiTM MOOC platform. Students who sits for this course were asked to enrol on this Thermodynamics MOOC. Different kind of videos were uploaded, where some of the videos are shared directly from other YouTube user and some are produced by the educator using the Explain Everything (see fig.2) and Screencast-O-Matic applications. For all the videos made by the educator, only the voice of the educator and some interactive problem solutions are presented. For a quick assess on students understanding from the video they have watched, they were sometimes asked to answer quizzes made online using Socrative applications.

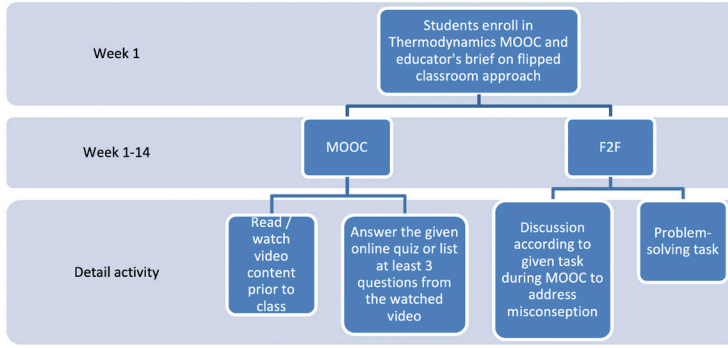

Fig. 1: Flowchart of Teaching delivery

In gathering the student's insight on the content delivered via MOOC, an online survey feedback was given to the students at the end of the semester. The survey questions are adapted from various study on flipped classroom (Love, Hodge, Grandgenett, & Swift, 2014; Ogden, 2015; Zainuddin & Attaran, 2016) and MOOC (Abeer & Miri, 2014; Hone & El Said, 2016; Yousef, Chatti, Schroeder, & Wosnitza, 2014). The 5-point Likert scale survey, ranging from strongly disagree to strongly agree consist of four sections which covers the students' demography, educator's clarity, students' perception and open-ended questions in acknowledging their preferences. However, in this study, only the item that related directly with MOOC simplified in table will be discuss further.

Table 1: Survey Item

Section 1	**Students' demography: Item 1 to 3**	
Section 2	Educator's clarity: Item 4 to 6	
	A1	Educator has stated clearly the outcome of each module.
	A2	The video on YouTube made by others, chose by educator on concept explanation are understandable.
	A3	The problem-solving example video made by educator is clear and understandable.
	A4	How much do you enjoy the power point lecture with the educator voice?
	A5	How much do you enjoy the blackboard/whiteboard style?
	A6	How much do you enjoy a lecture with physical presence of the lecturer? (In the tiny window frame at the corner of recorded video)
Section 3	Student's perception: Item 7 to 21	
	B1	The MOOC is more engaging than traditional classroom instructions.
	B3	The MOOC gives me greater opportunities to communicate with other friends.
	B12	MOOC helps me in practicing problem solving of thermodynamics problem.
	B13	I am more motivated to learn Thermodynamic problem solving in MOOC.
	B15	I feel I'm more motivated to study on my own after introducing with MOOC.
Section 4	Open ended questions: Item 22 to 26	
	C23	What are the disadvantages of the MOOC?
	C25	What improvements would you recommend improving learning in the MOOC?

RESULT

The survey conducted will gives latent trait of data in which can be measured using Rasch Model analysis. Items in section C as listed in Table 1 will tell us the students' level of acceptance and the hierarchy of endorsed item, based on tabulated Wright Map (Wright & Linacre, 1994). The quantitative results in examining the specific shortcoming will be support with the open-ended answers given in section 4 as means of suggested improvement.

The data gathered from the survey was analyse using Rasch analysis software (WINSTEPS) to evaluate the consistency of students' responses to each and every item on the survey(Smith, 2005). The result shows that the survey produce +.95 item reliability and +.75 person reliability, which according to Rating Scale Instrument Quality Criteria(Fisher, 2007) categorise the reliability of surveyed item as 'excellent' and surveyed population as 'satisfactory'. The person and item reliability are presented as follows;

Item Reliability

Table 2: Overall statistics of the 21 Items in the instrument

	Total score	Count	Measure	Model Error	Infit		Outfit	
					Mnsq	Zstd	Mnsq zstd	Zstd
Mean	248.7	66.0	.00	0.16	1.00	-0.1	1.01	-0.1
SD	31.4	.0	.75	0.01	0.35	2.0	0.40	2.2
Max	293.0	66.0	1.80	0.20	1.77	4.2	2.05	5.3
Min	165.0	66.0	1.26	0.14	0.55	-3.0	0.56	-3.0
Real RMSE 0.17				True SD .73	separation 4.21		Item reliability .95	
S.E. of Item MEAN = .17								

Person Reliability

Table 3:Overall statistics of the 66 students in the instrument

	Total score	Count	Measure	Model Error	Infit		Outfit	
					Mnsq	Zstd	Mnsq zstd	Zstd
Mean	**79.1**	21.0	1.02	0.29	1.09	-0.1	1.01	-.3
SD	8.2	.0	.68	0.3	0.77	2.1	0.66	2.0
Max	99.0	21.0	3.22	0.46	3.72	5.5	3.27	5.0
Min	59.0	21.0	-0.41	0.25	0.22	-3.9	0.22	-3.9
Real RMSE **0.34**				True SD .59	separation 1.72		Person reliability .75	
S.E. of Item MEAN = .08								

Wright Map

Further analysis on variable map or Wright Map was done to evaluate the students' level of acceptance and the hierarchy of endorsed item. Base on Table 2 and Table 3, the mean value measure for person and item is μPerson = 1.02 logit and μitem = 0.0 logit respectively which indicates the students are capable to answer all the 21 items. The Wright Map below provides better visualization on the capability and likelihood of individual students to endorse all the item in the survey.

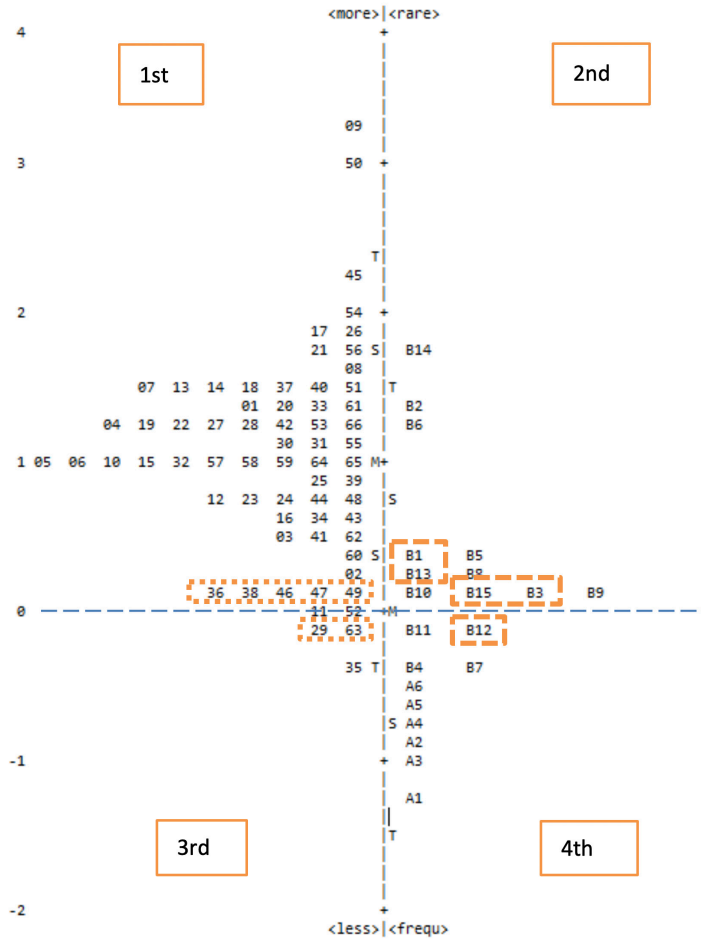

Fig.2: Wright's Map

For better explanation, the Wright map in fig.2 is divided into 4 quadrants labelled as 1st, 2nd, 3rd and 4th. The left side of the wright map labelled with number 01 to 66, represent respondents' capability in endorsing the given item whereas the right side labelled with A1 to A6 and B1 to B15, represent items' difficulties. Any number assigned as respondents that falls in the 1st quadrant indicates that the respondents have high capability and those in 3rd quadrant having low capability in answering the items given. Next in order is the 2nd quadrant indicates the most difficult item to endorse

with and 4th quadrant is the very least.

Respondents in the 1st quadrant are capable to answer all the given items that falls in the 4th quadrant but only some of them capable in answering item in 2nd quadrant. For instance, respondent's number 36 and 38 having difficulties to endorse item label B1 and B13 and having 50-50 chances to agree with item label B3 and B15. For respondents labelled as 09 and 50, both are highly capable to endorse all the item given in the survey, thus they are placed on the top level of 1st quadrant. Respondents that falls on the 3rd quadrant only capable to answer the item in 4th quadrant with respondent labelled 35 are the very least capable person to agree on all the given item. Base on the result, further discussion will focus on item labelled B1, B3, B12, B13 and B15 and the correspond respondents parallel to its left side of the wright map.

DISCUSSION

The focus of this research design is to framed specific shortcoming and suggested improvement given by the respondent in this study. We hypothesize that students who have difficulties in approving the item related to MOOC are the perfect candidates who will gives suggestions for the MOOC improvement. On the other hand, students who have no difficulties to agree with those items are believed to has no improvement suggestion. Base on the Wright's Map in Fig.2, students labelled 36,38,46,47 and 49 are the correspond respondent who have 50-50 chances on approving for item B1, B3, B12, B13 and B15. Whereas students label 17,21,26,45,54 and 56 has fully agree on the said items. Their answers for item C25 in section 4 of the survey gives a specific suggestion that they have in order to improve the MOOC delivery. The mapping over corresponded item with suggested improvement were simplified in Table 4 below;

Table 4: Correspond person with item C22 and C23

Ability to approve the MOOC items	*Respondent*	*What are the disadvantages of the MOOC?*	*What improvements would you recommend improving learning in the MOOC?*
Less able to approve	36	Difficult to ask	Create another segment on asking questions
	38	I'm not sure what is flipped classroom	I'm not sure what is flipped classroom
	46	Not very understanding	Make sure all student understands
	47	Some student doesn't listen it	More detail explanation
	49	Not good for me on manage time	Patient
Able to approve	17	Not with lecturer	More example
	21	Nothing much I see	Make more video of a lecturer in it rather than someone else. It would be much more understandable
	26	Make students become lazier	Discuss the application in daily life will make students more understand
	45	It makes me feel lazy if it not madam's video	more understanding on how to solve problems
	54	Easy to learn	explain more effectively
	56	MOOC is using the internet.	Put more picture or design so student will not boring watch it.

Base on tabulated answer in Table 4 it shows that the provided open ended section does helps in a sense of giving the students space to voice out their perceptions. However, the answers given by less able students are very generic; further in-depth interview will help researcher to understands more by using the open-ended answers given as guidance. Suggestion made by the more capable students are quite the opposite as expected. They specifically suggest on more problem-solving example video need to be put on the MOOC and suggesting that the present of lecturer who teach the subject in the made video will helps in the learning.

CONCLUSION

Base on the Rasch analysis, we can identify two sets of students who are able and less able to approve with the proposed teaching delivery approach. We then framed their specific suggestion based on the open-ended section where the students were asked to suggest anything in improving the MOOC. The findings defy our hypothesis; where the more capable students are the

one who gave constructed suggestion on improvising the MOOC delivery. Whereas the less able students are having difficulties in expressing their thoughts. Hence, for future research, further in-depth interview must be conducted in order to gain insight from their perspectives. It is important since this will keep on motivates the students in self-learn via MOOC platform.

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