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# Implementation of Data Structure Subject in MOOC with Authentic Learning Environment

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**Abstract:** Massive Open Online Course (MOOC) provide a new methodology for teaching and learning with exciting new possibilities in learning. MOOC is one of the medium for university to globally connect higher education players all over the world. However, among the issue in MOOC is the high dropout rate among the students registered. This issue poses challenges to the educators to design and develop the learning environment that able to maintain the student's retention in MOOC. This study discusses on the implementation of data structure course in an authentic learning environment. MOOC features are designed to engage authentic learning which allows students to create a meaningful, useful shared outcome. There are real life tasks or simulated tasks that provide the learner with opportunities to connect directly with the real world. The MOOC design is based on few features such as course promotional video, topic and subtopic, weekly learning outcomes, learning materials, learning activities assessment and additional resources. The study found that students with low learning progress has possibility to trigger high attrition issue and thus by providing materials that are meaningful to them will maintain the student's retention.

**Key words:** MOOC, authentic learning environment, authentic learning features, learning outcome, learning materials

## INTRODUCTION

Currently, Massive Open Online Course (MOOC) has rapidly emerged in the educational world and aimed for massive participation and open access using web as a platform (Kennedy, 2014; Lebron and Shahriar, 2015; Fei and Yeung, 2015; Sachdeva *et al*., 2015; Karlen, 2013). MOOC promotes flexible learning in which students are not bind to register to certain institution and can learn anywhere thru web. However, the issues of high attrition rate (Fei and Yeung, 2015) and the increased of drop out (Kennedy, 2014; Fei and Yeung, 2015; Sachdeva *et al*., 2015; Smith and Eng, 2013; Espada *et al*., 2014) among students have been the main focus of MOOC. The inappropriate content of MOOC that caused the user's dissatisfaction towards the system and the unattractive learning environment become the main factors of the dropout. Therefore, learning environment plays an important role in influencing student's attitude and aptitude (Oblinger, 2003) which may lead to promote or demote the student's intention and usage of e-learning (Ratna and Mehra, 2015).

Authentic learning environment proposed by Herrington and Oliver (2000) is based on the situated learning theory and is one of the effort to support student's learning environment. Meisenhelder (2013) defined authentic learning as a way of learning that encourage students to create a meaningful, useful and shared outcome in real life thru simulated tasks provided by the instructor. Even though, there are difficulties in implementing authentic learning activities in a classroom (Chang *et al*., 2012) but with the emergence of innovative and advanced technological tools, the barriers in implementing the learning environment can be shortened (Herrington *et al*., 2003, 2006; Rochester *et al*., 2012).

MOOC applied self-learning due to there is no direct learning with the instructor while studying using MOOC. Meanwhile, authentic learning is suggesting a real-world simulation or problems that have to be applied by student while learning. The combination of MOOC and authentic learning can give better learning outcome because students are able to solve the real problem given after learning all the theory from the materials provided by instructor. Lombardi (2007) mentioned that "learning-by-doing is generally considered the most effective way to learn". Thus, this study discusses the implementation of data structure course in MOOC which applied authentic learning environment. In this learning environment the course activities' and tasks are

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implemented based on ten authentic learning activities suggested by Lombardi (2007), Herrington and Oliver (2002).

**Literature review:** Up to date, there is only a few studies on authentic learning implementation that have been done (Ter and Herrington, 2014; Pillay *et al*., 2015). Stein *et al*. (2004), the author found there is a gap between learning in class and learning within real-life that needed to be investigated while Ter and Herrington (2014) proposed the design perspective and the use of education research design for authentic e-learning design. In order to implement authentic learning, there is a need for support and training, reward and provision of time..

Therefore, this study intends to embed pedagogical (authentic learning) in data structure course implementation. Further, the student's access pattern is identified in this study to give the value insight on the student's engagement with MOOC which also may give views on the student's attrition rate. The next section discusses the implementation of one of the pilot MOOC course in Universiti Teknologi Malaysia (UTM) which is Data Structure course.

## MATERIALS AND METHODS

**Data structure implementation in MOOC:** MOOC has been popular globally since 2012 while MOOC in Malaysia has started since 2013 and initiated by Taylor's University Malaysia using OpenLearning as the platform (Fadzil *et al*., 2015). More universities applied MOOC later includes UTM which started its own MOOC based on edX platform and currently on open learning. The implementation is a great start in supporting government plan to launch MOOC at national scale to promote self-learning and life-long learning.

**Mooc framework:** This section describes the MOOC framework which consists of several phases as shown in Fig. 1. The framework is developed to implement authentic learning environment into MOOC conducted. The implementation of MOOC started with; course setup, course design, course development, implementation and maintenance and benchmark. Course setup lets user manage the course being in-charged that include the appearance of the course. This also include the course profile like name, coordinator, course outline and the duration of the course. Other than that, the course setup enables user's role assignment and manage modules and activities. The instructor's interface enables them to visualize the course analytic result of the whole course and hence enable instructor to generate a report easily.

MOOCs features are designed to engage authentic learning which allows students to create a meaningful, useful shared outcome. Real life tasks or simulated tasks provide the learner with opportunities to connect directly with the real world. MOOCs development involves team-based approach to create learning environments that allows specialist to contribute their expertise. This requires people across the institution to collaborate in ways not native to higher education. The UTM-MOOC design is based on few features such as course promotional video, topic and subtopic, weekly learning outcomes, learning materials, learning activities assessment and additional resources. Learning materials include notes and video with the most video uploaded are lecture video and tutorial video.

The last phase which is maintenance and benchmark, is also crucial for the quality of the course which providing update, provide feedback, secure copyright and at the same time meeting institutional requirement.

**Brief nature of data structure course:** Data structures is a popular course which has also been provided by other MOOC providers (Nath *et al*., 2014). In UTM, Data structure and algorithms course has been implemented in MOOC platform starting September 2015. Table. 1 shows the distribution of percentage for online activities in the course. As shown in Table. 1, the course activities consist of 69% content and 31% task. The task has four components which include 12% of online quiz, 11% of discussion forum, 7% of online activities and 1% of modules.

The course content which mostly videos with 40%, followed by 18% of the content are files and 11% of HTML. The list of the course type of content for MOOC data structure which is the majority of activities is shown in Table 1.

For video, most videos are made in production studio settings which involved students to explain a situation ask questions and role-play. An example of video is shown in Fig. 2. There are also videos of the instructor

Table 1: Distribution for activities In data structure course

| Activities | Percentage of activities |
|---|---|
| **Content** | |
| Video | 40 |
| File | 18 |
| HTML | 11 |
| **Task** | |
| Online quiz | 12 |
| Forum | 11 |
| Online activity | 7 |
| Module | 1 |

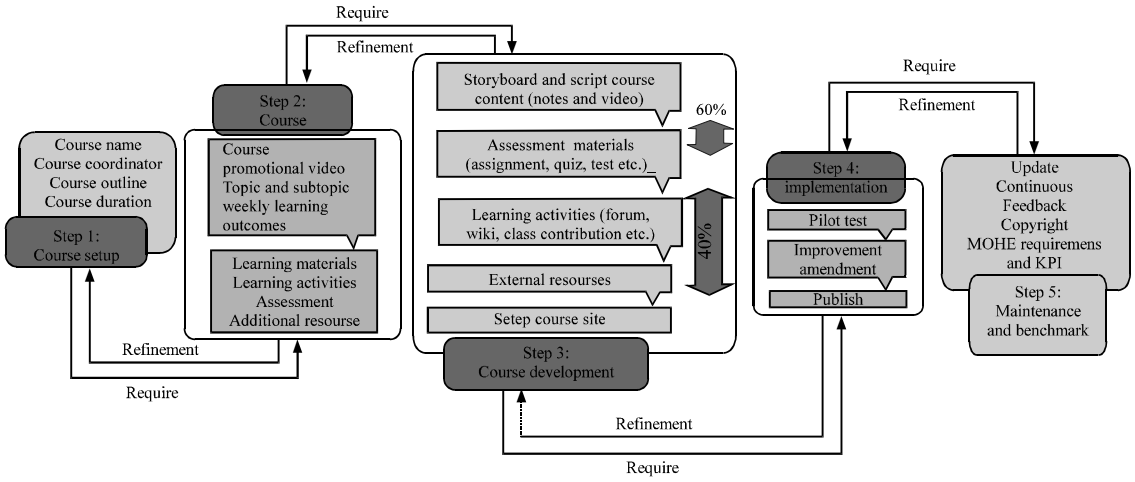


Fig. 1: Framework of MOOC implementation


Fig. 2: Example of case study video presented by students

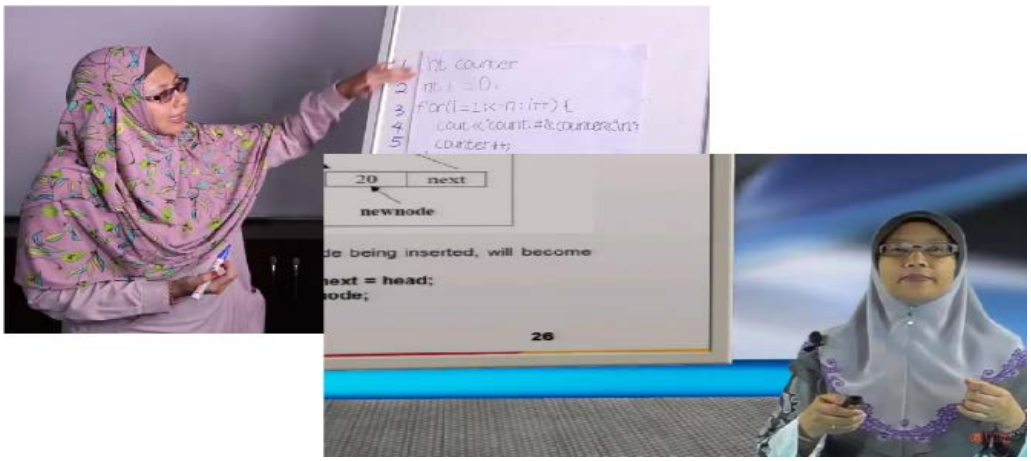


Fig. 3: Example of lecture video

giving lectures with presentation slides or drawing hand, shown in Fig. 3. Other type of video include simulation video (animation) and case study video (production studio settings). For file, the course provide links for downloadable slides from topic 1 until topic 11 which can also be viewed directly with HTML content.

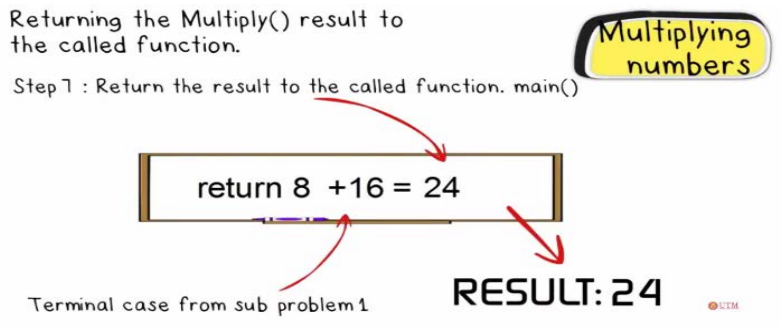


Fig. 4: Example of problem solving video

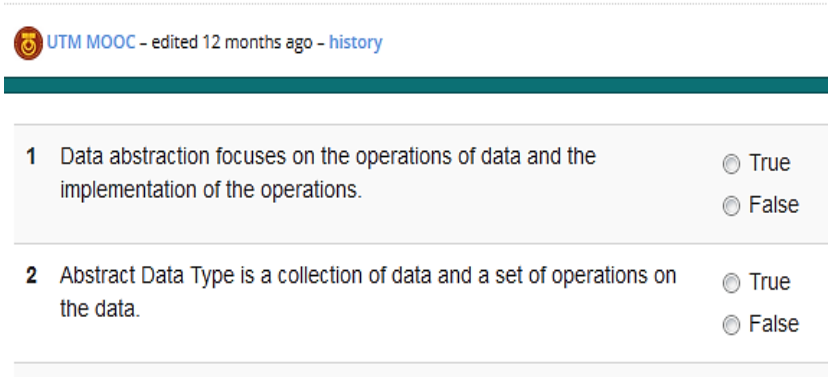


Fig. 5: Example of true false questions

**Implementation of authentic learning:** Authentic learning usually need to associate with the nature of the course that is being implemented. Therefore, this paper discusses the features of authentic learning which has significant impact on the learning process of Data Structure subject. This study adapted ten authentic learning environment features suggested by Lombardi (2007), Herrington *et al.* (2003) and Reeves *et al.* (2002) into Data structure course. The features being selected are based on the most features adapted from previous studies.

The first feature is real-world relevance whereby the course contents are presented in videos and online activities. The videos contain lectures and problem solving. The students are expected to have the ability to make decision, know how to perform the task or solve the problem on their own after learning using videos. The second feature is ill-defined where the students are required to define tasks and sub-tasks needed in order to complete an activity. The problem given is not easily solved or common problem but rather need student to figure it out and ask question. A case study video with a question which uploaded by lecturer in this course is well represented the feature. Complex, sustained tasks is where the task given encouraged students to get occupied with a problem. Students are given time to investigate and ask questions for the problem solving video.

Next, multiple perspectives feature is garnered through various resources which is suggested through external links. Students interpret and evaluate problem in certain topics from various perspectives. In terms of collaborative feature, there is space under every task where students can leave comments and encouraged collaboration to solve given problem. While value-laden feature is recognized from the perspective of students on certain topics or opinion. The nature of education itself is value laden (Seah and Bishop, 2002), thus in this course which involved solving algorithm problem revealed student's value through decision-making and repetitive exercise. Figure 4 shows an example of problem solving video.

The course provides students with interdisciplinary perspective through the task or assignment whereby students have to learn and think from different discipline. For instance, students have to consider math calculation during programming exercise. Whereby integrated assessment is not confined to single type of assessment. Apart from true false questions (Fig. 5), open end question and multiple answers also considered through online quiz. Another feature of authentic is

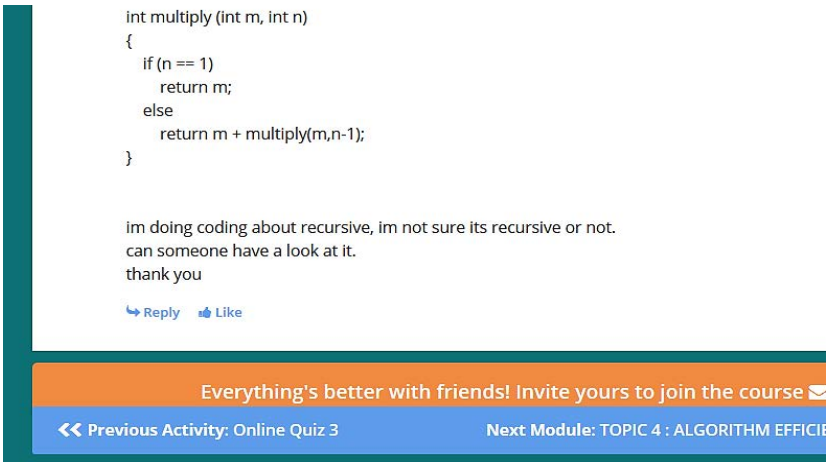


Fig. 6: Example of student posting answer

authentic products which authentic activities encouraged students to provide various opinion and suggestion that led to better solution. Figure 6 shows one example of student posting answer to a problem given. Other than that, through forum activities, students are trained to multiple interpretations and outcomes where the problem given are not limited to one correct answer instead are open to various acceptable solution.

## RESULTS AND DISCUSSION

Dataset of cohort 1 until latest registration for the aata structure course with 628 students is chosen for analysis. Instances include enrolment date, end date, student name, progress, country, comment and university. This analysis aims at finding the statistical result of the data which implemented authentic learning. The study proceeded with statistical analysis which looked into demographic patterns and progress of activities.

**Data analysis and result:** The analysis based on the student's demographic pattern reveal that the student registered in the course come from 48 countries and 19 unknown countries. In this initial study, the result of first batch of students show progress. Figure 7 shows the top five of countries with highest participation. Malaysia who has highest students registered, lead the ranking followed by United States India, Germany, Philippines, Australia, Mexico and Spain.

From the whole course, 70 students did at least access a file. Which means majority of the students has no progress as shown in Fig. 8.

Figure 8 shows 89% of students have no progress, 10% for 0-9% completed, 0.9% for 10-19% completed and

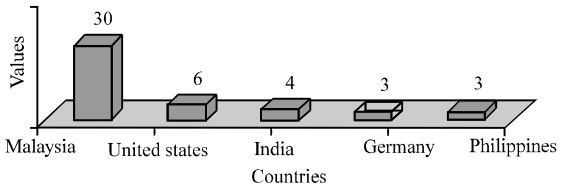


Fig. 7: Top five of countries with highest participation

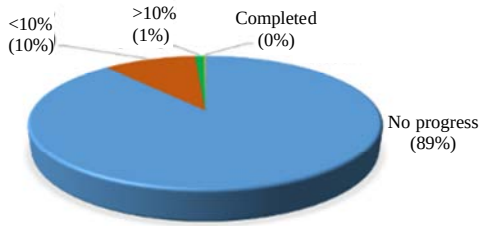


Fig. 8: Total students for each group of progress

0.1% for student who has complete the course. However, even the whole cohort shows low progress, there is at least a student who completed the course. In Fig. 9, each file has average accessed from 12 students. Highest accessed, F1 has a big gap compare with other total accessed. F18 has the lowest accessed. After investigation, the study found out that all files could be downloaded, however there is a technical problem when opening F18 compare to other files during that time. Therefore, the result help in discovering problem occurred that need attention.

Figure 10 shows the highest accessed of HTML are H1, H4 and H5 while H2 has not been accessed by anybody. After investigation, there is no problem in opening the HTML, however the HTML is for Topic 2

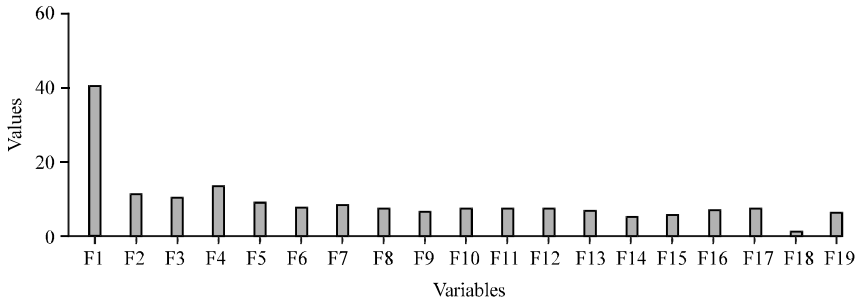


Fig. 9: Total accessed for each file

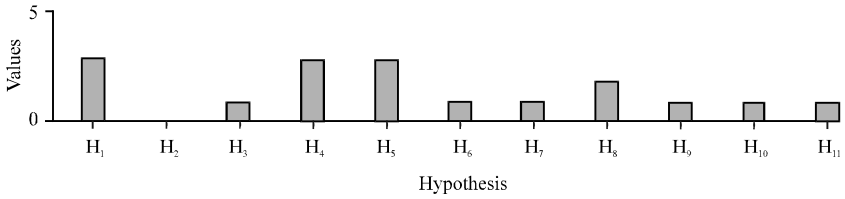


Fig. 10: Total accessed for each HTML

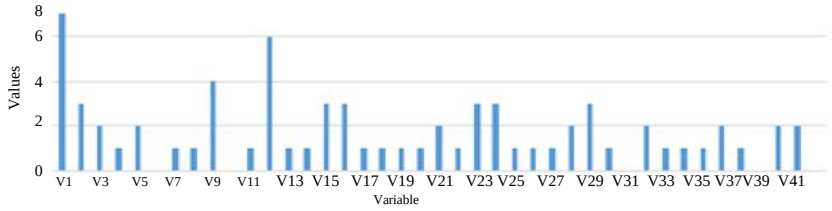


Fig. 11: Total accessed for each video

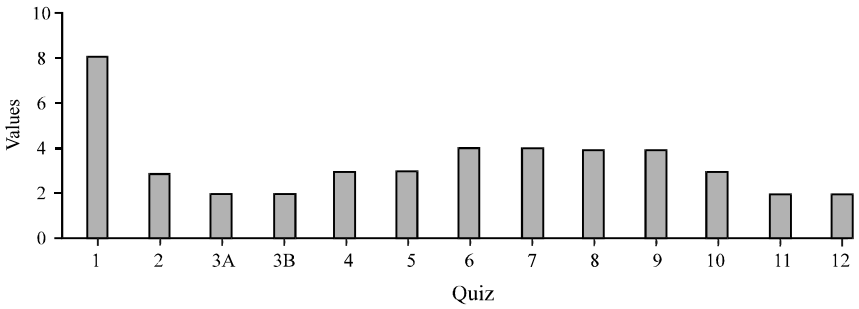


Fig. 12: Total of students who complete quiz

which the video of the topic also has not been accessed. In average, almost 2 students have accessed each HTML. Total accessed of video (major percentages of course content) is shown in Fig. 11 and 12. V1 is the highest total of accessed. The average total of accessed each video is almost 2 students. Meanwhile, the analysis from the log files also show highest participation in completing the quiz at the beginning. However, there is inconsistent number of students completing the rest of the quizzes.

## CONCLUSION

In summary, there is no standardization or consistency in the student's pattern of accessing the file after the investigation. For example, the videos which have not been accessed is short videos yet there is shorter video which have been accessed. The videos with highest accessed is long but there is longer video which has average accessed. Also, the activities with highest completion rate such as file and online quiz are activities that require short time to spent with.

## LIMITATIONS

The result also has limitation. For example, MOOC is self-evaluated where students need to tick if they have done certain task. Therefore, it is unknown whether the students really have completed the task or if they have completed the task but do not tick them. The same goes for other information given such as background info. This is in fact the weakness of online.

Overall, there is low percentage of students that show progress. This might be a possibility that contribute to higher dropout rate as studied by (Lykourentzou *et al*., 2009) which took progress data and detailed student activities as significant element in predicting dropout rate. With the limitation of the data (no data on daily actions done), we can only assume that as long as the student stays in the course, there is possibility the student will continue the learning process with participating in the activities provided, supported by the authentic learning environment.

## IMPLEMENTATIONS

This study discussed on the implementation of data structure course in authentic learning environment. The study found that there is high participation from students of various countries. However, until the first cohort end, there is low percentage of students who have accessed the full content of MOOC Data Structure which is a worried situation that contribute to the high attrition rate issue discussed previously. To show good progress in authentic learning, the study believed the communication between the instructor and the student are important and need to be maintained. However, to implement authentic learning, is time consuming for the lecturer which become another issue of the development. Thus, there is potential for further study in identifying the best method to maintain communication and management in order to support authentic education.

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