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Research paper



A Learning Analytics View on Dispersion of Learning in MOOCs

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Abstract

Learning analytics of massive open online courses (MOOCs) can assist educators and researchers to understand learning patterns in MOOCs. As learning in these types of environments are still relatively understudied, learning analytics can help in visualizing patterns of learning which include dispersion of learning. Previous studies have indicated that a higher level of dispersion of learning may indicate that a learner is actively participating in a MOOC. As such, the study aims to investigate the dispersion of learning in MOOCs from a learning analytics view and identify the relationships among factors such as total active learning time, peak learning times, and number of comments. The study involved investigating learning analytics of a MOOC for postgraduate studies learning about educational technology with an enrolment of over 660 students. The findings of the study show that high dispersion of learning could indicate that student require a slower pace of learning, while a lower one could indicate vice versa. Results also show that learners with lower completion rates and high dispersion of learning were one who contributed more to the community (i.e. had the greatest number of comments). In sum the findings suggest that dispersion of learning is related to students' overall engagement in MOOCs and dispersion of learning cannot be made the sole measure of learning as it could be related to pace of learning.

Keywords: *active learning time, dispersion of learning, completion rates, higher education, pace of learning, massive open online courses.*

1. Introduction

Researches on Massive Open Online Course (MOOC) have received limitless attention in educational context particularly among course instructors of tertiary institution. In online learning context such as MOOC, students' retention is highly driven by their motivation and interest towards the course [11,15]. In defining students' retention, previous researchers concluded that the amount of students' retention is highly corroborated with their willingness and extension of commitment to be involved in learning [10,18]. Flexibility and practicality of learning materials are the most asserted facets in researches pertaining learners' retention. In general, dispersion of learners' retention patterns could highly impact their involvement and contribution in the lesson. Mechanisms in MOOCs such as discussion boards, animated videos and extensive reading materials could positively impact students' motivation; henceforth improve their students' retention rate in an online learning context such as MOOC [26, 27]. Students' interactions among learners with low dispersed learning retention rate in MOOC were reported to be highly active compared to students with high dispersion of learning retention rate [5,8,[9]. Communicating with peers in a MOOC through comments in discussion boards found to be more interactive in comparison to conventional platform. This is due to the features in MOOC which allow real-time feedbacks from peers and instructors. Therefore, students who are exposed with engaging mechanisms in MOOC will undergo a more satisfying learning experience.

Blended learning is the process of knowledge or skills acquisition through experiences, practice and teaching from both online and offline contexts [29]. A teacher-centred approach is referred to traditional learning as practiced by instructors in a conventional classroom context. Students in a traditional, face-to-face classroom heavily rely on the teachers who play the main role as the knowledge providers. The teaching approach is referred to in a passive learning environment whereby the students perceive large input of information from the instructors who delivered the contents of the lesson (e.g: lecturing in a small and large-scale community). Delivery of in lectures happened with very little involvement from the students in the lesson. Students only listen lectures and remember the facts given by the teacher and widely known as a teacher-centred teaching [27,30]. These passive learners should delve into a more active learning context as the teaching approaches enable students to engage extensively. Therefore, improvement of students' retention rate in a blended learning course will occur.

Simultaneous interaction of students and instructors with collaborative learning strategies can stimulate students by activating existing knowledge and linking with new knowledge [3,32]. This newly acquired knowledge will continue to be adopted in the future as one of the learning methods that can provide students with the ability to solve a more critical and complex challenges in real life situation [4, 17]. Researches that have been conducted previously showed that student-centred learning approach is an alternative strategy of producing autonomous learners who can solve problems critically, prioritizing learning independently and actively in facing the world's challenges today [7]. Scholars have also asserted that collaborative learning strategies will further enhance students' acquisition of knowledge, attitude change and students' behavior [19, 25].

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In a blended learning course, task-based learning activities are the most desirable practice in teaching as they could enhance learners' motivation as they generally achieved task completion that included substantial interaction with their peers [20]. In MOOC, instructors are dealing with learners' motivation and reinforcement through real-time "feedbacks" and "comments" which allow a more natural, human-like interaction with the students; therefore, establish an effective rapport between two parties [6]. In a study on students' retention in MOOC, Cornillie, Clarebout and Desmet asserted that effectiveness learning might not only depend on the amount of active time spent on the MOOC [7]. Dispersion of learning retention rate could have possible effects on the effectiveness of students' learning which was reflected on their contribution on discussion section (number of comments). On the basis of this insight, other researchers have discovered that learners with high completion rate have different pattern of learning retention dispersion in an online learning context such as MOOC [16, 26]. Despite of the same achievement from the learners, these students could have a different preference of learning styles that could have possibly impacted their learning analytic in terms of their dispersion of learning retention rate. Considering the affective barriers from the students, incorporation a blended learning course would generally improve students' interaction [19]. In general, passive students showed less interactivity with their peers in face-to-face classroom. However, these students will actively take part more actively in an online learning context [13, 14].

Previous studies have asserted that students' retention in an online learning platform is becoming the one of the daunting challenges by all instructors. One of the earliest studies conducted in the United States on the retention rate of students in online classroom has reported a noticeable decline of 25% [1]. The findings are further supported by a study conducted in East Carolina University, USA which reported a problematic retention rate of distance learners to enrol for a course in an online learning platform [2, 21, 31]. From the analysis, the researcher asserted that students' perception and satisfaction in learning are the key determinants towards sustainable retention of students in an online learning platform. Factors that determine the retention rate in an online learning platform were further investigated by a researcher from Minnesota using Noel-Levitz Priorities Survey for Online Learners™ (PSOL). He concluded that learners' satisfaction in the lesson is the main determinant that could deviate the retention rate in an online classroom. Another factor discovered that hinder retention rate includes learners' time commitments, followed by personal problems and instructor-related problems [2, 22, 25] Therefore, it is concluded that the teaching approaches employed by the instructors is also crucial in maintaining the learners' retention rate in the classroom.

2. Method

The study was conducted in a MOOC developed by the Faculty of Education, Universiti Kebangsaan Malaysia under the Malaysian MOOC initiative. The current enrolment of the MOOC is over 660 students from more than 20 countries. The MOOC was developed to cater the needs of future educators to develop online courses for a blended learning experience. The MOOC contents are in-line with the Malaysian e-Learning policy and is open to the public for via OpenLearning platform.

The syllabus of this MOOC was based on educational technology course for postgraduate students. The educational technology course is a compulsory course for postgraduates majoring in resource and information technology and an elective course for all postgraduates in the Education faculty. In line with the Malaysian e-Learning policy, the course was conducted in a blended learning format, where learning tasks and instructions were conducted both in face-to-face classroom and the online platform via MOOCs.

To investigate learning retention rates in MOOCs, the analysis of the study was conducted based on the learning analytics from February to July 2018. Analytics were assessed in terms of learning retention with regards to total active time, highest time spent on MOOC, and number of comments.

3. Results

Learning Analytics (Dispersion of Learning in MOOC across active time)

Four learners were chosen randomly for each MOOC to illustrate the dispersion of learning retention in the MOOC. Learners were also chosen in terms of the total completion rate in the MOOC with varied active time spent on the MOOC.

Figure 1 shows a learner with a high dispersion of learning throughout the course. In the figure, the highest peak of learning time is 3161 minutes followed by 1526 minutes. The retention rate is highly dispersed across five months (from March to July 2018) where the total active time was nine days indicating high retention rate with 100% course completion. The learner has also contributed quite actively with a total 25 comments in the MOOC.

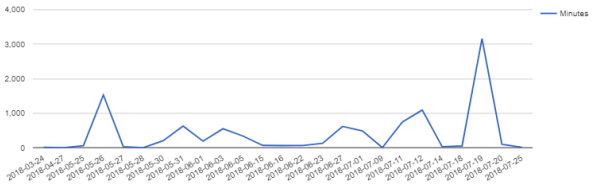

Fig. 1: Highly dispersion of learning with 100% completion rate

In figure 2, learning analytics showed a low dispersion of learning with high completion rate (100%). Here, the learning analytics showed that the learner's total active time was 10 days 11 hours. Although the dispersion of learning retention is quite low, the learning time peak was very high with a total of 11,016 minutes spent in a day (July 6, 2018). Even though the learning retention was lowly dispersed, the learner showed a very high completion rate (100%).



Fig. 2: Low dispersion of learning with 100% completion rate

The learning analytics in figure 3 shows a high dispersion of learning with a course completion of 84%. Here, it was observed that the highest time spent on the MOOC (peak time) is 3161 minutes with an active time of 9 hours and 34 minutes. Although the highest peak time is quite low, the learning is dispersed between March and July 2018.

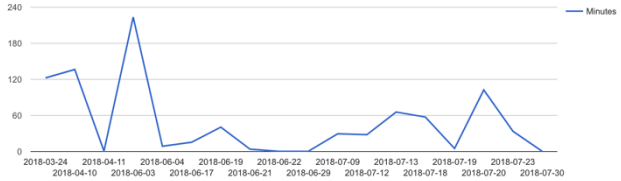

Fig. 3: High dispersion of learning with a completion rate of 84%

Figure 4 displays analytics of a learner with a completion rate of 84%. Here, the learning retention is rather concentrated at a point

of time where it achieved a peak of 373 minute (highest active time) and a total active time of 10 hours and 40 minutes, which is slightly higher than the one with high dispersion.



Fig. 4: Low dispersion of learning retention with a completion rate of 84%

Learning analytics (Learning dispersion, total active time, peak time, and number of comments)

Analysis of learners' interaction and active participation were also analysed with regards to the number of comments against the total active time in MOOCs. Table 1 shows the comparison of learner with high and low dispersion of learning retention with 100% and 84% completion rates by total active time, highest peak time, and number of comments. From the table, results revealed that the learner with high dispersion of learning retention spent a total active of 9 hours and 34 minutes, with 25 comments while the learner with low diversion had a total active time of 10 days and 16 hours with 37 comments. Here, the learner with higher dispersion of retention had a lower active time (9 hours as compared to 10 days) and had lesser number of comments.

As for the learners who achieved 84% completion, the learner with higher dispersion had a total active time of 14 hours and 34 minutes with 98 comments, while the lower dispersion one had an active time of 10 hours 40 minutes with 31 comments. When comparing both learners with 100% and 84% completion status, the results were inverse, where higher dispersion ones (84% completion) had higher active time and higher number of comments and lower dispersion one had a lower active time with a lower number of comments.

Table 1: Comparison of types of learning retention dispersion in MOOC

Completion Status	Dispersion of learning	Total Active Time in MOOC	Highest Time Spent on MOOC (Peak Time)	Number of Comments
100%	High dispersion	9 hours and 34 minutes	3161 minutes	25 comments
100%	Low dispersion	10 days and 16 hours	11016 minutes	37 comments
84%	High dispersion	14 hours 34 minutes	223 minutes	98 comments
84%	Low dispersion	10 hours 40 minutes	373 minutes	31 comments

4. Discussion and Conclusions

The findings of these study show that high dispersion of learning does not constantly refer to higher active learning times. With regards to the learner with 100% completion status, the learner had a higher dispersion of learning (spread over four months), yet the one with lower dispersion had a higher active time in MOOCs (10 days as compared to 9 hours). The results also showed that the highest peak was over 11000 minutes with lower dispersion learners while higher dispersion one had only a highest peak of over 3100 minutes. In sum, we can conclude that having a higher dispersion of learning does not constantly refer to having a higher active time and peak of learning. This can be related to the fact that each learner has styles of learning with regards to time and pace of learning. In the MOOC, the learner with lower dispersion and higher active time (with 100% completion status) preferred to concentrate and focus on learning in one particular period of time – hence producing the high peak of time (11016 minutes). Yet, other learners could prefer a slower pace of learning over a longer period of time. This can be related to the work of Durkensen et al. where they found that learning autonomy (i.e. freely decide on pace of learning) may have an effect to competency [24] [12]. In other words, allowing learning to cater for different paces of learning is important to increase learners' understanding or increase level of competency.

Interestingly, findings also indicated that the learner with the highest number of comments was the learner with 84% completion rate (with 93 comments) rather than the one with 100% completion. This shows that course completion does not constantly refer to active contribution in learning communities. This can be related to the findings of Koller et al. (2013), where they discovered that active participation in MOOCs does not necessarily refer to the fact that learners are community contributors [20]. In other words, learners can be active learners in a MOOC, but they could prefer a more individualized and unsocial approach to learning, where they interact with learning materials and environment rather than with learning communities. On the contrary, learners who prefer a more social approach to learning would contribute more to the community (referred to as "community contributors" by Koller et al., 2013) but may or may not have a high dispersion of learning time [20, 23, 28].

From the findings, we can conclude that dispersion of learning is related to students' overall engagement in the lesson. Yet, findings revealed that the levels of learning dispersion are is related to active learning time in both direct and inverse manners [29]. Learning dispersion can also be related to learning peak times and number of comments where a lower level of learning dispersion could indicate that a learner may prefer a faster pace of learning vice versa.

Despite of interesting findings discovered, it is worthwhile to note several limitations of this study in terms of students' background, learning content and duration of course conducted. Students who involved in this study were postgraduate students of a public university in Malaysia. Although the samples are randomly selected, the background of the samples was not varied as all of the learners mentioned in this study are from Malaysia. Further analysis to learners from different geographical background in terms of preferred learning styles and retention rate dispersion will shed different findings in the future. Next, the learning content provided in this MOOC is restricted to educational technology contexts. Therefore, the results presented in this study are limited to students' retention rate in the educational technology MOOC. Lastly, analysis of learners' dispersion of learning retention rate was done after the completion of one semester. Therefore, longer duration of course completion should be considered to obtain deeper insights and better findings in the future.

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