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A Learning Model for Grouping Learners and Encouraging Participation for MOOC Environments

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Abstract

Massive Open Online Courses (MOOC) have the potential of bringing quality education to the doorsteps of everybody irrespective of geographical location. However, evidence suggests that only a small percentage of enrolled participants complete their courses partly due to the lack of adequate social presence and timely support when learning impasse occurs. Class size, knowledge gap and the digital divide that exists among participants contribute immensely to the challenges in implementing an appropriate instructional model and online learning collaboration in MOOC. In a MOOC environment, there are less resourceful learners who could drop out easily, and more resourceful learners who could support their peers when provided with an adequate environment. Therefore, this paper proposes an amalgamated learning model that uses online dynamic rewarding and ad-hoc grouping mechanisms to sustain learning in MOOC. Previous experiments in blended learning contexts show that affect and social factors, such as the joy of achieving a higher social status, peer presence, and also peers supports sustained learning, which in turn improves learning outcomes.

Key Words: MOOC, CSCL, Learner Motivation, Amalgamated Learning

Introduction

The rapid advancement of ICT and educational technology have led to the proliferation of information across the globe. This changed paradigm in knowledge dissemination contributed to the growth of Massive Open Online Courses (MOOC). According to McAuley, Stewart, Siemens and Cormier (2010), a MOOC is an online learning environment that integrates the connectivity of social networking, the facilitation of an acknowledged expert in a field of study, and a collection of freely accessible online resources. Additionally, MOOCs build on the engagement of several to thousands of learners who self-organize their participation according to their learning goals, prior knowledge and skills, and common interests. They may share some characteristics with conventional (traditional) platforms where courses are organized in a predefined timeline with weekly or periodical topics. On the other hand, MOOCs are mostly fee-free and without predefined expectations apart from Internet access and interest for participation, and usually, they have no formal accreditation and prerequisites.

MOOCs have the potential of giving educational opportunities to a global audience, though studies show that only a small percentage of enrolled participants complete their courses (Wang, 2014). Some of the reasons for the dropout include the lack of support when learning impasse occurs and inadequate online social presence (Hone & El Said, 2016). Consequently, learners do not enjoy adequate affective and social benefits of learning. On the other hand, studies have also shown that online learning collaboration improves motivation and learning outcomes (Wenger, 1998; Heinze & Procter, 2006). However, the implementation of online learning collaboration in MOOC environments is challenging, especially when the class is large and participants are from different parts of a world with a digital and information divide.

Therefore, this paper proposes a social learning model that uses online pairing and rewarding mechanisms for MOOCs. Learning activities in this model are divided into three constructs. These include learn, understand and facilitate, which enable learners to be rewarded with points. The accumulated points are used to assign social statuses to learners, where the learners with the highest status play the role of facilitators. To improve social presence and support, the pairing mechanism enables a learner in an impasse to find resourceful peers, or vice versa, for collaboration in order to solve the encountered difficulties. A previous experiment in a blended learning context showed that this game feature in collaboration triggered affect and social factors such as the joy of having a higher social status and cooperative competition among the group. In addition, the peer presence and support sustained learning, which in turn improved learning outcomes.

Background

Information technology and social innovation have become the panacea of knowledge in the 21st century. This has paved the way for the development of MOOCs (McAuley et al., 2010; Wang, 2014; Hone & El Said, 2016), which have become promising tools for education across the globe, despite debate among several stakeholders concerning their sustainability. Furthermore, many candidates with varying backgrounds from across the globe have taken advantage of the many courses that are offered as MOOCs. In spite of these benefits, there is still a persistent need to sustain leaners to the end of their enrolled courses. In MOOC environments, there are more resourceful learners such as teachers, professionals and advanced learners who usually have higher metacognitive skills and in-depth knowledge, and less resourceful ones such as beginners and "laypersons" who have lower metacognitive skills. Moreover, there are lurkers who fall under both categories. Therefore, the lack of standard instructional and collaboration models for MOOC environments to sustain learning has led to many learners focusing mainly on their individual interests and curiosities, and only in some cases are they able to interact with their instructors and some peers.

In the meantime, emphasis has been placed on social constructivism, which encourages community or social learning. The notion of community learning can be traced back to the work of Vygotsky and Piaget which found learning to be essentially social (Ravenscroft, 2003). The activities in a learning community environment promote learners' mental functioning in the creation of ideas, sharing of experiences and evaluating acquired knowledge and processes through higher order thinking. The learner, as a member of a community, participates in actual practice and, as such, gradually learns how to think and act as a community member (Wenger, 1998). Additionally, such environments trigger Learning by Teaching (LbT) (Grzega & Schoner, 2008) where learners improve their knowledge and metacognitive skills by teaching their peers. Furthermore, learners usually have internal and external motivations for learning through which they complement each other. And game theory is one of the means to encourage learning in the absence of external stimuli such as certificates, physical instructors, and so on. Game theory shows that people do what they believe is in their best interest, and therefore pay attention to how others might react if they choose to do one thing or another (Bruce, 2010). Game theory has sustained learning among both young and adult learners as it encourages healthy competition when implemented adequately.

Therefore, implementing appropriate MOOC instructional models that blend some social psychology tools to motivate learners' affective participation, and narrow the knowledge gap between the less resourceful learners and their more resourceful peers, is the focus of this article.

Method

The Learning Model

Amalgamated Learning combines sociocultural and behaviorist theories. This is to ensure effective participation among learners, observing and rewarding learners' efforts as they engage in learning in their community of practice. In Amalgamated Learning, learners combine different modes of learning to achieve their learning goals, which is similar to our physical social environment. Their learning is influenced by an instructor's facilitation and their learner-centered activities, including individual, collaborative and learning-by-teaching. In Amalgamated Learning, a learner's activities in the community are modeled as LEARN, UNDERSTAND and FACILITATE states or constructs.

LEARN is mapped to cognition. In this state learners interact with online content through self-regulation to create their own mental model of the context. In self-regulation, learners take an active role in their learning - mostly in context - in response to a demand, or solve a particular problem by using appropriate tools. Thus, when a learning impasse occurs, they are supported to consult a resourceful learner or their instructor, or are identified and helped in order to sustain their learning. This underpins the need for pairing and incentive mechanisms that will enable easy and effective contacts and rewards to the resourceful learners.

UNDERSTAND is also mapped to cognition and affective factors. Understanding is the fundamental goal of teaching because learning with understanding is a sense-making, meaning-making, or knowledge building activity. This underpins a need for a knowledge progress and confidence evaluation mechanism that ensures formative, summative and diagnostic evaluations (Table 1). Function A is linked to an online multiple choice quiz (OMQ) that uses the knowledge and comprehension levels of Blooms' cognitive taxonomy. Function B is linked to a Knowledge Confidence Discrepancy check, which uses the values "Skip", S, "Understood", U, "Not Clear", C, and "Not Understood", N available on each topic, and every learner must select one before proceeding to the next topic. When a learner selects "Skip", "Understood", and "Not Clear," they have to answer an OMQ that has 10 questions that have been carefully designed to cover the entire topic to aid in ascertaining learners' understanding of the topic.

FACILITATE is mapped to collaborative or social learning. It occurs when a learner has gained knowledge and skills to support other peers. This enables a learning-by-teaching situation (Table 2). The learner in the facilitate mode is able to create learning objects by sharing ideas and their understanding of a topic, download and recommend documents.

Function A			Function B	
Score Range	***Reward Point***		***Knowledge Confidence***	***Reward Point***
Highest	a_n		S	b_n
⋮	⋮		U	b_3
Lower	a_2		C	b_2
Lowest	a_1		N	b_1

Table 1. Knowledge Progress and Confidence Check

Function C	
Facilitating Activity	***Reward Point***
⋮	c_n
Search and help	⋮
Share ideas and understanding	
Recommend online info	c_3
Download and Bookmarking	c_2
⋮	c_1

Table 2. Facilitation

The Learner Model

The Learner Model represents structured information about the learner's learning process, and this structure contains some values of the learner's characteristics that allow the learning system to take appropriate actions (Van Rosmalen, Sloep, Brouns, Kester, Berlanga, Bitter, & Koper, 2008). The following parameters are considered in this proposal with some example values.

Learn Activity - This consists of learning and collaborative activities that a learner engages in. The parameters used are:

Learn_ Mode << 0 = Self Learning, 1= Discussion
Collab_ Mode << 0 = Receiving Support, 1= Giving support, 3=None
TopicID << Pi ∈{Current and Completed Topics (i.e. P_1*...Pm)}*
PageID << p∈ Pi = {Current and Visited Pages}

Problem - Consists of information about anticipated problems a learner can have during learning. It helps in diagnostic and formative feedback, and parameters used are:

Problem_ Mode << 1 = Problem; 0 = Solved
1==> when difficulty occurred or Confidence-Check = N or Quiz failed
ProblemID = TopicID + PageID + (difficulty or Confidence-Check = N or Quiz failed and Time)

Problem Familiarity - This helps the system to identify if a learner is familiar with the current difficulty that another learner has. It has the following parameters:

*Familiarity (**F**) << 3 = Offered support on the current difficulty before; 2 = Received support on the current difficulty before; 1 = Currently has same difficulty; 0 = No familiarity.*

Competence - Consists of a learner's (ID) knowledge progress and confidence and the facilitation activities per a topic (pi). It has the following parameters:

$A_{ID,pi} + B_{ID,pi} + C_{ID,pi}$

Minimum competence per topic $(MnS_{pi}) = A_{1,pi} + B_{1,pi} + C_{1,pi}$

$$\textit{Maximum total reward scores per topic } (MxS_{pi}) = A_{n,pi} + B_{n,pi} + C_{n,pi}$$

Social Label - This stores the social status and facilitating role code of a learner. It has the following parameters:

Social-Status = $\Phi_1, \Phi_2, \ldots, \Phi_\beta$
Facilitating Role (R)<< 1 = Facilitating Role; 0 = No Facilitating Role

Learning Time - This has different parameters that store the time spent on a page, topic and the entire course.

Amalgamated Learning

The learning allows self-efficacy building through learner-content interaction, and social speech through synchronous and asynchronous human interactions. It has five stages that form "a learning cycle." The respective stages are as follow:

Goal Setting: This is the beginning of the learning where the instructor explains the goal of the course, the topics involved, and how to achieve the learning goals. All learners start learning with the lowest social status, and are informed that their participation effort will be recognized for promotion, which then will affect their course credits. The goal-setting narrows learners' attention and directs their efforts to mainly goal-relevant activities, and it influences their persistence towards goals, especially if the ultimate goal is divided into sub-goals (Miner, 2005).

Content Exploration: This is the stage where individual learners interact with online content from the first topic through to the last topic, inside and outside the classroom, within a set goal to master self-regulation (Pintrich, 1995), and to create their own mental schema of the topics. The *Learn_ Mode=0* at this stage. In addition, the learners' previous knowledge, topic comprehension and knowledge confidence are tracked by the functions $A_{ID,p}$ and $B_{ID,p}$. When a learner selects a confidence check on a topic then the following algorithm will be executed:

If a learner selects **U** or **C** or **S**, then learner will take the OMQ to confirm the choice.
If the learner passes the OMQ, points are awarded, through $A_{ID,p}$ and $B_{ID,p}$, and the learner continues to the next topic.

Learning Impasse/ Difficulty Situation: This is a situation in the exploration stage where learners encounter content or cognitive difficulties, and may not know the next action to take (Bolman, Tattersall, Waterink, Janssen, van den Berg, van Es & Koper, 2007), which could lead to drop-out (Willging & Johnson, 2004). This difficulty could be an item or object on a page, selection of N or failing the OMQ after the learning the topic.

If the learner fails the OMQ then the learner will be considered as selecting N. Then, the *Problem_Mode* is set to1, and the learner has to select one of the following actions in order to continue learning:

i- Collaborate with Peers Immediately (for Synchronous).
ii- Read discussions already held on topic's difficulty items.
iii- Post difficulty items to a bulleting board system or send mail to instructor (for Asynchronous).
iv- Learn the current topic again.

When the *Problem_Mode* is set to 1, it enables a resourceful peer with a facilitation role or the instructor to locate and help that learner. On the other hand, when a learner is idle, a timer-agent compares the learner's average learning rate with that of the group. Then, if the elapsed time is "big," it sends help messages to the learner to enable that learner to select an appropriate action to continue learning.

Learning Socialization: This is the human interaction stage. It occurs when *Problem_Mode* =1 and *Collab_ Mode = 3*. The social learning occurs when the learner in difficulty (X) is assigned an online resourceful learner (RL), or is located by a RL or instructor for a synchronous dialogue. If *X* has posted a question to the community, any RL or instructor can respond asynchronously. Any dialogue and the IDs of learners involved are stored for future use, and the RL is rewarded through the function $C_{ID,p}$ after *X* has passed the OMQ. To select an appropriate resourceful peer for X, the following parameters and algorithm, shown in table 3, are used as the pairing mechanism.

Parameters	Conditions	Selection Priority
Problem Familiarity	F=3, F=2, F=1, F=0	F=3&2, then F=3, then F=2, then F=1, and then F=0
Social Status Gap	$\Phi_X<\Phi_Y$, $\Phi_X=\Phi_Y$, $\Phi_X>\Phi_Y$	$\Phi_X = \Phi_Y$, then $\Phi_X < \Phi_Y$, and then $\Phi_X > \Phi_Y$
Topic Distance	$D = P_Y - P_X$, $D \in I$	Min (D) where $P_Y >= P_X$ Max (D) where $P_Y < P_X$
Availability	*Collab-Mode=3*	*Collab-Mode=3*

Table 3. Conditions and Priorities for Selecting Resourceful Peer

Suppose, X, on a social status, Φ_X, has a problem with an ID *ProblemID* and *Problem_Mode*=1, on topic P_X, an appropriate RL, *Y*, on a position, Φ_Y and topic P_Y, will be selected to collaborate with X.

If a learner contacts a friend or any peer directly, bypassing the system, both learners would be assigned appropriate F values after the challenged learner has passed the quiz on that topic.

Evaluation: Evaluation is in two phases. One is individual learner evaluation through the OMQ at the exploration stage for the formative and diagnostic assessment. The other is the summative assessment where online social statuses are considered in addition to scores of exams or other activities, if any, which could use the third to sixth levels of the Bloom's Taxonomy.

Rewards and Social Status Promotion

The learning environment used for this study is the AL system whose design, functions and implementation have been discussed by Farouck and Watanabe (2009). However, some important features that are relevant to this article will be discussed. These are the social incentive and pairing mechanisms that are used to improve learners' sense of community.

The social incentive mechanism (SIM) is used to determine a learners' social label parameter. This parameter stores a learner's social status, which is determined by the competence parameter. It also stores a learner's facilitating role, which is assigned when a learner attains the highest social status.

The social status of a learner is determined by the Competence parameter, which is calculated as follows:

$$TRS\,(ID) = \sum_{p=1}^{m} (A_{p,ID} + B_{p,ID} + C_{p,ID})$$

Where *TRS(ID)* is the learner's total reward score for all completed topics *m*. Anytime a learner completes any topic, learners' activity log data will be checked automatically and the current positions are computed and displayed, which may promote or demote a learner. If a learner reaches the highest position, i.e Φ_β, a facilitating role will be assigned automatically (figure 1).

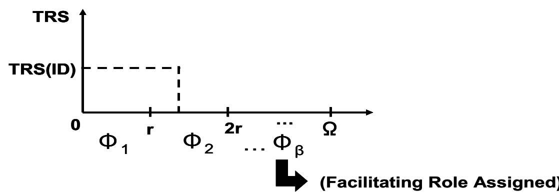

Figure 1. Learner Promotion

The **Ω** = Maximum (TRS (ID)), $\forall$ ID $\in$V, where V is the classroom community. Its value changes when a new learner's or same learner's TRS is greater than the current **Ω** value. The **Ω** value is then divided by **β** (number of social statuses) to get a range magnitude, say **r**, which is distributed as follows, Φ_1= r, Φ_2= 2r, …, Φ_β= βr. Learners can also upgrade their competences by doing any of the following actions:

- Learn topics again to improve knowledge comprehension to better their $A_{ID,p}$ score.
- Select an appropriate or better knowledge confidence check after (re)learning topics to improve their $B_{ID,p}$ score.
- Support challenged learners who have made contact for help, or have posted questions on BBS to better their $C_{ID,p}$ score.
- Search and support learners in difficulty to better their $C_{ID,p}$ score - for learners with a facilitating role.

Experiment

A focus group of 23 university students were the subjects of a one-week experiment. The subjects were enrolled in an Introduction to Java programming course.

The subjects were from Africa, America, Asia and Europe, and were familiar with computer learning. Some of them already knew other programming languages. The one-week course covered four main topics such as Introduction to Object Oriented Programming, Identifiers, Operators, and Input/Output, although the aim of the research was to propose a generic environment that ensures social, cognitive and affective factors of learning. Java programming language was chosen for the experiment for various reasons. According to Jenkins (2002), pedagogical suitability and affection are of greater importance to motivate learners in programming class, not necessarily the choice of programming language. Additionally, the learning style in programming can be classified into "Surface" and "Deep" levels. The surface level involves remembering details of general orientation, notation, syntax, operator's precedence, and so on, while the deep level involves the skills of planning, developing, testing, debugging, and so on. Additionally, the surface level conforms to the knowledge and comprehension levels of Bloom's cognitive taxonomy as discussed earlier. The deep level falls within the fourth to sixth levels of bloom's cognitive taxonomy where learners' ability to program can be tested. The social statuses used in this experiment are Beginner, Assistant and Master. Furthermore, all the learners began learning with the Beginner status. Data collection was done through observing learners' online activities, interviews, a questionnaire that used a Likert scale, and by extracting from the system's log data after the one-week course.

Data and Findings

The summary of the findings is presented in percentages as follows. The "%age" in the tables means percentage of total learners who responded to the given questions.

Effects of the Social Incentive Mechanism

Table 4 shows how the learners felt, and to what extent the incentive mechanism affected their cooperative learning.

<table>
<tr><th>Category</th><th colspan="2">Response</th><th>%age</th></tr>
<tr><td rowspan="2">Higher Status OR If Promoted</td><td colspan="2">Felt proud and helped my peers.</td><td>48%</td></tr>
<tr><td colspan="2">Felt proud and relaxed from learning.</td><td>20%</td></tr>
<tr><td rowspan="3">Lower Status OR If Demoted</td><td colspan="2">Studied much harder.</td><td>49%</td></tr>
<tr><td colspan="2">Contacted my peers for help.</td><td>36%</td></tr>
<tr><td colspan="2">Felt unhappy</td><td>4%</td></tr>
<tr><td rowspan="3">Personality Issue</td><td rowspan="3">When I found some of my peers that I perceived I was better than, but found them on higher position:</td><td>I made effort to rise.</td><td>40%</td></tr>
<tr><td>I did not care.</td><td>40%</td></tr>
<tr><td>Learning became boring.</td><td>12%</td></tr>
<tr><td>Satisfaction</td><td colspan="2">Learning was more interesting and fun.</td><td>52%</td></tr>
</table>

Table 4. Effects of the Social Incentive Mechanism

Some learners also added the following noteworthy comments if they had perceived that they had better knowledge than someone but found them to be in higher positions:
"I might quit the course if it gives others the opportunity to take advantage of me."
"The social status put too much pressure on me as I have to work harder to rise, especially when demoted."
"I will not like anybody to see my position apart from my teacher, if they like me because they perceived me to be smart and I got demoted it may change their impression about me. And that might destroy our relationship."

However, two learners also commented that "I may not worry if I find myself on a lower position because the system scores according to knowledge progress but also how much you help others, then a 'low score' does not necessary mean that you don't know. Maybe your knowledge progress is good but you don't help anybody;" "Some of my friends were calling me Master in the class and that was fun."

Effects of the Role Assignment

Table 5 shows how the learners felt, and to what extent the facilitating role affected their cooperative learning.

Category	Response Item	%age
Social Affinity	Gave me better sense of community.	92%
	Took the opportunity to make more friends.	72%
	Strengthened my relationship with my peers.	72%
	Happy to search for peers in difficulty to help them.	68%
	Used my free time to help others.	52%
Knowledge Evaluation	Understood the topics better.	92%
	Got more confident on what I knew about the topics.	68%
Solution	Solved some difficulties that I could not solve by myself.	84%

Table 5. Effect of Role Assignment

Two learners added the following noteworthy comments on the facilitating role: "I may not want to help anybody, so if the system assigns me a facilitating role, I don't think I feel comfortable". This comment could have come from a learner who has an external responsibility, such as family or work, and will only focus on the topic knowledge.

General Outcome and Impression

At the end of the experimental course, 56.5% ended up in a Master position and 43.5% in an Assistant position. None remained in the Beginner position. Table 6 shows the learners' responses to the question, "If you were a teacher would you use such an online environment to support your students?"

Response	Yes	No	Don't Know
%age	62%	21%	17 %
Reasons according to some learners	"It will make the students do their effort to study and solve the problems by themselves. If they couldn't do it, they can ask each other for help. Otherwise, they can contact to me (as the teacher) to get some hints."	"I don't want to classify the students to make them feel that he/she is better or worse than the others. This is not friendly. In contrast, they have to race to reach a better position...."	"It depends on how well the online learning is compared to traditional classroom. Can my students understand the content better using the online or face-to-face environment?"

Table 6. Learners' General Impression

Some learners also gave the following noteworthy comments, "As I am not talkative in the classroom, the system made me more active in the brainstorming activities"; "The online allowed me to think and concentrate better and this made me to contribute effectively in the class." Additionally, language and technological barriers affected some students. English language was used for the experiment but only a few learners were first language speakers while the majority were foreign speakers while the rest were second language speakers. 64% indicated that they were affected by the use of English language, while 50% were affected by their ability to competently use a computer and internet environment to learn. However, they took the following actions to address their problems. 73% contacted their peers for help with computer and internet skills. 64% studied using materials in their native languages on the same topic.59% used online language translators and dictionaries.

Discussion and Conclusion

This study examined the effect of social and affective factors on effective knowledge construction and participation in MOOC environments. Previous work on this study has shown that learners' knowledge outcomes were statistically significant (Farouck & Watanabe, 2009). The learners' performance could be attributed to their higher sense of community, which was influenced by the social and affective factors of learning (Rovai & Jordan, 2004; Jones & Issroff, 2005). Online social factors, such as social status, facilitating role, and social presence, were dynamically used online through an incentive mechanism and a pairing mechanism to motivate learners.

The results show that even though the incentive mechanism has had a positive impact on the majority of learners in the class, it also affected some learners negatively. Most learners showed that when they were promoted to a higher social status they were encouraged to learn better and also support their peers more. However, the majority of such learners indicated that they were challenged to study harder or seek support from their peers to raise their social status again. Learners were also motivated to study harder when they found out that the peers they had perceived "knowledgeably weaker" than them were in a higher position than themselves. However, a few learners found learning boring because they were not encouraged when demoted, which might have led to drop-out. Such learners may need additional support to maintain their participation in a future study. A similar result can be found in Vassileva and Sun (2007) where social status was used in a peer-to-peer system. In their study it was found that there was a decrease in learner participation among few learners, especially the higher achievers.

Therefore, the facilitating role implemented in this study has the prospect of keeping such learners busy, which will improve their social presence and human assistance in the community. Learners who used the facilitating role in this study indicated that they did not only utilize it to search and help their peers who were in difficulty. In addition, it gave them the opportunity to understand and cooperate with their peers better, make more friends, further understand the topics, and also use the opportunity to cross-check their knowledge with others. This can be a good tool to influence friendships in MOOC environments, because by assigning roles and rewarding learners dynamically based on their competencies, learners will learn how to cooperate with each other, and eventually become friends. However, a limitation that needs further study in the future is how to handle learners with more external commitments who would not be able to support their peers.

Learners showed that they were satisfied with their community as it was easier to contact others for help or to give help. This social presence was stimulated by the pairing mechanism that enabled resourceful peers to locate and support their peers in difficulty, and also challenged learners to see and consult more resourceful peers in the community. From a psychological point of view, people become happy with their community if they can find the right people to solve their problems in difficult times (Unger & Wandersman, 1985; Jones & Issroff, 2005). However, learners would not like to collaborate with "just anybody" in their learning community (Heinze & Procter, 2006). From the results of this study, learners' preferences of a collaboration partner are in the following order: any peer who has solution to their problems, any peer who had solved the problem before, any peer who currently has a similar problem, any peer who can recommend a document to solve their problem, and any peer who is in a higher social position. Interestingly, the results show that friendship does not really count when there is a problem at stake unless that friend falls within the order mentioned above. This could not be generalized as other contexts might give different results, especially in traditional settings.

In conclusion, previous researchers have cited many factors that can be used to encourage participation among learners in an online community. Since a community consists of human players whose actions are mostly driven by their emotions and cognitive thinking, this study shows that by ensuring social factors such as dynamically recognizing learners' effort and rewarding them as they progress with their learning, such as assigning social status and providing a facilitating role based on learner competence, and increase social presence with an ad hoc pairing of resourceful learners with learners in difficulty for collaboration, learners' motivation would be stimulated to sustain participation in MOOC environment, which will help develop their cognitive thinking through learning and understanding, and also develop online facilitating skills.

However, a longer implementation time and larger learner size in different contexts would be necessary for determining real dynamics of this learning model.

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