The Report Committee for Qingyuan Jia
Certifies that this is the approved version of the following Report:

Learner-Learner Interaction in MOOCs: A Literature Review

APPROVED BY
SUPERVISING COMMITTEE:

Min Liu, Supervisor

Jason Rosenblum, Co-Supervisor

Learner-Learner Interaction in MOOCs: A Literature Review

by

Qingyuan Jia

Report

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Arts

The University of Texas at Austin

May 2022

Dedication

To my family, parents, and lovely friends.

Acknowledgements

I would like to express my gratitude to Dr. Jason Rosenblum and Dr. Min Liu for their invaluable feedback and input on this report. Dr. Rosenblum, thank you for your insightful suggestions and advice. Dr. Liu, thank you for your unwavering guidance throughout my time in the Learning Technologies program.

I would also like to thank my family and friends for their love, care, and encouragement during my study at the University of Texas at Austin. I could not make it without your unrelenting support during the pandemic.

Abstract

Learner-Learner Interaction in MOOCs: A Literature Review

Qingyuan Jia, M.A.

The University of Texas at Austin, 2022

Supervisors: Min Liu, Jason Rosenblum

The emergence and development of Massive Open Online Courses (MOOCs) has provided access to countless learning resources globally. Although many researchers have investigated the effect of interaction between students' learning experiences and outcomes, there is still a lack of studies on the factors impacting learner-learner (L-L) interaction and ways to promote L-L interaction in MOOCs. Through a systematic review of relevant articles on L-L interaction in MOOCs, this report synthesizes the factors related to L-L interaction, and methods for improvement, in MOOCs. A total of fourteen peer-reviewed journal articles published in the past ten years were included. The findings indicate that learners' backgrounds and competencies, course designs, activity levels, and discussion content affected L-L interaction. In addition, methods related to peer-review and discussion can be implemented. The report also proposes some suggestions for course design and future research.

Table of Contents

List of Tables

Chapter 1: Introduction

As a new form of distance learning, Massive Open Online Courses (MOOCs) have attracted millions of learners by providing a significant amount of high-quality learning resources and better learning outcomes and experiences. In 2008, the first MOOC was launched by University of Manitoba with more than 2,200 students registered (Mackness, Mak, & Williams, 2010). Since then, many MOOC platforms have emerged. 370,000 students enrolled in edX's first official courses in fall 2012, while Coursera already had 1.7 million registered users (Pappano, 2012). MOOCs soon became a "change agent in higher education" (Liyanagunawardena et al., 2013), and the "educational buzzword of 2012" (Daniel, 2012). In the last ten years, MOOCs have witnessed a dramatic increase in distance learners and course offerings. The number of learners grew to 220 million in 2021, with 194,000 courses offered by 950 universities all over the world (Shah, 2021). Both educators and learners benefit from MOOCs. Hew and Cheung (2014) reviewed 25 articles before 2014 and suggested that teaching via MOOCs contributes to practicing teaching skills, while students can learn new topics by enrolling in previously unavailable courses. Not only can MOOCs enhance self-directed learning (Aljaraideh, 2019), and improve students' academic performances and learning processes (Al-Rahmi, 2019), but they also bring more equitable learning opportunities to marginalized groups (Lambert, 2020). The widespread of MOOCs brings knowledge to millions of people and helps them out of poverty (Jacob, 2013).

In comparison with other kinds of distance learning, MOOCs have unique advantages. In correspondence studies, students are unlikely to collaborate with others due to the limitation of content delivery modes (Anderson, 2003). Similarly, students in asynchronous learning environments also find it hard to build personal connections (Hiltz, 1997). Traditional education concentrates high-quality resources, but the participants were still limited. MOOCs break the restriction of time and space, provide open resources to students of all demographics, and facilitate knowledge sharing.

In MOOCs and other distance learning settings, the learning materials are usually videos and texts delivered by instructors. To make up for the deficiency of this instruction mode, most of the MOOC platforms provide unique ways to interact and simulate an in-person experience. Interaction is a critical element in both brick-and-mortar classroom and distance education settings (Gunawardena & Zittle, 1997; Swan, 2001). Garrison and Cleveland-Innes (2005) believe that learners' interaction helps build social relationships and improves learning experiences. Learners' interaction with course content and instructors can have a significant influence on their satisfaction (Kuo et al., 2014). As for the low completion rate of MOOCs (Rai, 2016), Sunar et al. (2017) report that following and interacting with other users would encourage them to stay and complete the course. From the perspective of media, the Internet makes it more convenient for people all over the world to communicate and build learning communities, constructing a basis for active learning (Lin et al., 1995). Harasim (1990) points out that students would feel more equal when communicating online, and Swan et al. (2000) state the important influence of student interaction in online courses. In asynchronous online discussions, learners have more

chances to think and reflect on others' thoughts, thus creating an atmosphere of reflection (Poole, 2000). However, Eastmond (1995) reminds us that online learning is not inherently interactive in nature. Compared with in-person learning, where learners communicate more efficiently, a well-supported community needs to be created to promote communicating online (Ruberg et al., 1996). As MOOCs usually contain a larger number of students, learner-learner interaction plays a crucial role in learners' success. Therefore, the design of learner-learner interaction is essential to the success of a MOOC.

Outline and Purpose of the Report

This report is a literature review of peer-reviewed articles on learner-learner interaction in MOOCs from 2012 to March 2022 and offers suggestions for the design of future MOOCs.

The research questions guiding this review are:

1. What factors may influence learner-learner interaction in MOOCs?

2. What methods can be applied to promote learner-learner interaction in MOOCs?

There are four chapters in this report. The first chapter introduces the research background and purpose of the report. The second chapter describes the methods of screening articles and an overview of the selected literature. The third chapter summarizes the findings of the reviewed empirical studies, concerning factors that impact learner-learner interaction in MOOCs and some methods provided. The fourth chapter draws a conclusion from the research findings and provides suggestions for interaction designs in future MOOCs.

DEFINING MOOC

To provide a more interactive and connective learning experience, Stephen Downes and George Siemens developed the course *Connectivism and Connectivity Knowledge* in 2008, which was referred to as a MOOC. The core features of MOOCs are free, credit-less, and massive (Pappano, 2012), which compose its full name, "Massive Open Online Course." "Massive" indicates the vast number of students that could be enrolled in one course at a time. "Open" refers to the open access to course software, registration, curriculum, information, and assessment (Rodriguez, 2012). McAuley, Stewart, Siemens, and Cormier (2010) conclude that MOOCs are based on the participation of a group of active students who have a common goal and interest.

There are two major types of MOOCs, cMOOCs, and xMOOCs. CMOOCs are "based on social learning, cooperation and use of web 2.0," (Fidalgo-Blanco, 2016), and learners control their own learning experiences in broader online spaces. In xMOOCs, which are closer to traditional learning modes, learning activities occurs on course sites or on a designated online platform.

DEFINING LEARNER-LEARNER INTERACTION

Moore (1989) suggests three types of interaction in distance education, namely learner-content interaction, learner-instructor interaction, and learner-learner interaction. Other researchers define interaction as "communication facilitated by networks of computers or a social and psychological connection" (Wanstreet, 2006). Interaction is a crucial component of instruction, which can increase students' interests, cognitive

processes, and student/teacher collaboration (Milheim, 1996). Trentin (2000) also views interaction as the key element in distance courses.

The three types of interaction are essential in online learning environments. Learner-content interaction constitutes the basic communication, by which students interact with the learning materials and construct their own knowledge. Learner-instructor interaction plays an important role if the teachers participate in the learning process. Learner-learner interaction is not common in self-directed learning but is beneficial. Sharp and Huett (2006) maintain the importance of learner-learner interaction in distance education, because it helps to improve learning experiences and creates a sense of community, which is indispensable in the traditional classroom. Learner-learner interaction includes the interactions of students in groups, classes, or just between one student and another (Moore & Kearsley, 2011). In web-based environments, learner-learner interaction has positive effects on the satisfaction of students (Swan, 2002; Sher, 2009), students' achievement (Kurucay & Inan, 2017), and deep learning (Ke, 2013). The attributes of MOOCs attach more importance to learner-learner interaction. A MOOC usually has thousands of students with a limited number of teachers and teaching assistants, which means there are fewer chances for students to interact or get feedback from instructors. The contributions from peers can compensate for a lack of interpersonal interaction with the educator.

Chapter 2: Methods

The procedure for selecting articles follows the four-phase flow from the PRISMA statement: Identification, Screening, Eligibility, Included (Moher, Liberati, Tetzlaff & Altman, 2009). In the identification phase, the number of records from database searching and other sources was identified, and then duplicates were removed. Next, the articles that did not meet the screening criteria were excluded. The third step was eligibility, in which full-text articles were assessed. Finally, the number of articles included was decided.

IDENTIFICATION

In the identification phase, the following electronic databases were used for searching: APA PsycInfo, ERIC, Education Source, LearnTechLib, and Wiley Online Library. In the searching process, the term "MOOC" was combined with "learner interaction," "student interaction," "learner interact," and "student interact." The literature was peer-reviewed and published from 2012 to March 2022, with a focus on learner-learner interaction in MOOCs.

SCREENING

After the first-round search, 88 relevant papers from academic journals were retrieved from the databases above. To narrow down the scope, the following criteria were implemented for screening:

(1) discussed learner-learner interaction in MOOCs

(2) provided methods of promoting learner-learner interaction in MOOCs

Studies that did not meet at least one of the criteria were excluded. After the screening process, 37 articles were selected for the next step.

ELIGIBILITY

After the screening process, ten articles remained. The author added four additional research papers from the references of articles searched for analysis.

INCLUDED

After examining the eligibility, 14 articles were included for conducting the literature review (see Table 1). The articles selected have a variety of research methodologies and contexts. Six articles used mixed methods, six articles used quantitative methods, and two articles used qualitative methods. The topics and context of MOOCs also had discrepancies. Some studies were conducted on international MOOC platforms like Coursera and edX, while some studies did not indicate the site or used self-developed platforms.

Table 1:

Empirical studies on learner-learner interaction in MOOCs

Reference	Research Focus	MOOC Topic	MOOC Platform	Method	Sample	Key Findings
Elizondo-Garcia & Gallardo, (2020)	Peer feedback practices	Energy Saving	MexicoX	Mixed	486 participants	Peer assessment was beneficial for problem-solving strategies and learners' feedback
Castellanos-Reyes, D. (2021).	What influences learner-learner interaction	Information Technology (IT) and Computer Science and Language	FutureLearn	Mixed	386 learners	The quality of posts in discussions determines the type of learner-learner interaction. Learners' popularity had a positive effect.
Chen, Gao, Yuan & Tang. (2019)	Developing a MOOC commenting tool to facilitate participation	Perception and Action: System Neuroscience,	N/A	Quantitative	28 students from a university	The tool "DanMOOC" improved students' cognitive, social, and teacher presence, and resulted in higher performance.

Table 1 (continued)

Reference	Research Focus	MOOC Topic	MOOC Platform	Method	Sample	Key Findings
Tawfik et al. (2017)	Investigates the nature and level of learner–learner interaction.	Chemistry	Coursera	Quantitative	274 students	Learner-learner interaction, which relied on active participants, remained at a low level, and would decrease with time.
Chiu & Hew, (2018).	Investigates the effects of three types of online MOOC discussion forum activities on student peer learning and performance.	American poetry	Coursera	Quantitative	1563 learners who participated in forum activities	Viewing and commenting on discussion messages contributed to peer views and academic performance.
Wise & Cui (2018)	Explores the interactions and the social relationships that developed around the discussion of the content.	Statistic (StatMed'14)	Lagunita (Stanford)	Mixed	567 forum participants	Content-related discussions could promote interpersonal connections.

Table 1 (continued)

Reference	Research Focus	MOOC Topic	MOOC Platform	Method	Sample	Key Findings
Jitpaisarnwattana, Reinders & Darasawang (2021	Examines factors that encourage or prevent learners from interaction in a language MOOC.	Presentation @work (a language MOOC)	N/A	Mixed	136 learners	Users who had a higher sense of belonging and English ability would interact more.
Bozkurt, Koutropoulos, Singh, & Honeychurch (2020)	Examines LPPs (Legitimate Peripheral Participants) in online networked learning spaces through three lenses.	Connected Learning	N/A	Mixed	136 participants with 90% lurkers	More interaction and connection between learners led to a higher tendency to participate in the interaction.
Chen & Chen (2022)	Analyzes of the patterns of study group interaction in face-to-face and online/Facebook settings.	An Introduction to Marketing	Coursera	Qualitative	Four college students	The blended MOOC study group could increase peer interactions and assistance.

Table 1 (continued)

Reference	Research Focus	MOOC Topic	MOOC Platform	Method	Sample	Key Findings
Chen & Yeh (2021)	Examines three types of role-assignment in a MOOC.	Tao of Learning	Ewant (based on Moodle)	Quantitative	4239 learners	Partial role-assignment was effective, which could promote interaction in discussion forums.
Cohen et al. (2019)	Explores learners' participation patterns in MOOC forums, and the factors related to learners' participation.	the emergence of the modern Middle East	Coursera	Quantitative	2110 learners	The result showed that a small group of active learners constitutes half of the forum activities. The interactions between learners are the major activity in forums.
Cisel (2018)	Explores interactions between learners outside of course forum boundaries and their tendencies.	11 MOOCs	France Université Numérique and Canvas.net	Qualitative	7614 learners	Learners preferred to interact with those they already knew.

Table 1 (continued)

Bonafini (2018)	Characterizing highly active participants and understanding their contributions back to the network in a MOOC.	Statistics teaching and the use of statistical investigations in teaching	N/A	Mixed	328 participants	The active participation of "super-posters" boosted the communication in discussion forums.
Baek & Shore (2020)	Studies the impact of forum size in the contribution of content per person.	Sabermetrics 101 courses from Boston University	edX	Quantitative	2000 learners	Larger discussion forums produced more posts per learner.

Chapter 3: Findings and Discussion

This chapter will address the two research questions based on the findings and results from the reviewed literature:

1. What factors may influence learner-learner interaction in MOOCs?
2. What methods can be applied to promote learner-learner interaction in MOOCs?

FACTORS INFLUENCING LEARNER-LEARNER INTERACTION IN MOOCS

This section describes the findings that answer the first question: What factors may influence learner-learner interaction in MOOCs? Seventeen factors in total were mentioned in the reviewed articles: personal interest, expertise, background, sense of belonging, diversity of learners, course duration, activity instruction, media, size of the discussion forum, super-posters, participant popularity, engagement, competency, personal schedule, discussion topic, discussion quality, and feedback.

Table 2:

List of factors affecting learner-learner interaction reviewed in this report

Factors	Findings	Reference
Personal interest	Lack of interest reduces learners' willingness to interact.	Bozkurt, Koutropoulos, Singh, & Honeychurch (2020)
Expertise	Most of the learners wish to discuss with those on or not on the same level of knowledge as themselves.	Elizondo-Garcia & Gallardo (2020)

Table 2 (continued)

Background	Learners prefer to interact with who they already know.	Cisel (2018)
Background	Learners tend to interact with people who have a similar background to them.	Jitpaisarnwattana et al. (2021)
Sense of belonging	A sense of belonging attracts learners to interact with others.	Jitpaisarnwattana et al. (2021)
Diversity of learners	The variety of learners' knowledge and language increases the difficulty of interaction.	Tawfik et al. (2017)
Course duration	As the course goes on, the engagement in discussion goes down.	Tawfik et al. (2017)
Activity instruction	The ambiguity of instructions hinders learners from participating in peer evaluation.	Elizondo-Garcia & Gallardo (2020)
Media	The usability of communication channels influences learners' interaction.	Jitpaisarnwattana et al. (2021)
Size of discussion forum	Larger discussion forums produce more posts per learner.	Baek & Shore (2020)
Super-posters	The active participation of "super-posters" boosts the communication in discussion forums.	Bonafini (2018)
Popularity	Learners' popularity results in more replies in discussions.	Daniela Castellanos-Reyes (2021)
Engagement	More interaction encourages learners to participate more.	Bozkurt, Koutropoulos, Singh, & Honeychurch (2020)
Feedback	More timely and appropriate feedback brings a higher tendency to discuss, and vice versa.	Chiu & Hew (2018)

Table 2 (continued)

Ability	A learner's knowledge of the topic affects whether to interact with others.	Jitpaisarnwattana et al. (2021)
Personal schedule	The lack of time is a reason for not participating.	Bozkurt, Koutropoulos, Singh, & Honeychurch (2020)
Discussion topic	Discussing content-related topics of the course helps to build connections between learners.	Wise & Cui (2018)
Discussion quality	The quality of posts in discussion determines the type of learner-learner interaction.	Daniela Castellanos-Reyes (2021)

The factors ranged from several articles with different research methodologies and contexts. To provide a general discussion of the factors that influence learner-learner interaction in MOOCs, the author will summarize and separate them into different themes, based on the attributes they have in common. The five themes are: learners' backgrounds, course design, activity level, learners' competencies, and discussion content.

Learners' Backgrounds

Learners' backgrounds are the generalization of the following factors: personal interest, expertise, background, sense of belonging, and diversity of learners. These initial factors contain the influences from the learners themselves and their peers. Bozkurt, Koutropoulos, Singh, and Honeychurch (2020) found that the main internal reason for some learners to become lurkers in MOOC communities was due to their lack of interest and curiosity. In their research, a lurker was also defined as a "legitimate peripheral

participant", indicating that these learners were almost inactive in the community. Lurkers seldom participated in discussions and spent most of their time viewing and observing. In addition to the learners' interests, other researchers emphasized the influence of peers. Elizondo-Garcia and Gallardo (2020) interviewed 272 students in a Chemistry MOOC and found the majority of learners were willing to engage with those who have the same expertise level as them, and they were also ready to share knowledge with learners that didn't have adequate experience. This result was consistent with the findings of Tawfik et al. (2017) that the diversity of learners in a MOOC could bring various topics which promoted interaction. However, the different backgrounds among learners could also be an obstacle to deep and persistent interaction (Tawfik et al., 2017). Some learners attributed their participation to the sense of belonging to a group; other students preferred to interact with learners who have similar backgrounds to them, such as attending the same school or workplace (Jitpaisarnwattana et al., 2021). Cisel (2018) also found that some learners preferred to interact with who they already knew, like classmates or family members.

Course Design

Activity instruction, media, size of the discussion forum, and course duration are sorted into course design, because these factors are settled in the design phase of the MOOCs, and greatly influence how learners interact with each other. According to Elizondo-Garcia and Gallardo (2020), some learners reported that the instructions for peer evaluation assignments were not clear enough, which led to confusion about the activity. The complexity of the submission process also became a barrier for some students that had

no prior knowledge of the technology (Elizondo-Garcia & Gallardo, 2020). Similarly, Jitpaisarnwattana et al. (2021) reported that learners were more likely to interact with others if the communication tools were easy to use.

The result of the experiment conducted by Baek and Shore (2020) showed the relationship between the size of the discussion forum and the number of postings: a larger forum size led to more postings per learner. But they mentioned that forum size was not a predictor of the number of people who participated. A more reliable predictor was the course duration. As the course kept going, there would be fewer learners participating in the discussion (Tawfik et al., 2017).

Activity Level

Activity level refers to the extent that learners and their peers participate in MOOC activities, including super-posters, popularity, engagement, and feedback. Learners who frequently participate in MOOC communities have a promoting effect on the overall interactivity. In a MOOC on statistic teaching, Bonafini (2018) analyzed the engagement of four "super-posters" who contributed to nearly 10% of the discussions and indicated that their participation increased the interactivity of the MOOC overall. These active participants brought their professional knowledge to the MOOC and led the discussion by launching topics and sharing resources (Bonafini, 2018). In addition to the contribution to the community, other benefits were found for active learners. If learners replied to others very often, they would receive more comments from peers in return (Daniela Castellanos-Reyes, 2021). Likewise, if many learners communicated with them, they attracted more

interactions, resulting in a virtuous cycle (Daniela Castellanos-Reyes, 2021). The same pattern was also reported by Bozkurt, Koutropoulos, Singh, and Honeychurch (2020), who stated that more interaction encourages learners to participate more. Also, Chiu and Hew (2018) found that timely and appropriate feedback would increase learners' tendency to discuss. However, timely feedback was not a significant reason for the learner interviewed in Jitpaisarnwattana et al. (2021)'s study.

Learners' Competencies

Ability and personal schedules are included in the theme "learners' competencies" because they reflect learners' skills on a certain topic, and their time resources. In a language MOOC, some learners may refuse to interact with other students because of their English ability (Jitpaisarnwattana et al., 2021). In other words, higher proficiency in the language would encourage them to join in communication. Another reason reported by Jitpaisarnwattana et al. (2021) was lack of time, as some learners may not have extra opportunities for interactions after viewing the course materials.

Discussion Content

The last theme is discussion content which integrates two factors: discussion topic and discussion quality. Discussion forums in MOOCs are a place where learner-learner interaction occurs. When discussing topics that related to learning content, the personal connections between learners were tighter (Wise & Cui, 2018). They suggested that instructors should encourage content-related discussion, which made the interactions more

meaningful. Except for the size, the quality of discussion also decides the types of interactions. Daniela Castellanos-Reyes (2021) used social network analytics to study the interactions between learners in a MOOC about information technology. They found that the comments in the discussion needed to be high-quality, to trigger replies and initiate conversation. Otherwise, the interactions would only be "liked," which was considered enough for a particular post (Daniela Castellanos-Reyes, 2021). Learners believed that the quality of the comments they viewed decided whether they should provide higher-level interactions, like analysis and reply, or just express some acknowledgement, such as pressing the "like" button (Daniela Castellanos-Reyes, 2021).

Summary

In this section, five themes from the factors that affect learner-learner interaction in MOOCs were described, including learners' backgrounds, course design, activity level, learners' competencies, and discussion content. Each theme was generalized from the findings of different researchers as they had a variety of focuses. Some detailed factors may have contrary results, which may be due to the context and participants of the studies. For example, Chiu and Hew (2018) stated that timely feedback was important to learner-learner interaction, but the findings from Jitpaisarnwattana et al. (2021) suggested that it did not matter. Moreover, there were even opposite results in Tawfik et al. (2017)'s study, which examined the effects of diverse backgrounds. The disagreement indicated that the influences of the factors might partially depend on the context, like course content, the

features of the subjects, learners' backgrounds and learning styles, etc. Further research is needed to test and validate the effects in different environments.

METHODS FOR PROMOTING LEARNER-LEARNER INTERACTION IN MOOCS

The following section introduces some methods from the reviewed articles that can help to promote learner-learner interaction in MOOCs. To be specific, six kinds of methods will be described: peer review, role-assignment, time-anchored commenting tool, small discussion group, sub-discussion group, and blended study group (see Table 3).

One thing to note here is that the research contexts of these empirical studies may vary a lot. The design of the platforms and MOOC content are variables that affect the implementation of methods. Due to the limitation of the scope, this report will not discuss the differences between technology features.

Table 3:

Methods for promoting learner-learner interaction reviewed in this report

Method	Benefits	Reference
Peer review	Different thoughts and problem-solving strategies.	Elizondo-Garcia & Gallardo (2020)
Role-assignment	Learners show higher levels of interaction and knowledge construction.	Chen & Yeh (2021)
Time-anchored commenting tool	Increase learners' engagement, performance, as well as cognitive, teaching, and social presence.	Chen et al. (2019)
Small discussion group	Increase social presence, sense of community, and familiarity with other learners.	Tawfik et al. (2017)
Small discussion group	Individualized personal experience, and easy-to-control discussions.	Cohen et al. (2019)

Table 3 (continued)

Blended study group	Increase peer interaction and assistance.	Chen & Chen (2022)

Peer Review

Because of the disproportion between the number of students and instructors, the discussion forum is a popular way to provide interactions. However, many participants mentioned that the feedback they received in discussion forums was not adequate or valuable, often taking the form of agreement and compliments (Elizondo-Garcia & Gallardo, 2020). More meaningful activities, such as peer reviews, are needed. Peer review provides the opportunity for learners to view and evaluate each other's work, which serves as an exchange of different opinions, perspectives, and problem-solving strategies. As mentioned in the previous sections, diversity of learners could bring new topics to the context, in which all the learners' benefit.

Role Assignment

In a quasi-experimental study on the effect of role-assignment strategy, Chen and Yeh (2021) compared the interaction levels among three groups. Part of the students in the first experimental group and all students in the second experimental group were assigned different roles, including starter, summarizer, searcher, scholar, and moderator. The students in the control group were not assigned any roles. Results of their research showed that no matter how many students were assigned roles in the discussion forums of their MOOC, there were higher interaction levels in the entire group. Even two percent of the

learners that were assigned roles could be effective. This method echoes the findings that "super-posters" can boost interactivity and make positive contributions to MOOCs (Bonafini, 2018; Wong et al., 2015).

Time-Anchored Commenting Tool

The time-anchored commenting tool is a unique way to provide discussion activities in MOOCs. Chen et al. (2019) developed DanMOOC, a time-anchored commenting tool that enabled learners to leave comments on the course videos and evaluated its effect. For example, if a learner asks a question about the concept explained in the video, they can input a comment in the textbox. The comment is then presented on the video screen, anchored to the timeline. When other learners watch this moment, they can see the question and post replies, which will also emerge on the screen. All comments also appear on the scrolling list next to the video, synchronizing with the timeline. With this commenting tool, students will be able to discuss the video content as they watch it. In regular discussion forums, learners describe the background of the questions whereas with DanMOOC, the comments are context-related, so that learners can easily join in the discussion. According to the experiment results, learners did participate more in DanMOOC-supported courses than in traditional MOOC forums (Chen et al. 2019), and they performed better in cognitive and affective learning. In traditional online learning settings, time-anchored peer comments were also found beneficial to learners' social interactivity (Lee et al., 2015).

Small Discussion Group

Usually, the discussion forums in MOOCs are comprised of many students and instructors. Larger discussions incorporate a variety of topics and threads, but most of the participants may become lurkers (Bozkurt, Koutropoulos, Singh, & Honeychurch, 2020). Therefore, smaller groups may be more productive. In the social network analysis of a chemistry MOOC, Tawfik et al. (2017) examined several modules and found an interaction pattern of one-on-one. Instead of discussing in forums with a crowd of participants, a learner only interacted with one other learner on average. Even in larger discussion cohorts, learner-learner interaction highly relied on small groups of learners (Tawfik et al., 2017). The study conducted by Cohen et al. (2019) showed that only eight percent of the learners who completed the course sustained the activities in discussions. Hence, they proposed that sub-discussion groups need to be provided to learners with different purposes. Not only can these sub-groups offer a personalized experience, but they are also easier to organize and manage during the discussions.

Blended study group

Although the interaction in MOOCs is often limited to asynchronous events, synchronous activities can still be applied to promote interaction. Chen and Chen (2022) designed a study group for a nine-week MOOC. During the nine weeks, participants had six scheduled meetings for group discussion, and they spent six hours per week finishing other course requirements. Statistics showed that the most interactions they had in face-to-face meetings consisted of chatting and asking questions (Chen & Chen, 2022). The

discussion forum, however, was mainly used for following the topics they discussed in meetings. In general, the mix of face-to-face meetings and discussions facilitated learner-learner interaction compared to discussion-only settings.

Summary

This section summarizes the methods of promoting learner-learner interaction addressed in the reviewed articles. Due to the limited number of articles, four of the five solutions focused on discussions among learners, while one research talked about peer review activity. Some common features can be found among the methods discussed. For example, role-assignment and peer review all enable students to have extra experiences rather than merely being learners. Peer review requires a higher knowledge base because learners need to evaluate others' work. When assigned roles in discussion, learners also participate more based on their responsibilities. The time-anchored commenting tool extends the space where learners can communicate with other audiences. Blend-study group incorporates face-to-face meetings in MOOC environments, which could increase the familiarity between learners. These methods contribute to learners' interaction levels, and learning experiences, and offer implications for MOOC designers and instructors.

DISCUSSIONS

There are some discrepancies among the findings of the articles. As mentioned in the previous paragraphs, the difference in factors that affect learner-learner interaction in MOOCs may come from the research methods, participants, course content, technology,

etc. Therefore, the generalization and synthesis of the factors and methods would be limited. In this section, a brief discussion of the findings is provided.

Research Methods and Participants

The research methods and participants in the reviewed empirical studies varied widely. The findings from Elizondo-Garcia and Gallardo (2020) indicate that the lack of expertise would not prevent learners from discussing with each other, while Tawfik et al. (2017) argue that the diversity of learners makes it difficult to communicate. In fact, Elizondo-Garcia and Gallardo (2020) conducted a mixed-method study on 486 participants, but Tawfik et al. (2017) implemented content analysis and social network analysis on the transcripts of online discussions between 274 students. Chiu and Hew (2018) retrieved the discussion data from 1563 learners and concluded that timely and appropriate feedback increased the tendency for interaction. However, the questionnaire from Jitpaisarnwattana et al. (2021) shows that the long waiting time for feedback was not the reason for not interacting with peers, which was generated from 111 results.

Course content

The content or the subject areas of courses also lead to variations of conclusions. In the result of a quantitative study on over 2000 learners in a statistic course, Baek and Shore (2020) claimed that larger sizes of discussion forums would produce more posts per learner. On the contrary, Cohen et al. (2019) suggested the creation of small sub-discussion groups based on the 2,110 learners in a course about Middle East history. The sample size of their studies was similar, but the course topics differed. In a study on a language MOOC,

Jitpaisarnwattana et al. (2021) acknowledged the effect of learners' abilities on whether they were willing to interact with peers. Similar results were not found in other MOOCs, like STEM courses. It cannot be ignored that language learning needs a lot of communication whether the learner is a novice or veteran, and the confidence to express oneself is crucial. In that case, learners may also not want to interact with those whose expertise is too high.

Technology Issues

The courses from the articles included in this report were also published on different platforms, which can be a restriction for the studies. For the blended study group designed by Chen and Chen (2022), they used Facebook as an additional place for online meetings and stayed on Coursera for learning material. To realize time-anchored discussion along with video, Chen et al. (2019) developed a new commenting tool and compared it with traditional MOOC design. Some researchers did not show the details of the MOOC platforms and the functions they used. Publishing on different MOOC platforms would impose restrictions on the course design and study design.

Summary

Different research methods, participants, course content, and technology issue can all influence the findings and analysis of the articles reviewed. Due to the various resources, the themes summarized in this report may not fully reflect the features of the factors. Some connections between the factors under one theme are not ideal, because the research backgrounds of the articles are not the same. The author intended to provide a

clear view of the factors affecting learner-learner interaction in MOOCs based on the interpretation of the studies, and future researchers might have different classification methods and standards. Also, the effects of discrepancies in technology systems need further investigation, which is beyond the scope of this report.

Chapter 4: Conclusion and Implication

This report reviewed selected articles about learner-learner interaction in MOOCs published from 2012 to March 2022. Fourteen peer-reviewed articles published in academic journals were included.

For the first research question relating to factors that may influence learner-learner interaction in MOOCs, five major themes were identified: learners' backgrounds, course design, activity level, learners' competencies, and discussion content. The themes above were summarized from the factors analyzed by different researchers, in support of a general discussion. The original factors were personal interest, expertise, background, sense of belonging, diversity of learners, course duration, activity instruction, media, size of discussion forum, super-posters, engagement, feedback, popularity, competency, personal schedule, discussion topic, and discussion quality.

For the second research question related to methods of promoting learner-learner interaction in MOOCs, five solutions were introduced based on the reviewed articles: peer review, role assignment, time-anchored commenting tool, small discussion group, and blended study group. Compared with traditional MOOC environments, these methods focus on communication and knowledge sharing on small scales and multiple channels, which facilitate a higher level of learner-learner interaction and result in better learning experiences.

After answering the two research questions, this report provides some suggestions for learner-learner interaction design in MOOCs. First, more ways of interaction need to

be developed to improve learner-learner interaction. Most of the current methods put emphasis on the design of discussion, which is the most convenient and popular pattern of interaction. Although learners can benefit from the diversity of the members and environment, few learners actively participate in the big forum. MOOC designers could offer individualized discussion groups to encourage more learner interaction. Second, technology support is vital. Designers and MOOC platforms should consider the effect and limitations of technologies, and integrate new approaches to interaction, such as online social virtual reality and bulleting comments providing instructors with more choices in designing activities. Third, the potential of learners remains untapped. Among the mass number of learners enrolled in a MOOC, there should be some students who are willing to play important roles during the course period. Both themselves and their peers will have a more enjoyable experience and better outcomes. It may also help create a sense of community and prevent students from dropping the course.

There are several limitations of this literature review. Although MOOCs have been developing quickly in the past ten years, research focusing on learner-learner interaction is still limited. The small sample size of peer-reviewed articles from academic journals makes it difficult to draw a comprehensive conclusion. Moreover, this report does not differentiate the articles based on the type and content area of MOOCs, which may lead to different effects in different contexts such as language MOOCs and STEM MOOCs. Future research could compare the ways of promoting learner-learner interaction across different course content, MOOC types, and platforms.

Bibliography

A brief history of moocs. MAUT. (2015, November 16). Retrieved April 11, 2022, from https://www.mcgill.ca/maut/news-current-affairs/moocs/history

Aljaraideh, Y. (2019). Massive Open Online Learning (MOOC) benefits and challenges: A case study in Jordanian context. *International Journal of Instruction*, *12*(4), 65-78.

Al-Rahmi, W., Aldraiweesh, A., Yahaya, N., Kamin, Y. B., & Zeki, A. M. (2019). Massive open online courses (MOOCs): Data on higher education. *Data in brief*, *22*, 118-125.

Anderson, T. (2003). Modes of interaction in distance education: Recent developments and research questions. *Handbook of distance education*, 129-144.

Baek, J., & Shore, J. (2020). Forum size and content contribution per person: a field experiment. Management Science, 66(12), 5906-5924.

Bonafini, F. C. (2018). Characterizing Super-Posters in a MOOC for Teachers' Professional Development. Online Learning, 22(4), 89-108.

Bozkurt, A., Koutropoulos, A., Singh, L., & Honeychurch, S. (2020). On lurking: Multiple perspectives on lurking within an educational community. *The Internet and Higher Education*, *44*, 100709.

Castellanos-Reyes, D. (2021). The dynamics of a MOOC's learner-learner interaction over time: A longitudinal network analysis. *Computers in Human Behavior*, *123*, 106880.

Chen, K. Z., & Yeh, H. H. (2021). Acting in secret: Interaction, knowledge construction and sequential discussion patterns of partial role-assignment in a MOOC. *Australasian Journal of Educational Technology*, *37*(6), 41-60.

Chen, P. J., & Chen, Y. H. (2022). Massive Open Online Course Study Group: Interaction Patterns in Face-to-Face and Online (Facebook) Discussions. *Frontiers in Psychology*, *12*, 670533.

Chen, Y., Gao, Q., Yuan, Q., & Tang, Y. (2019). Facilitating students' interaction in MOOCs through timeline-anchored discussion. *International Journal of Human–Computer Interaction*, *35*(19), 1781-1799.

Chiu, T. K., & Hew, T. K. (2018). Factors influencing peer learning and performance in MOOC asynchronous online discussion forum. *Australasian Journal of Educational Technology*, *34*(4).

Cisel, M. T. (2018). Interactions in MOOCs: The hidden part of the iceberg. International Review of Research in Open and Distributed Learning, 19(5).

Cohen, A., Shimony, U., Nachmias, R., & Soffer, T. (2019). Active learners' characterization in MOOC forums and their generated knowledge. *British journal of educational technology*, *50*(1), 177-198.

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. *Journal of interactive Media in education*, *2012*(3).

Elizondo-Garcia, J., & Gallardo, K. (2020). Peer Feedback in Learner-Learner Interaction Practices. Mixed Methods Study on an xMOOC. *Electronic Journal of e-Learning*, *18*(2), pp122-135.

Fidalgo-Blanco, Á., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2016). From massive access to cooperation: lessons learned and proven results of a hybrid xMOOC/cMOOC pedagogical approach to MOOCs. International Journal of Educational Technology in Higher Education, 13(1), 1-13.

Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American journal of distance education*, *11*(3), 8-26.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. The American journal of distance education, 19(3), 133-148.

Harasim, L. M. (1990). Online education: Perspectives on a new environment. Greenwood Publishing Group Inc..

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. Educational research review, 12, 45-58.

Hiltz, S. R., & Wellman, B. (1997). Asynchronous learning networks as a virtual classroom. *Communications of the ACM*, *40*(9), 44-49.

Jacobs, A. J. (2013, April 20). *Two cheers for web U!* The New York Times. Retrieved April 10, 2022, from https://www.nytimes.com/2013/04/21/opinion/sunday/grading-the-mooc-university.html

Jitpaisarnwattana, N., Reinders, H., & Darasawang, P. (2021). Learners' Perspectives on Interaction in a Language MOOC. *JALT CALL Journal*, *17*(2), 158-182.

Lambert, S. R. (2020). Do MOOCs contribute to student equity and social inclusion? A systematic review 2014–18. *Computers & Education*, *145*, 103693.

Lee, Y. C., Lin, W. C., Cherng, F. Y., Wang, H. C., Sung, C. Y., & King, J. T. (2015, April). Using time-anchored peer comments to enhance social interaction in online educational videos. In Proceedings of the 33rd annual ACM conference on human factors in computing systems (pp. 689-698).

Lin, C. H., Zheng, B., & Zhang, Y. (2017). Interactions and learning outcomes in online language courses. *British Journal of Educational Technology*, *48*(3), 730-748.

Harasim, L. M. (1990). Online education: Perspectives on a new environment. Greenwood Publishing Group Inc..

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2013). MOOCs: A systematic study of the published literature 2008-2012. International Review of Research in Open and Distributed Learning, 14(3), 202-227.

Mackness, J., Mak, S., & Williams, R. (2010, May). The ideals and reality of participating in a MOOC. In Proceedings of the 7th international conference on networked learning (Vol. 10, pp. 266-274).

McAuley, A., Stewart, B., Siemens, G., & Cormier, D. (2010). The MOOC model for digital practice.

Milheim, W. D. (1996). Interactivity and computer-based instruction. *Journal of educational technology systems*, *24*(3), 225-233.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.

Moore, M. G., & Kearsley, G. (2011). *Distance education: A systems view of online learning*. Cengage Learning.

Pappano, L. (2012). The Year of the MOOC. *The New York Times*, *2*(12), 2012.

Poole, D. M. (2000). Student participation in a discussion-oriented online course: A case study. Journal of research on computing in education, 33(2), 162-177.

Rai, L., & Chunrao, D. (2016). Influencing factors of success and failure in MOOC and general analysis of learner behavior. *International Journal of Information and Education Technology*, *6*(4), 262.

Rodriguez, C. O. (2012). MOOCs and the AI-Stanford Like Courses: Two Successful and Distinct Course Formats for Massive Open Online Courses. *European Journal of Open, Distance and E-Learning*.

Poole, D. M. (2000). Student participation in a discussion-oriented online course: A case study. Journal of research on computing in education, 33(2), 162-177.

Shah, D. (2021, December 18). *A decade of moocs: A review of MOOC stats and trends in 2021 - class central*. The Report by Class Central. Retrieved April 9, 2022, from https://www.classcentral.com/report/moocs-stats-and-trends-2021/

Sharp, J. H., & Huett, J. B. (2006). Importance of learner-learner interaction in distance education. Director, 07.

Sher, Ali. "Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in web-based online learning environment." *Journal of Interactive Online Learning* 8.2 (2009).

Sunar, A. S., White, S., Abdullah, N. A., & Davis, H. C. (2016). How learners' interactions sustain engagement: a MOOC case study. IEEE Transactions on Learning Technologies, 10(4), 475-487.

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. Distance education, 22(2), 306-331.

Swan, K. (2002). Building learning communities in online courses: The importance of interaction. *Education, Communication & Information*, *2*(1), 23-49.

Swan, K., Shea, P., Fredericksen, E., Pickett, A., Pelz, W., & Maher, G. (2000). Building knowledge building communities: Consistency, contact and communication in the virtual classroom. Journal of Educational Computing Research, 23(4), 359-383.

Tawfik, A. A., Reeves, T. D., Stich, A. E., Gill, A., Hong, C., McDade, J., ... & Giabbanelli, P. J. (2017). The nature and level of learner–learner interaction in a chemistry massive open online course (MOOC). Journal of Computing in Higher Education, 29(3), 411-431.

Trentin, G. (2000). The quality-interactivity relationship in distance education. *Educational Technology*, 17-27.

Wanstreet, C. E. (2006). Interaction in online learning environments: A review of the literature. *Quarterly Review of Distance Education*, *7*(4), 399.

Wise, A. F., & Cui, Y. (2018). Learning communities in the crowd: Characteristics of content related interactions and social relationships in MOOC discussion forums. *Computers & Education*, *122*, 221-242.

Wong, J. S., Pursel, B., Divinsky, A., & Jansen, B. J. (2015, March). An analysis of MOOC discussion forum interactions from the most active users. In *International conference on social computing, behavioral-cultural modeling, and prediction* (pp. 452-457). Springer, Cham.

Vita

Qingyuan Jia was born in Yangzhou, China. He received a Bachelor's degree of Science in Educational Technology and a Bachelor's degree of English (minor) from Shanghai International Studies University, China in 2020. After that, he entered the University of Texas at Austin to pursue a Master's degree in Curriculum and Instruction with an emphasis on Learning Technologies.

Permanent email: qingyuan_jia@163.com

This report was typed by Qingyuan Jia.