

A Case Study of Discussion Forums in Two Programming MOOCs on Different Platforms

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An Analysis of Participation in Discussion Forums on Two Different MOOC Platforms

Abstract

In massive open online courses (MOOCs), discussion forums are used to facilitate learner interaction and provide a space for social learning. Some MOOC platforms, such as FutureLearn, are intentionally designed for social learning and encourage the use of discussion forums for learner-to-learner interaction. Other MOOC platform, such as EdX, focus more on presenting discussion forums primarily as a tool for asking questions. This study compared how learners enrolled in computer programming courses use discussion forums on these two different MOOC platforms. Each course had approximately 4700 learners who enrolled. Open coding was used to analyze the nature of the posts in the discussion forums, and subsequent analysis was done based on the categorization of each discussion thread. From the results, we found more participation in terms of the number of posts, learners posting, and learners responding for the FutureLearn course; however, few threads for either course had a deep level of discussion. Most posts in the FutureLearn course were social in nature or discussed course concepts, and most posts in the EdX course were social in nature or were about course assessments. We concluded that the discussion forums for the two MOOC platforms were used differently and tended to align with the role of the instructor and the design of the platform. However, the dominance of social posts and lack of in-depth discussion on both platforms suggests a need to investigate other methods of encouraging course content discussion.

Introduction

The continued growth of massive open online courses (MOOCs) gives learners access to educational experiences that typically have been limited by the need to be present in a physical classroom. However, MOOC virtual environments presents unique challenges for both instructors and learners. One of these challenges is the lack of face-to-face interaction, which affects how learners engage with one another and with the instruction team. From a constructivist perspective, this is problematic because social interaction and communication are vital to meaningful learning [1]. Communication is also necessary for instructors to answer questions, clarify concepts, and guide learners through their knowledge construction.

In order to facilitate social interaction and communication, MOOCs often use discussion forums where learners can post questions and comments relevant to the course. Through these discussion forums, both students and instructors can directly respond in the various discussion threads. Research has shown that discussion forums can promote a social learning environment which leads to deeper learning and increased student engagement [2]. Despite these advantages, getting learners to participate in discussion forums remains a challenge [3], [4]. Different MOOC platforms have attempted to use various strategies to promote social interaction, however it is not clear which strategies are effective [5], [6].

Based on this problem, our research questions are: (a) How does learner participation in discussion forums differ between MOOC platforms? and (b) How does the content of discussion forum data differ between MOOC platforms? Specifically for this study, we compare discussion

data for two MOOCs that teach computer programming subjects. The first MOOC on R programming is offered on FutureLearn, a platform explicitly designed to promote social learning. The second course on JAVA programming is offered on EdX. By answering these research questions, we hope to provide insights on how different factors influence learner use of MOOC discussion forums. Using this knowledge, MOOC instructors and designers may be able to identify ways to improve learner participation in discussion forums and encourage discussions that promote meaningful learning.

Literature review

Learning is an active and inherently social process

The importance of discussion forums in MOOCs is grounded in Vygotsky's sociocultural learning theory [5]. This theory frames learning as a social process whereby knowledge is constructed over time and is influenced by interactions with others. Accordingly, active participation is an essential part of the learning process that needs to be fostered in an educational environment. Since the MOOC learning experience takes place in a virtual environment, there needs to be an explicit focus on developing tools and strategies that can facilitate active learning. Many MOOCs have adopted the use of discussion forums to facilitate this active participation, where learners can interact with the both their instructors and their peers to enhance their learning experience.

In sociocultural theory, the concept of the zone of proximal development explains how social interaction and communication contribute to learning. The zone of proximal development defines what a learner can achieve with the assistance of an instructor or peer [5]. This concept highlights the importance of being able to interact with others for meaningful learning to occur. In MOOCs, the purpose of discussion forums is to provide a space where learners can ask questions to the instructors, engage in a dialogue with their peers, and assist each other with the course content. Thomas explains that learners are more likely to learn through active participation in discussion forums than from passively watching lecture videos or reading course materials [6]. Furthermore, Abeer and Miri suggest the diversity of MOOC learners has the potential to enhance meaningful learning by opening learners to various perspectives that would not be available in the traditional classroom [7].

How MOOCs have approached learning

When MOOCs first came online, educational researchers commonly classified them into two categories based on the pedagogical approaches that seemed to drive their design [8]. The first type, cMOOCs, were based on connectivism which focuses on conversational modes of learning. The second type, xMOOCs, took a more behavioristic approach by concentrating on delivering course content through lecture videos and reading materials. However, as MOOCs have evolved, xMOOCs are now incorporating the conversational approach through discussion forums or supporting sites such as Yellowdig and Piazza. Conversational modes of learning are now common in MOOCs, and the discourse has shifted towards the role of discussion forums in learning, why they are important, how to get more learners to actively participate, and the role of the instructor [9], [10], [11].

Much research on the role of discussion forums in learning suggests that learners who actively participate tend to perform better than those who do not participate, and that learners who engage with others on the discussion forum are more likely to complete the course [12], [13], [14]. The general conclusions are that discussion forums can reduce dropout, promote higher levels of cognition, and are necessary for deeper levels of learning that go beyond rote memorization of knowledge [6], [15]. However, Chueng and Hew emphasize that the presence of a discussion forum does not guarantee that learners will actively participate, nor will the conversations be of educational value [16].

Despite the widespread use of discussion forums in MOOCs and their contribution to meaningful learning, getting learners to participate is often cited as a challenge for MOOC instructors [9]. Many studies have found that participation rates tend to be quite low [4], [3], implying that most learners are not benefiting from this valuable mode of learning. In their systematic review of MOOC literature, Hew and Cheung found that learners will engage in discussion forums when they feel it helps with learning course material [9]. They also found that reasons for not actively participating in discussion forums included poor quality posts, posts on unrelated material, discussion forum formats which were not user friendly, and lack of presence from the instructors.

Mazzolini and Maddison identify three types of roles that instructors can adopt in MOOC discussion forums [17]. First is the “sage on the stage” which refers to instructors who lead discussions and provide the final comments. Second is the “guide on the side” which refers to instructors who take a constructivist role and do not dominate discussions. The third is “ghost in the wings” which refers to instructors who do not participate in the discussion forums at all. They assert that the role an instructor should take depends on the purpose of the discussion forum for the given MOOC. However, Salmon suggests that instructors need to take some form of active role in discussion forums to encourage learner participation [18]. While the presence of instructors in the discussion forum is important from the learner perspective, Swan and Shih found that more instructor involvement tends to decrease the length and frequency of discussion because learners become reliant on the instructor [19]. Thus, the role of instructor needs to be carefully and considered in regard to the purpose of the MOOC and the intended learning outcomes.

FutureLearn’s approach to MOOCs

FutureLearn is a MOOC platform originally designed by researchers at The Open University. They operate with the belief that conversation amongst learners is the fundamental element in the learning process [20]. Their pedagogy is guided by Conversation Theory, and their courses are designed using Conversational Framework. The goal of FutureLearn’s courses is to make conversation engaging and constructive through social interaction and peer learning. Discussion forums are a prominent feature of their platform, and learners are frequently prompted and encouraged to participate in discussion forums throughout their course.

EdX's approach to MOOCs

EdX is a MOOC platform founded by researchers at Harvard University and MIT. It was developed with the goal of increasing access to high-quality educational opportunities and offers an open platform that instructors can use to create their own MOOCs [21]. EdX also focuses on improving the learning and teaching experience through data analysis of user-generated data such as clickstream, time-spent on different sections, and assessments [22]. Their courses typically consist of lecture videos, reading material, and online assessments. They also include discussion forums for learners to post and respond to questions; however, EdX does not claim discussion is a key aspect of their pedagogical support as a platform. Instructors could choose to add third-party discussion platforms to their EdX offered course.

Methodology

In order to investigate the use of discussion forums, we analyzed discussion data from two MOOCs that focused on computer programming subjects. The courses were offered on two different MOOC platforms, FutureLearn and EdX. In the FutureLearn course, the instructor had the role of “guide on the side,” and in the EdX course, the instructor had the role of “sage on the stage.” Details about each of the courses are given in Table 1.

Table 1. *Descriptions of each MOOC*

Course Code	Instructor's Role	Course Topic	MOOC Platform	Enrolled	Course Dates
A	Guide on the side	R Programming	FutureLearn	4787	Spring 2017
B	Sage on the stage	JAVA Programming	EdX	4733	Summer 2017

For the FutureLearn course, about 3000 learners from 134 countries filled the pre-course survey but only about 8% answered questions related to demographics. Of those who responded, 55% were male and 45% were female, about 82% had university education. The age distribution was: 18-25 yrs: 20%, 26-35 yrs: 34%, 36-45 yrs: 22%, and above 46 yrs: 25%. For the EDX course, about 1570 learners from 116 countries filled the pre-course survey and most answered demographic questions. Of those who responded, 25% were female, 73% were male, and 2% did not respond. About 45% had university education, and the age distribution was: <20 yrs: 41%, 20-30 yrs: 26%, 30-40 yrs: 18%, and above 40 yrs: 15%.

Our analysis began by exploring the content of the posts in the discussion forum. For this analysis, we used open coding to assign a topic to each comment thread [23]. The analysis began with three researchers independently coding a sample of 100 comment threads. After the initial coding, all three researchers compared and refined the emergent themes. Using the refined themes, the researchers independently assigned codes to a different sample of 50 comment threads. Once this step was complete, the researchers reconvened and finalized the themes that describe the content of the discussion threads. These themes were: social, concept, assignment, and other. The descriptions of these codes are presented in Table 2. Using these final codes, all discussion threads for both courses were analyzed such that each thread was assigned a code by

two researchers. Any disagreement was reviewed by all three researchers and a consensus was achieved.

Table 2. *Description of codes that emerged from open coding*

Code	Description
Social	Introductions; Comments not directly related to course content
Concept	Questions and comments about material in lecture videos or readings (syntax, programming logic, importing/exporting data, etc.)
Assignment	Questions and comments about course assessments
Other	Course policy; Technical issues; General feedback

In order to compare the use of discussion forums on the different MOOC platforms, descriptive statistics were computed for the overall discussion forum data. We also computed descriptive statistics for the discussion data based on their open-coding categories. In particular, we were interested in the number of posts, the number of learners posting, the number of learners responding, and the number of posts in each discussion thread. We focused on these data to shed light on the activity in the discussion forums and to investigate any differences between the discussion forum activity on each MOOC platform.

Results and discussion

Overall analysis

From the analysis of the overall discussion forum data, Course A had a larger number of discussion threads than Course B. Likewise, Course A had more learners posting and responding compared to Course B. The contrast between these two courses is displayed in Figure 1. Despite these visible differences, both courses had approximately the same proportions of learners posting and responding relative to the total number of threads in each MOOC's discussion forum. Additionally, the size of threads in both discussion forums had similar distributions which are displayed in Figures 2 and 3. The majority of posts in both courses had either one response or no responses at all. Though Course B had many threads with a length of two (one post and one response), upon further inspection we found that most of these threads consisted of the instructor responding to the greeting posts from the MOOC learners. The analysis of thread sizes indicated that, in most cases, few posts elicited extensive discussion amongst learners in both MOOCs.

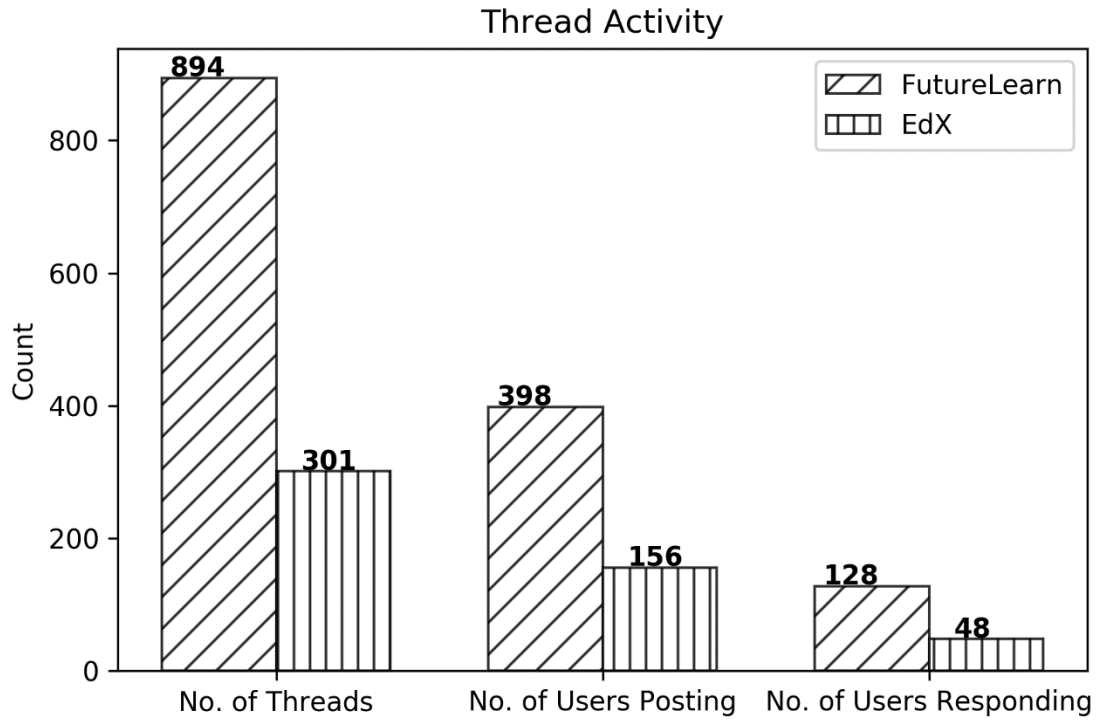


Figure 1. Comparison of the number of discussion threads, learners posting, and learners responding in each MOOC.

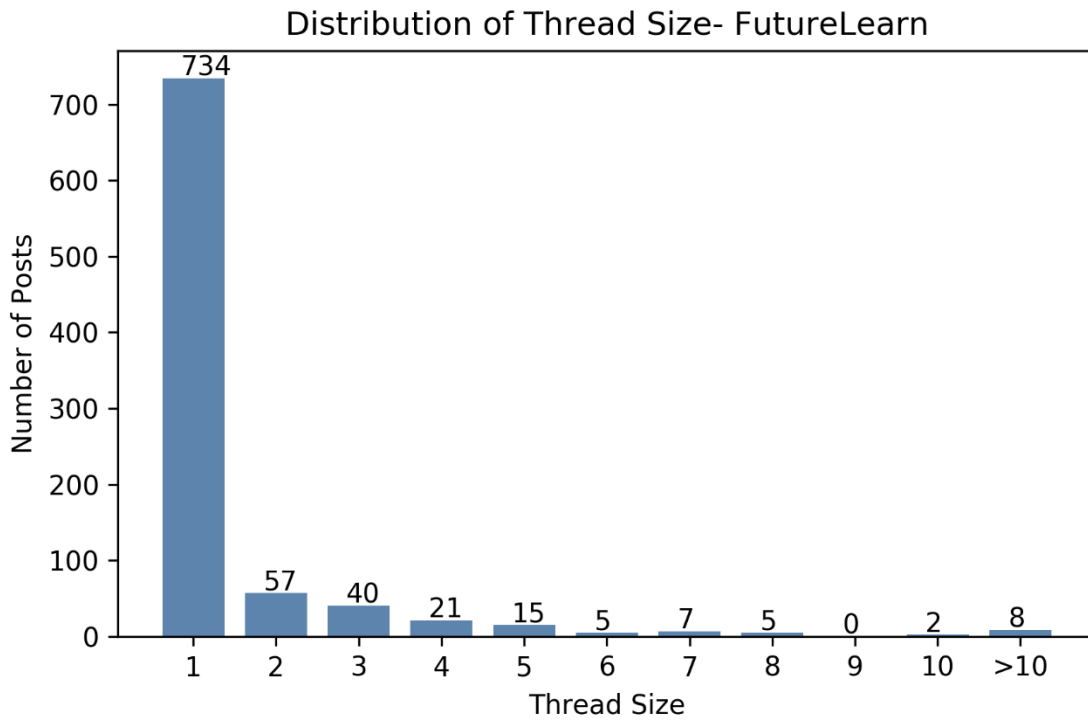


Figure 2. Thread sizes of FutureLearn discussion data

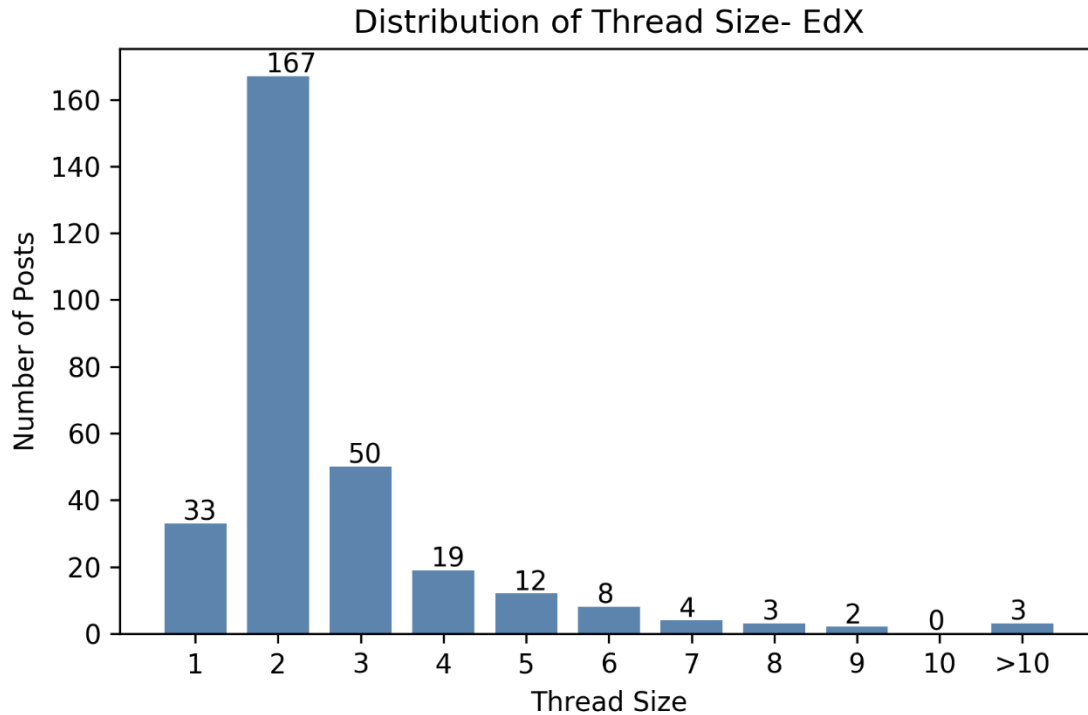


Figure 3. Thread sizes of EdX discussion data

Topic-wise analysis

In order to answer our second research question, we compared learner participation in MOOC discussion forums based on the content of the discussion threads. Using the results from the qualitative coding analysis, we analyzed the percentages of discussion threads in each category for each MOOC. The results, which can be seen in Figure 4, indicate that both courses had a large percentage of “social” posts, however Course A had a much larger percentage than Course B. These “social” posts primarily consisted of learners introducing themselves or making generic comments about their learning experience without discussing the course content. For discussion threads categorized as “other”, both MOOCs had small percentages, however Course B had approximately double the percentage compared to Course A. Similar to “social” posts, “other” posts did not focus on course content and instead included questions about course policies, technical issues with software or the MOOC platform, and general course feedback. If we aggregate these results, 71% of discussion threads from Course A and 52% of discussion threads from Course B did not focus on the course content, however it is important to keep in mind that Course A had approximately three times as many comment threads than Course B.

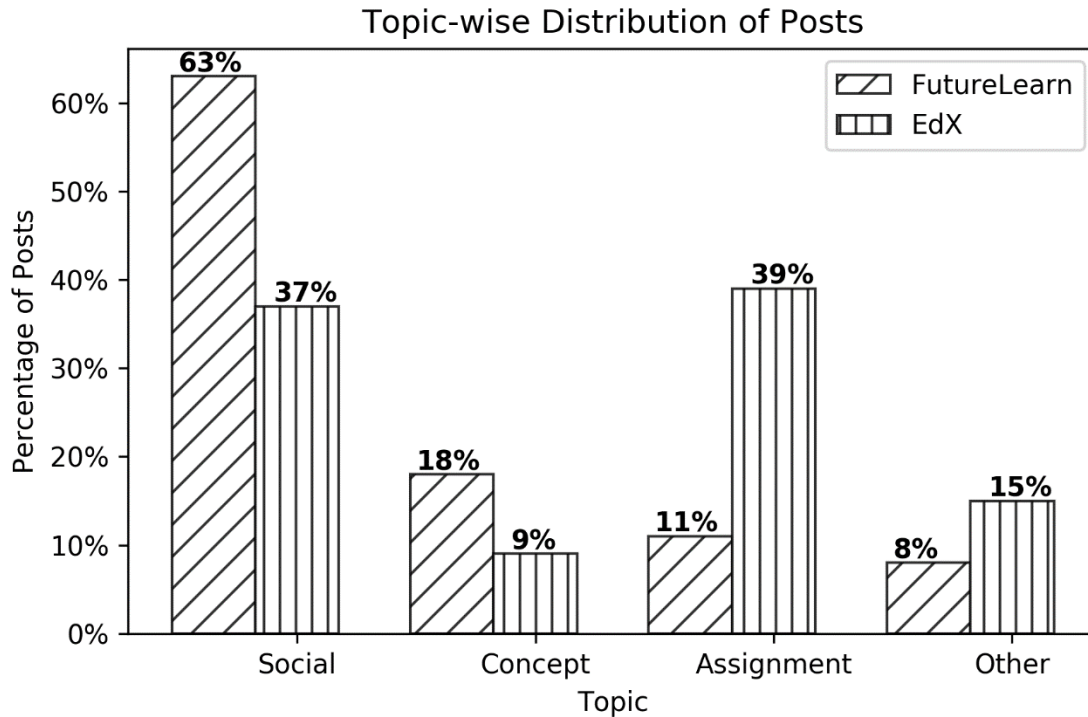


Figure 4. Distribution of posts in each category for both FutureLearn and EdX courses

For discussion threads that focused on course content, Course A had more “concept” posts than “assignment” posts though the difference was not particularly drastic. Conversely, discussion threads for Course B were primarily “assignment” posts, while “concept” posts were minimal. Furthermore, there were more “assignment” posts in the discussion forum for Course B than any other type of post. Comparing the percentage of threads in these two categories, the learners in Course A seemed to participate in the discussion forum when they needed clarification on the concepts covered in the course. On the other hand, it seemed that learners in Course B tended to participate in the discussion forum when they were having trouble completing course assessments.

We continued our analysis by considering the number of learners posting and responding in the discussion forums in terms of discussion topics that were identified from the qualitative coding analysis. Figure 5 shows the percentage of learners starting discussion threads in each category relative to the total number of learners posting in each MOOC (which are reported in Figure 1). Figure 6 shows the same information for percentage of learners responding to posts from other learners.

For learners posting questions and comments in the discussion forums, a similar percentage of learners for both MOOCs did so through “social” posts. The results in Figure 5 show that approximately 75% of those who started a discussion thread, regardless of the specific MOOC, created posts that were social in nature. The same result was seen for “other” posts, which had a similar percentage of participation, approximately 15%, in both MOOCs. For “concept” posts, Course A had a much larger percentage of participation than Course B, which was expected based on the topic-wise distribution of posts. Likewise, for “assignment” posts, Course B had a

larger percentage of participation from learners who started discussion threads compared to Course A, which was aligned with the topic-wise distribution results.

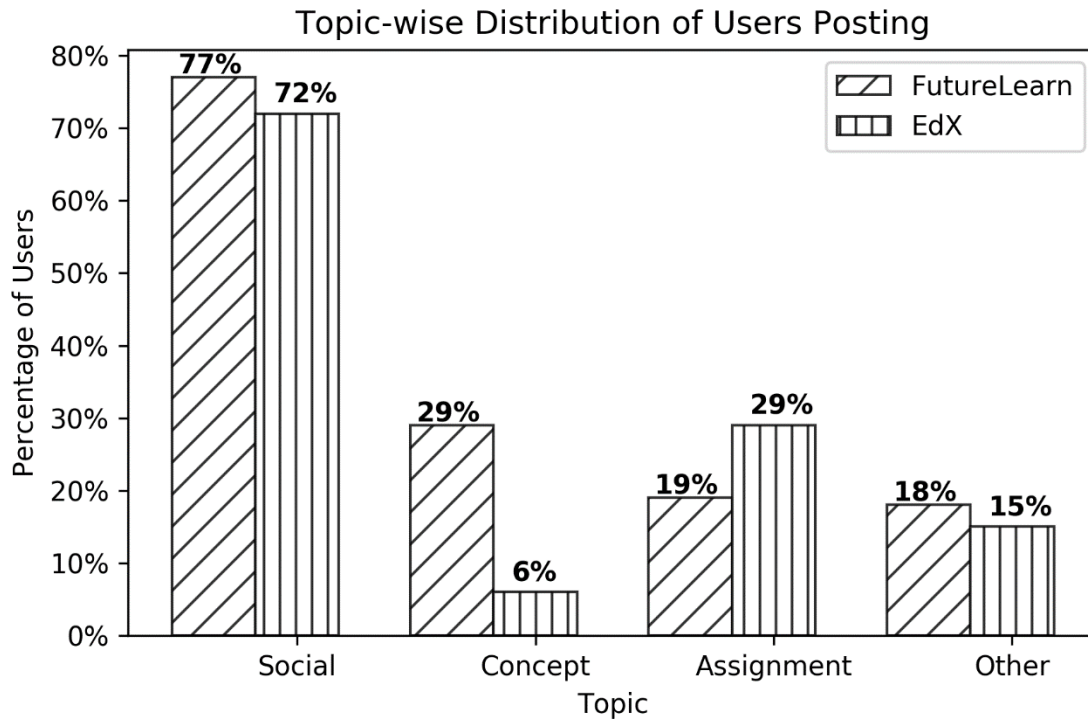


Figure 5. Percentage of learners posting in each category relative to the total number of learners posting in each course

Because of the low percentages in all other categories, we inferred that most learners limited their participation in the discussion forum to introducing themselves and making generic comments about their experience in the course. Also, there seemed to be more participation from learners in Course A across all other categories of posts compared to learners in Course B. Rather, Course B seemed to have a large percentage of learners asking questions about course assignments, while a very small number of learners were creating comment threads related to course concepts.

The analysis of response data in the discussion forums revealed that many learners in Course A were responding to “social” posts which can be seen in Figure 6. Conversely, “social” posts in Course B had the lowest percentage of participation from learners who responded to discussion threads. Upon further inspection of this discussion data, many of the responses to “social” posts were made by the instruction team. These responses were typically welcome messages to learners who were introducing themselves.

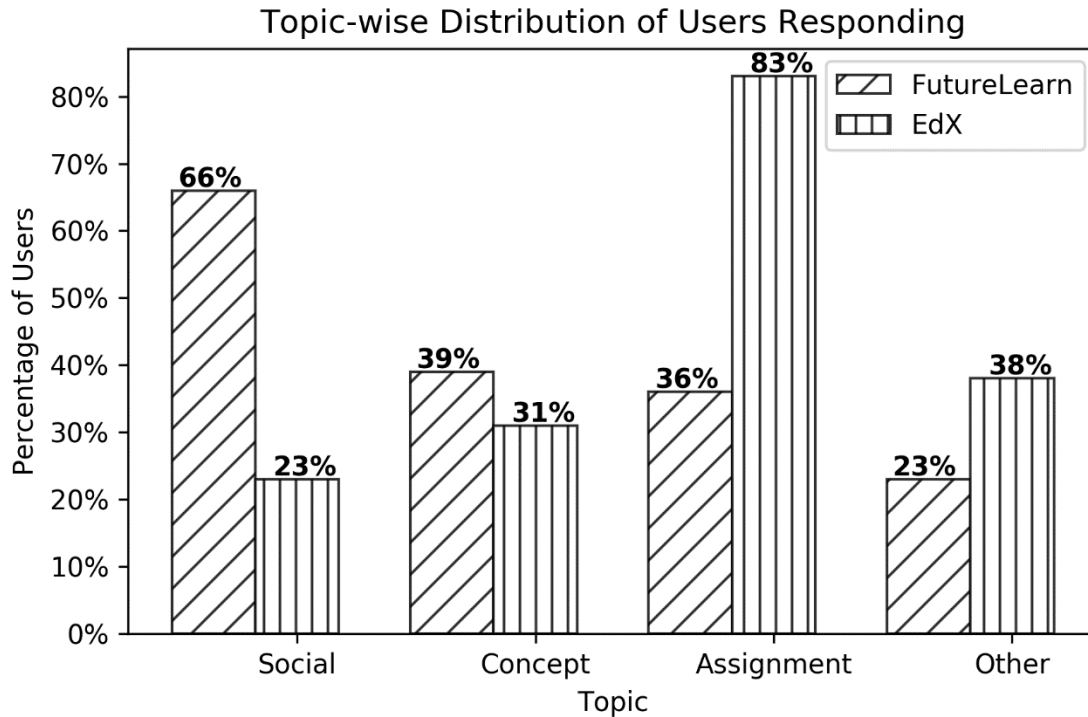


Figure 6. Percentage of learners responding in each category relative to the total number of learners responding in each course

For responses to comment threads that discussed course content, Course A had a similar number of learners responding to both “concept” and “assignment” posts despite having more learners starting discussion threads about course concepts. For Course B, a notable finding was that almost all learners who responded to discussion posts did so to “assignment” posts. Additionally, the percentage of learners responding to “concept” posts was noticeably less than the percentage responding to “assignment” posts, though comparable to Course A. Again, when interpreting these findings, it is important to be cognizant of the difference in number of learners responding in each of the MOOCs.

Overall, the results indicate that the discussion forums were used differently by the learners in each of the MOOCs. Given that Course A was offered on FutureLearn’s social learning platform, the instructor built-in frequent prompts to encourage conversation. Many of these prompts were social in nature such as “introduce yourself” and “how was your experience this week.” This approach seemed to engage a good number of learners, however most posts remained social in nature and did not lead to discussion of course content. Despite this, Course A had more participation from learners, suggesting the social learning platform pedagogy can help increase learner participation in discussion forums.

For Course B on EdX’s platform, prompts to participate in the discussion forum were rare. We found that learners in this course tended to turn to the discussion forum when they struggled with assignments. Furthermore, instructors were usually responding to these assignment posts and thread lengths were typically short. This supports Swan and Shih’s research that a high degree of instructor involvement can limit contributions from learners [19]. In comparison, Course A had

more posts about the concepts being covered. This suggests that the conversational pedagogy in the social learning platform encourages learners to participate in the discussion forum when they are struggling with the course material, rather than only using when it comes to time to complete assessments.

One of the limitations of our study is that we examined two MOOCs on the topic of computer programming thus the findings may not be applicable to MOOCs on different topics. It is also important to consider that these courses were taught by different instructors. This makes it difficult to differentiate between the effects from the MOOC platform and the effects from the instructors. However, the pedagogies employed by each of the instructors aligned well with the intended use of each of the MOOC platforms.

Conclusion

Our analysis of discussion forum data from two programming-related MOOCs offered on different MOOC platforms suggests that learners differed in their use of the discussion forums. The discussion forum for Course A, which was offered on a social learning platform and had an instructor who played a “guide on the side” role, was primarily used for social interaction and discussing course content. For Course B, which had a lecture style approach with an instructor who acted as the “sage on the stage”, discussion forums were predominantly used to ask questions about various course assessments. However, posts in both MOOCs were not able to elicit many deep conversations about the course material.

For future research, we recommend analyzing discussion forum data across additional MOOCs and across different offerings of the same MOOCs. This approach will help differentiate between how the role of the instructor and the MOOC platform impacts participation. While our study looked at the nature of participating in discussion forums through quantitative metrics, it is important to consider that the educational value of discussions may not depend on the size of the discussion thread. We suggest exploring the actual contents of discussion forum data for quality of conversation. We also recommend investigating methods of eliciting in-depth discussions about the course content covered in MOOCs.

References

- [1] D. Laurillard, *Rethinking University Teaching: A Framework for the Effective Use of Educational Technology*, London, England: Routledge, 1993.
- [2] M. A. Andresen, "Asynchronous discussion forums: success factors, outcomes, assessments, and limitations," *Journal of Educational Technology & Society*, vol. 12, no. 1, pp. 249-257, 2009.
- [3] L. Breslow, D. E. Pritchard, J. DeBoer, G. S. Stump, A. D. Ho and D. T. Seaton, "Studying learning in the worldwide classroom research into edX's first MOOC," *Research & Practice in Assessment*, vol. 8, pp. 13-25, 2013.
- [4] A. Koutropoulos, M. S. Gallagher, S. C. Abajian, I. de Waard, R. J. Hogue, N. O. Keskin and C. O. Rodriguez, "Emotive vocabulary in MOOCs: Context and participant retention," *European Journal of Open, Distance and E-Learning*, 2012.

- [5] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*, Cambridge, MA: Harvard University Press, 1978.
- [6] M. J. W. Thomas, "Learning within incoherent structures: the space of online discussion forums," *Journal of Computer Assisted Learning*, vol. 18, no. 3, pp. 351-366, 2002.
- [7] W. Abeer and B. Miri, "Students' preferences and views about learning in a MOOC," *Procedia - Social and Behavioral Sciences*, vol. 152, pp. 318-323, 2014.
- [8] J. Daniel, "Making sense of MOOCs: Musings in a maze of myth, paradox and possibility," *Journal of Interactive Media in Education*, no. 3, p. 18, 2012.
- [9] K. F. Hew and W. S. Cheung, "Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges," *Educational Research Review*, vol. 12, pp. 45-58, 2014.
- [10] O. Almatrafi and A. Johri, "Systematic review of discussion forums in massive open online courses (MOOCs)," *IEEE Transactions on Learning Technologies*, 2018.
- [11] M. Zhu, A. Sari and M. M. Lee, "A systematic review of research methods and topics of the empirical MOOC literature (2014–2016)," *The Internet and Higher Education*, vol. 37, pp. 31-39, 2018.
- [12] E. Webb, A. Jones, P. Barker and P. van Schaik, "Using e-learning dialogues in higher education," *Innovations in Education and Teaching International*, vol. 41, no. 1, pp. 93-103, 2004.
- [13] C. He, P. Ma, L. Zhou and J. Wu, "Is participating in MOOC forums important for students? A data-driven study from the perspective of the supernetwork," *Journal of Data and Information Science*, vol. 3, no. 2, pp. 62-77, 2018.
- [14] A. F. Wise and Y. Cui, "Unpacking the relationship between discussion forum participation and learning in MOOCs: Content is key," in *Proceedings of the 8th International Conference on Learning Analytics and Knowledge*, New York, NY, 2018.
- [15] V. P. Dennen and K. Wieland, "From interaction to intersubjectivity: Facilitating online group discourse processes," *Distance Education*, vol. 28, no. 3, pp. 281-297, 2007.
- [16] W. S. Cheung and K. F. Hew, "Examining students' creative and critical thinking and student to student interactions in an asynchronous online discussion environment: A singapore case study," *Asia-Pacific Cybereducation Journal*, vol. 2, no. 2, pp. 1-11, 2006.
- [17] M. Mazzolini and S. Maddison, "Sage, guide or ghost? The effect of instructor intervention on student participation in online discussion forums," *Computers & Education*, vol. 40, no. 3, pp. 237-253, 2003.
- [18] G. Salmon, *E-moderating: The Key to Online Teaching and Learning*, 3 ed., New York, NY: Routledge, 2011.
- [19] K. Swan and L. F. Shih, "On the nature and development of social presence in online course discussions," *Journal of Educational Technology & Society*, vol. 12, no. 1, pp. 249-257, 2009.
- [20] M. Jenner, "Are learners learning? (and how do we know?)," FutureLearn, [Online]. Available: <https://about.futurelearn.com/research-insights/learners-learning-know>. [Accessed 31 1 2019].
- [21] "About edX," EdX, [Online]. Available: <https://www.edx.org/about-us>. [Accessed 31 1 2019].

- [22] "Research & Pedagogy," EdX, [Online]. Available: <https://www.edx.org/about/research-pedagogy>. [Accessed 31 1 2019].
- [23] J. Saldaña, *The Coding Manual for Qualitative Researchers*, 3 ed., Los Angeles, CA: SAGE, 2016.