DanMOOC: Enhancing Content and Social Interaction in MOOCs with Synchronized Commenting

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Abstract. To enhance interactions between learners, instructors, and content for MOOC courses, this study purposes a new video lecturing interface that embeds synchronized discussions and notes anchored to the video timeline. The design concept was evaluated with 4 MOOC instructors, 8 teaching assistants, and 7 learners using a prototype. Most participants agreed that the design would enhance learner-content, learner-learner, and learner-instructor interactions, and may further improve learning performance, satisfactions, and may decrease dropout rate. However, the form of presenting discussions and possibly unrelated content may distract learners, and the design requires further improvement.

Keywords: E-learning · MOOC · Online video interface · Synchronized commenting

1 Introduction

Massive open online courses (MOOCs) developed fast and became popular in the past few years. The features of MOOCs, such as openness, diversity, autonomy, interactivity and connectedness attracts people to join in [1]. However, very few learners can keep on learning and complete a course. One of the reasons is the insufficient interactions in MOOCs among learners, between learners and instructors, and between learners and content.

Researchers have revealed the importance of these interactions in a successful learning process. Higher learner-instructor interaction during class [2], more participation in forum discussion [3, 4], and more cooperation among learners [5] have been found leading to better learning performance. Discussions among learners and instructors increase course completion rate [6, 7]. Learning activities through social network services also improve learning performance, satisfaction and motivation level [8]. Higher interaction level is related to higher learners' satisfaction to the course and the MOOC system [9, 10].

However, these interactions in MOOCs are still unsatisfying. On the one hand, according to a survey study of MOOCs [7], learners complained about the chaos of discussion forum, the lack of interaction with instructors, and the lack of help. On the other hand, although instructors wanted to interact with learners as much as possible,

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the large scale of MOOC participants makes it impossible to communicate as much as in the face-to-face classes. Compared with face-to-face courses in school, the class in MOOCs is lack of students' responses and feedback to instructors, and discussions among students [11]. This lack of interactions also leads to a lower sense of belonging to a class and less satisfying learning experiences, which may further lead to high dropout rates. To improve the interactions between learners, instructors, and content for MOOC courses, this study purposes a new video lecturing interface that embeds synchronized discussions and notes anchored to the video timeline. The design concept was evaluated with 4 MOOC instructors, 8 teaching assistants, and 7 learners using a prototype.

2 Related Work of Designs for Lecture Videos in MOOCs

To enhance interaction of MOOCs, researchers designed innovative video interaction techniques for lecture videos. For example, Kim et al. designed LectureSpace [12], a video system with an interactive timeline based on edX. A 2D rollercoaster timeline shows the amount of navigation activities, such as pause, resume, or jump, and the peaks of the amount are marked. When the cursor is around peaks, the friction to move the cursor increases. The interview for usability evaluation showed that by using this system, learners perceived higher level of interaction with video content and other learners than that when using the original edX platform.

To stimulate during class discussions, Yousef et al. designed L2P-bMOOC [13] for blended MOOC, a lecture video system in which learners can make annotations such as suggestions and questions on the timeline. These annotations are public to all other learners and learners can comment or like annotations. The annotations can enhance interaction in the blended MOOCs, in which a relatively small scale of learners take part. In xMOOCs or cMOOCs with thousands of learners, the enormous annotations are hard to directly present on the video timeline.

Another approach to present during viewing discussion is to overlay comments anchored to the video timeline in the form of moving subtitles on the video screen, which is called Danmaku commenting. Comments from previous viewers at specific time points of a video are presented to all the other viewers who watch the same video latter. Danmaku commenting originated in Niconico Douga, which is one of the most popular video sites in Japan. It is now popular in China and most video sites in China (such as Bilibili, Tudou, and Youku) support Danmaku commenting. Danmaku commenting can satisfy viewers' needs for video-related information and facilitate information seeking activities [14]. By applying Danmaku commenting in MOOCs, learners can see discussions about particular sections of the video as soon as they see the video contents. Therefore, Danmaku commenting may improve interaction in MOOCs.

Lee et al. studied the effect from Danmaku commenting on the experience of learning MOOC lecture videos [15]. They conducted laboratorial experiments and found that Danmaku commenting can increase learner's perceived engagement and engage them into the discussions. Compared with the static list of comments, these dynamicallyflying comments increase perceived social interaction. Comments about

the lecture content increase learning outcomes, meanwhile comments for social interaction do not decrease learning outcomes.

However, these comments are short and cannot be replied, therefore cannot support deeper during class discussions. To improve interaction and performance of MOOC lecture learning, we try to adopt features of Danmaku commenting and design DanMOOC, a video lecture interface to enhance both content-learnerand social interaction in MOOCs.

3 User Needs Gathering

We investigated the current situation of interaction in MOOCs from both literatures and interviews with five participants. They were two students, two teaching assistants, and an engineer in XuetangX (one of the most popular MOOC platforms in China), aged from 22 to 30. Their experience with MOOCs ranged from 6 months to 2 years. Their experience with Danmaku commenting ranged from 6 months to 7 years. We interviewed them about the interaction among learners, instructors, and content under different situations (i.e., face-to-face classes or MOOCs). The two students were asked why they joined in MOOCs. The five participants were also asked their opinions about applying Danmaku commenting in the MOOC videos.

Both literatures and results of interviews suggested various motivations to join in MOOCs. Learners with different motivations to join in MOOCs have different needs for interaction. Some of the MOOC learners want the certification and they may treat MOOCs as important as offline courses and learn MOOCs according to the time table. These learners may need more interaction during lecture learning and timely helps like in the face-to-face class. Some learners want to make friends or learning with others by MOOCs. They need interaction with other learners and collaborative learning. Some learners take MOOCs to complement their offline learning, and treat MOOCs as supplementary resources or learning materials. They do not care about whether complete the whole course. For these learners, the system is required to provide the most relevant knowledge and effective and efficient ways of information retrieval. Some learners browse MOOC videos for entertainment and satisfying the curiosity. For example, they may view MOOC lecture videos about art or history during eating the breakfast, and may not want to complete any assignment. To attract these learners and increase retention rate, the course and system need to be lively and entertaining.

Participants said Danmaku commenting had the potential to improve interaction, but some of them worried that the Danmaku commenting distracted learning. If too many comments overlays on the screen, these comments may distract viewers and bring visual clutter, increase cognitive load, and further reduce learning performance. In videos for learning, this problem is more severe than that in the most online videos for entertainment. In addition, one of the two students suggested that some of the Danmaku comments may supplement the current content in the lecture video, and he had the need to clip these comments to his notes or take notes anchored on the video timeline.

To satisfy these needs, we aim to design an interface with the following goals:

1. Enhance interaction, i.e., facilitate discussion specific to video content, and enhance the sense of learning with the accompany of a class
2. Facilitate discussion for different learning needs or motivations
3. Reduce visual clutter and cognitive load caused by discussion
4. Enhance the connection of notes and video content.

4 DanMOOC: MOOC Videos with Synchronized Commenting

To achieve these goals, we proposed an interface of MOOC lecture videos called DanMOOC. We introduce three interaction features: (1) comments and threads on timeline, (2) filter of comments and threads, and (3) notes anchored to the timeline.

4.1 Comments and Threads on Timeline

We adopt Danmaku commenting, i.e., the commenting technique that overlays comments synchronized with the video timeline in the form of moving subtitles on the video screen. In our design, both comments and threads are overlaid on the screen and scrolling on the right sidebar list synchronized with the video timeline (see Figs. 1, 2, and 3). Comments enhance co-viewing experience and the sense of learning with the accompany of other learners (goal 1). Threads connect long and deep discussions with video content (goal 1). To avoid visual clutter (goal 3), the title of each thread is shown in the Danmaku commenting and sidebar list. To see detailed content and following comments of a thread, viewers need to click it and skip to the area D in the Fig. 1, which shows both threads to the whole video and the threads anchored to the timeline. Users can expand a thread to see detailed content and the replies of it. Unlike the anonymous Danmaku commenting in the most video sites such as Bilibili and Niconico Douga, in this design the author's social information, such as the username, avatar, the type of the user (e.g., teacher, TA, or active user), is shown in the sidebar list (goal 1).

4.2 Filter of Comments and Threads

To avoid visual clutter and reduce distraction, viewers can choose to see only a part of the comments and threads by types (comments/threads) in the setting panel in the sidebar (goal 2 and 3, see Fig. 3). They can also choose to only see the comments and threads from active learners or reviewed by the instructor. Viewers can set the maximum amount of comments and threads on the screen at one time point, and then system will only show comments and threads with high quality or priority, which is calculated by, e.g., the number of likes and comments and whether reviewed and accepted by instructors (goal 3). Viewers can also adjust the transparency of comments on the video or hide all comments and threads (goal 3).

Fig. 1. Overview of DanMOOC. (A) The video with flying overlaid comments and titles of threads. (B) The sidebar that shows all comments and titles of threads. (C) The area for sending comments and threads. (D) The area for both threads to the whole video and the threads anchored to the timeline. Users can expand a thread to see detailed content and the replies of it.

4.3 Notes Anchored to the Timeline

Learners can take notes anchored to the video timeline when learning the video (goal 4). His/her notes are shown in the order of the video playback time in the sidebar, in a

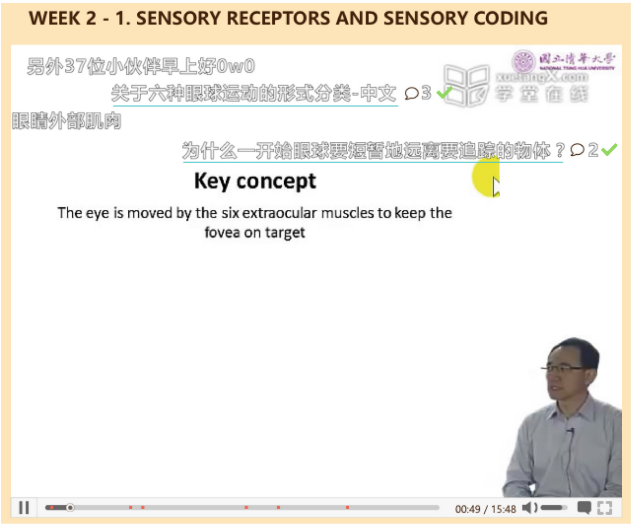

Fig. 2. The flying overlaid comments and threads on the video area

Fig. 3. The list of comments and threads in the sidebar

form of vertical timeline (see Fig. 4). At each note point, both screenshot and learner's notes are listed. In addition, each note point is marked as red points in the video timeline.

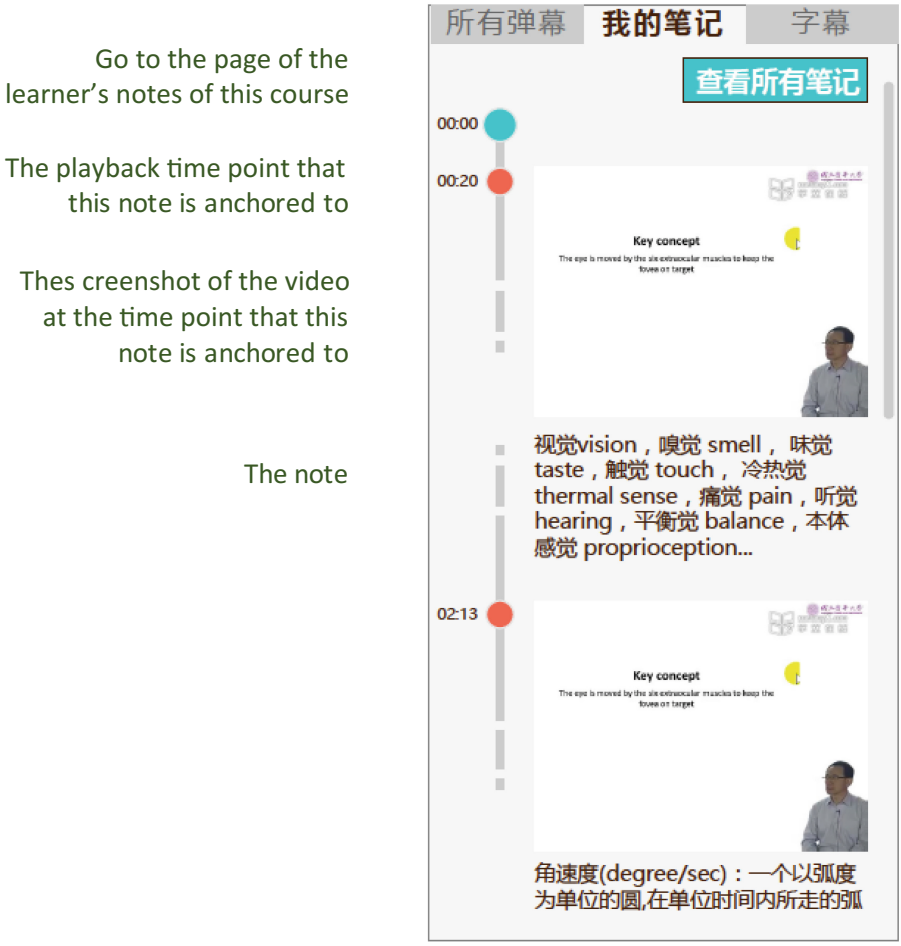

Fig. 4. Notes of the video in the sidebar

5 Evaluation

5.1 Method

We made a static prototype (see Fig. 1) based on the lecture interface of XuetangX, which is one of the most popular MOOC platforms in China. We illustrated the interface in the following scenarios: (1) when the user enters the interface, (2) when the user posts a comment or thread, or takes a note, (3) when the user modifies the filter settings, (4) when the user goes see the detailed content of a thread, and (5) when the user switches the sidebar tabs to see his/her notes. To initially evaluate the design, explore how it can enhance interaction, and improve the design, we interviewed 4 teachers, 8 teaching assistants, and 7 learners.

Participants. The teachers and TAs were invited through XuetangX. We tried to interview instructors from diverse subjects. The 4 teachers from Tsinghua University taught Introduction to modern biology, C++ programming, Principle of Marxism, and Medical parasitology respectively in XuetangX. The 8 teaching assistants from Tsinghua University worked for the following courses in XuetangX: Financial analysis, C++ programming, Principle of circuits, Linear algebra, Great art, Zi Zhi Tong Jian (History as a Mirror). This is medical science, and Listening and speaking of daily English. The 7 learners were recruited from a WeChat group of active users of XuetangX and the researchers' personal social networks. Their age ranged from 18 to 28 ($M = 21.6$, $SD = 3.3$). Most of them were students (from high school students to graduated students) except one who worked in a HR department. They had been learning MOOCs for from 2 months to 4 years. All of them had the experience of learning MOOCs on XuetangX.

Procedure. All participants were interviewed in the quiet environments. Six of the seven students were interviewed by QQ (a video chatting tool). Other participants were interviewed face to face. First, we gathered the participant's demographic information and MOOC experience. Then we introduced our purpose, showed the prototype of DanMOOC, and introduced the features. Then we interviewed him/her about (1) how DanMOOC may affect the interaction and learning performance, (2) how the flying overlaid comments may distract the learning, and (3) the effectiveness of notes. We also interviewed learners about their opinions of design details (e.g., how to present expanded content and replies of a thread). Each of the semi-structured interviews lasted about 30 min. All interviews were audio-recorded and transcribed into text for further analysis.

5.2 Results

Most participants were satisfied with the system and they reported the score of satisfaction from 5 to 6 (maximum 7). Five of the seven students would like to try this system.

Interaction of Commenting System. Most participants agreed that the connection of discussion and content at different video time points may enhance learner-content interaction, promote understanding, and increase learning efficiency. First, the connection may stimulate discussion. Two TAs said that students may miss many instant thoughts, questions or comments if they discuss after finishing viewing the lecture video. A teacher said the synchronized overlaid comments may create an atmosphere of discussion and attract more learners to join in. Second, the connection may make it convenient to discuss or ask questions about content at certain time points in the lecture video. TAs said this feature may reduce their work load of searching students' questions in the lecture video. Interviewed learners said that these comments and threads provided helps and summaries of questions immediately when they learnt the concept, and therefore the repeatedly asked questions would be reduced. Third, the connection may enrich the lecture content. As TAs said, this synchronized commenting system may provide an entrance from the video to user generated content, expand the lecture content, and promote collaborative learning.

The commenting system may enhance learner-learner interaction. TAs said students may get to know others' feelings, such as perceived difficulty. Some learners said they could share inspirations with others and the sense of accompany could be enhanced. They could even make new friends and further develop a sense of belonging to the class. Teachers said the overlaid flying comments can create a lively atmosphere similar to the face-to-face class. For example, the teacher of Medical parasitology said the learners would not be scared of the parasites with the company of comments. These merits may increase the completion rate. However, the TA of Linear algebra said that few learners needed to discuss in the Math class and it was hard to type formula immediately during class. Therefore, he thought it was hard to enhance learner-learner interaction.

The commenting system may enhance learner-instructor interaction. Teachers and TAs said that by the amount of comments and threads, they may figure out which parts of the video attracted or confused learners. The system could also help learners correct the mistakes of videos, and make it easier to ask or answer questions located in specific time points. Although the commenting system may provide an approach of learner-instructor communication, the major of participants said that instructors needed effective and efficient ways to learn students' feedbacks from a potentially large scale of comments and threads. Useful information required to be abstracted and presented in a clear form.

Although the commenting system may enhance interaction, a few participants said that the interaction brought more harms than benefits. Some learners worried that the during class discussion would distract them from focusing on the video content. One teacher and one student said that although the connection of video content and discussion was helpful, the overlaid flying comments were distracting and they preferred other forms such as the list in sidebar. Some participants said the enhanced student-student interaction may increase useless information and therefore decrease the learning efficiency.

Distractions. Most participants said too many comments overlaid on the screen would distract learning, therefore they appreciated the functions of filter, transparency setting, and hiding.

However, they still concerned about the quality of comments and the visual clutter. First, the commenting system may increase discussions both related and unrelated to the course. Most participants said content-related comments could benefit learning, but they had different opinions about other comments, such as comments for social interaction. Some of them said social comments could attract learners and create an active atmosphere, whereas others said social comments may provide useless and chaotic information for learning. Second, learners of MOOCs usually have different levels of knowledge and skills. Some interviewed learners worried that they were forced to see comments and threads that may be too easy or boring to them, even if the comments were related to the content. Third, in addition to the individual learning habits and knowledge levels, the form of the video also influenced the perceived distraction. Most students and TAs said if there were slides with dense texts in the video, the overlaid comments would be more distractive than that when a teacher was present and speaking in the video.

Notes. Only one of the seven learners used Evernote when learning MOOCs. Other learners took notes on paper notebooks when learning MOOCs. Therefore, although most participants said the notes may be convenient, they may not want to use it. The teacher of Medical parasitology also said paper was more suitable for notes of Medical parasitology. The Evernote user in the seven learners and some teachers and TAs said learners may try to take notes in DanMOOC system if they could export their notes organized in a clear layout from the DanMOOC system, for reviewing after class.

Teachers and TAs said that notes may reflect learners' learning process. For example, playback time points with many notes may indicate that the content there was difficult to many learners. Teachers could find out unexpected difficult points of the lecture and adjust his/her teaching.

Design Details. In the prototype, the detailed content and following replies of each thread were shown in the area D in Fig. 1. Most participants said that this skip from the view of video to the bottom of the page would interrupt the learning ofthe lecture. In

Fig. 5. Detailed content and replies of a thread is showed on the sidebar in the improved design

addition, in the most current MOOCs, forum is independent from the lecture videos. Few courses provided the function of discussing a specific video. Therefore, we removed the area for threads to the whole video, and presented the detailed content and following repliesof threads anchored to the timeline directly in the sidebar (see Fig. 5).

6 Discussion and Conclusion

To enhance interaction in MOOCs, this study purposes DanMOOC, a video lecture interface for lectures of MOOCs that shows synchronized discussions and notes anchored to the video timeline. The design was evaluated by interviews of 4 teachers, 8 teaching assistants, and 7 learners of MOOCs.

On the one hand, most participants agreed that the design would enhance learner-content, learner-learner, and learner-instructor interactions. The connection of discussion and lecture content can stimulate thinking and collaborative learning, facilitate Q&A between learners and instructors, help learners to develop a sense of accompany, and create a lively atmosphere that attract learners. These merits may further improve learning performance and decrease dropout rates.

On the other hand, the form of overlaid flying comments and the unrelated content may distract learners. Previous research suggests that some unrelated comments (e.g., for social interactions) anchored to the video timeline do not decrease learning outcomes [15]. However, in our study, some participants concerned that, if they are forced to see all discussions, unrelated comments and discussions that are too easy for them may distract their learning and reduce learning efficiency. Therefore, future research may focus on how to present adaptive and personalized comments and threads on the video for different learners.

This study has the following limitations. First, we only designed the interface for learners. Instructors require information such as which parts of the lecture triggers a large number of comments and threads and what are the most asked questions. The current interface cannot provide this information. Future research may investigate the needs of instructors and designed interface for instructors. Second, the interviews were based on pictorial prototypes and descriptions of the researchers. The prototype may be less clear to present the interactive features and discuss the impacts than a real system. Future research may develop an operable system, and conduct experiments to evaluate the real interaction, learning performance, and satisfactions of learners when they are learning MOOCs from this system.

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