Understanding Danmaku's Potential in Online Video Learning

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Abstract
Danmaku is a video comment feature which is used to overlay comments onto videos of many types and is gaining popularity in China. In this paper, we explore Danmaku's potential in online video learning. We present our survey results of 213 Chinese online users regarding their usage of danmaku. We also propose a new design in which danmaku is modified and leveraged to better facilitate user engagement and interaction in an online learning environment. Our results show that participants perceived both designs to have many benefits in terms of social presence and cognitive presence. Most of the participants post danmaku themselves instead of simply watching others' danmaku. In addition, about 40% of the participants who did not prefer the original design showed more positive feedback in the new design.

ACM Classification Keywords
H.5.2. [Information Interfaces and Presentation (e.g. HCI)]: User Interfaces.

Author Keywords
Danmaku; online video learning; social presence; community of inquiry; interface design; video comments.

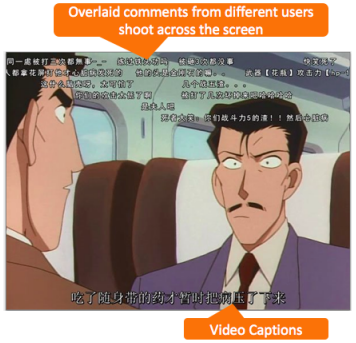

Figure 1: A sample screenshot of a video with danmaku.

Introduction

Danmaku, a video comment feature, has been gaining popularity in Asia recently, especially since it has been adopted by many major Chinese websites (e.g. Bilibili.com) starting in 2007. Unlike traditional video sites where comment fields simply appear below the video, on a danmaku site users are able to comment directly on the video timeline so that their comment appears at that exact point in the video, scrolling from right to left until it disappears from the screen [6], as illustrated by Figure 1.

The comment feature was introduced on Niconico, a Japanese video-sharing website created by Hiroyuki Nishimura [1, 9] in 2006. As a result of the way overlaid comments shoot across the screen, danmaku is named after Japanese danmu shooter games, visually mimicking the torrent of bullets in the games. Therefore, in English, danmaku is also known as “bullet screen”.

After its initial success with with anime, manga, and game fandom sites, it has since expanded to include sites with a wide variety of content, from news to arts and entertainment; these include live-broadcast sites, user-generated videos, and online streaming services [6]. Further, danmaku has begun to enter the mainstream via cinema (e.g., moviegoers texting comments to display on movie theater screens), advertising (e.g., ads by Coca-Cola water brand Ice Dew Chun Yue), and social media; these have all begun to experiment with danmaku to capture the attention of the lucrative teen- and twenty-something demographic [2].

However, danmaku has not yet been widely adopted in online learning environments, e.g., MOOCs (Massive Open Online Courses). While this new phenomenon has drawn researchers’ attention, existing findings suggest that there could be great potential for applying danmaku in online learning sites, such as Coursera [3] and Stanford Online [4]. First, researchers found that users post danmaku comments for four main reasons, which include: self expression, company (i.e., for a co-viewing experience), entertainment, and information (to provide it or seek it) [6]. These could all be motivations for students to better engage in online learning sites using videos. Second, the commenting feature can be used with both asynchronous and synchronous content, i.e., videos that are posted at one point in time on which people can then later comment, and live broadcasts with which people can engage in real time. With danmaku, even asynchronous experiences can feel like synchronous ones [9, 6]. This is especially helpful for online learning, because the simulated social presence might make students feel less lonely when studying, further encouraging them to complete the learning tasks. Third, it is suggested that the social elements of danmaku will become part of the content itself [10]. Danmaku may allow students to co-create learning content with the instructors by adding comments that are helpful explaining the learning materials. This idea of augmented, enhanced content can be compared with what some see as a disadvantage of danmaku, i.e., that it interferes with and even detracts from the original content of the video [7].

Indeed, the word “danmaku” itself translates more literally into English as “curtain fire” or “barrage,” indicating at the effect it may have on one’s viewing experience [6]. Therefore, before applying danmaku in an online learning environment, in this paper, we focus on addressing the following questions: what is the current adoption and usage of the original danmaku in general? What are the major concerns or benefits of using danmaku or contributing to danmaku? Will people accept danmaku in online learning environments? If so, who and why?

Our research makes three main contributions. First, we gain a better understanding of Chinese online users' usage of danmaku, as well as why people use or do not use danmaku. These findings will help us revise the design of danmaku for online video learning sites. Second, we find that participants who did not support the original danmaku format turned into advocates for the new design for online learning. Third, by using the community of inquiry model (CoI) [12] to evaluate participants' perceived social presence (*"the degree to which learners feel socially and emotionally connected with others in an online environment"* [12]) and cognitive presence (*"the extent to which users are able to construct and confirm meaning through sustained reflection and discourse"* [12]) of danmaku and the new design, we identify key features that could promote the success of danmaku in online video learning.

Table 1: Age Distribution

Age	Percentage
18-25	21.5%
26-45	69.5%

Table 2: Online Experience

Total Years	Percentage
>=5	63%
3-5	27%
<=3	10%

Table 3: Video Watching

Hours/Week	Percentage
>=10	30%
5-10	26.5%
<=5	43.5%

Study Design

We conducted an online survey in April 2016. To understand their current adoption and usage of the original danmaku in general, we asked participants several questions. For example, *"how long have you used danmaku?", "When do you turn off danmaku?" "how often do you send danmaku?"*, etc.

To understand their concerns and perceived benefits of using danmaku, we first asked the participants to provide feedback in a free-form format, then we measured their social presence and cognitive presence of using danmaku by asking them to answer a set of questions in a 5-point Likert scale. These questions were adopted from the Community of Inquiry (CoI) framework [12], which presents a process model of online learning [11]. The list of questions were presented in Figure 3.

After understanding their usage and perception of the original danmaku design, we presented and explained our new design which applies danmaku in an online video learning environment. To make a parallel comparison between the original danmaku design and the proposed new design for online learning, we asked the participants to answer the same set of questions regarding social presence and cognitive presence. We also asked participants to provide us feedback regarding the design in an open-ended question format. By comparing their scores and qualitative input, we are able to identify key factors that may influence participants' adoption of the new design.

We recruited participants through Zhu Ba Jie (http://www.zbj.com), a Chinese platform similar to Mturk. All respondents were from China and reported to be older than the age of 18. We received 213 valid responses. Each valid response was compensated for 5 RMB ($0.8). This research was approved by the Syracuse University IRB office.

Of all valid responses, 200 reported their demographic information. Among them, 45% are female and 90.5% received bachelor degrees. The rest demographic infomration are shown in Table 1 - 3.

Findings

We now present our major findings from two perspectives: (1) usage of the original danmaku comments and (2) perceived value of the revised danmaku design for online learning.

Regarding the Original Danmaku Design

Watching Danmaku - When participants were asked how much they relied on danmaku comments, depending on their response, they could be grouped into three categories: (1) *turn-on*: 125 (61%) participants chose to keep danmaku

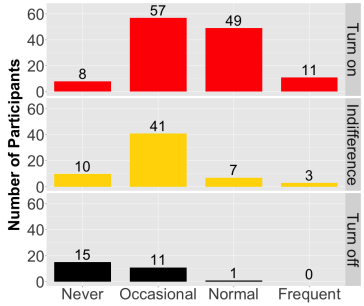

Figure 2: The x-axis stands for the frequency at which participants post danmaku. The y-axis stands for the number of participants, and they are organized in three groups based on their danmaku watching behavior ("Turn on": those who are highly dependent on danmaku comments; "Indifferent": those who are not really affected whether danmaku is on or off; and "Turn off": those who would turn off danmaku any time when watching videos).

turned on most of the time; (2) *indifferent*: 61 (30.5%) participants stated that having danmaku on did not affect their watching experience; and (3) *turn-off*: the remaining 27 (13.5%) participants chose to turn off danmaku most of the time. Interestingly, 64 out of the 125 *turn-on* participants would watch videos particularly because they wanted to watch the danmaku comments of those videos.

Posting Danmaku - When participants were asked how frequently they posted comments themselves, we gave them four choices, i.e., "Never" (had not posted any danmaku yet); "Occasional" (posting less than 2 danmaku comments every 5 videos); "Normal" (posting less than 10 danmaku comments every 5 videos); and "Frequent" (posting more than 2 danmaku comments per video). Figure 2 shows the number of participants who posted danmaku comments with different frequencies. The results are also presented in the above three user categories based on their watching behavior (i.e.,*turn-on*, *indifferent* and *turn-off*.

We conducted a chi-square test of independence to examine the relationship between watching behavior (three participant groups) and sending behavior (four sending frequencies). The test results showed that there was an interaction ($X2 = 57.617, p < .05$). Participants' frequencies of posting danmaku comments shift along with their dependency on danmaku when watching videos.

In brief, participants who watched more videos for danmaku posted danmaku comments more frequently. In particular, for the *turn-on* participants, 49% (57) of them posted danmaku at a normal or frequent rate, and 44% (49) posted danmaku occasionally. For the *indifferent* participants, 67% (41) of them posted danmaku occasionally, comprising the largest percentage of the participants. For *turn-off* participants, there were more users who never posted danmaku (15 participants) than those who posted danmaku occasionally (11).

A somewhat surprising result was that only 8 (7%) *turn-on* participants and 10 (16%) *indifferent* participants never posted danmaku, as we would expect more participants would be "free-riders" (who only viewed danmaku comment without sending any) than "contributors" (who sent danmaku) [5]. Additionally, even though the *turn-off* participants seemed not to like danmaku, 11 (41%) participants still posted danmaku occasionally. We reviewed the motivations of why these participants posted danmaku: 5 participants posted danmaku to comment on others'; 6 participants posted for fun; 7 participants posted to share their perspectives and seek other people who agree; and 3 participants posted to help and influence others.

Perceived Benefits and Drawbacks - Our participants reported several benefits of danmaku: 71% indicated that danmaku could make the video more fun; 70% thought that danmaku provided more information; 71% suggested that danmaku could engage the audience; and 82% also believed that danmaku encouraged audiences to share their feelings and opinions about the videos.

When asked why or when they would turn off danmaku, they reported the following drawbacks of danmaku: 85% of the participants pointed out that there were too many danmaku comments, and their watching experience was affected; 60% of the participants mentioned that there were too many critiques and too much insulting language in danmaku comments; 43% of the participants suggested that the content of danmaku comments was vulgar; and 36% of our participants suggested that they did not want danmaku to influence their understanding of the videos.

Category	Questions	Original Danmaku	Online Learning	P-value
Social Presence	Sending danmaku gave me a sense of belonging in the audience group	3.46	3.68	*
	I was able to form distinct impressions of some other participants	3.67	3.96	**
	Online or web-based communication is an excellent medium for social interaction	3.79	3.87	ns
	Danmaku could improve audience partcipation	3.89	4.06	*
	Danmaku could increase interaction satisfaction	3.67	3.94	**
	Damkaku could improve audiences' sense of presence	3.43	3.77	**
	Danmaku helped me to develop a sense of collaboration	3.35	3.63	**
Cognitive Presence	Danmaku increased my interest in video content	3.49	3.65	ns
	I felt motivated to explore video related questions	3.56	3.79	*
	Brainstorming and finding relevant information helped me resolve content related questions	3.89	3.9	ns
	Reflection on video content and discussions helped me understand fundamental concepts in this video Danmaku helped me construct explanations/solutions	3.84	3.94	ns
	Danmaku helped me construct explanations/solutions	3.88	3.84	ns
	I can describe ways to test and apply the knowledge created in this video	3.42	3.74	***

Figure 3: Comparing perceived social presence and cognitive presence of original danmaku design to that of our new design for online learning. All questions are adopted from Communities of Inquiry model proposed in [12]. We changed the system name to danmaku. All questions are in a 5-point Likert scale. We used * ($p<.05$), ** ($p<.01$), *** ($p<.001$) and ns ($p>.05$) to indicate the significance of the t-test result.

When we measured the perceived social presence and cognitive presence of the original danmaku (as shown in Figure 3), the highlighted benefits (with the highest rate in the 3rd column) were "danmaku could improve audience participation" in terms of social presence, and "brainstorming and finding relevant information helped me resolve content related questions" regarding cognitive presence.

Danmaku in Online Learning Environments

New Design - In order to maintain the social presence by presenting "real-time comments" without overloading the screen with comments, we created a new design to our participants in which we incorporated real-time comments into traditional online learning interfaces. As illustrated by Figure 4, in our design, users are able to make comments at a specific timestamp in the video, and others who watch the video later will see the comments at that time. This is the same comment feature as danmaku. However, in our design, comments are not overlapped with the video itself; instead, our design proposed a new area below the video where all the comments will shows up as the video plays. Our system provides a semi-synchronous viewing experience to users.

Comparing Social Presence and Cognitive Presence - Figure 3 compared the scores of the two designs. There was either a significant increase or the scores remained the same. More specifically, we investigated the scores of those *turn-off* and *indifferent* participants. Those who were initially negative about danmaku increased their ratings when applying danmaku in an online learning environment. Specifically, ratings to all questions in social presence showed significant increases in the mean scores. In cognitive presence, regarding the responses "I felt motivated to explore video related questions" and "I can

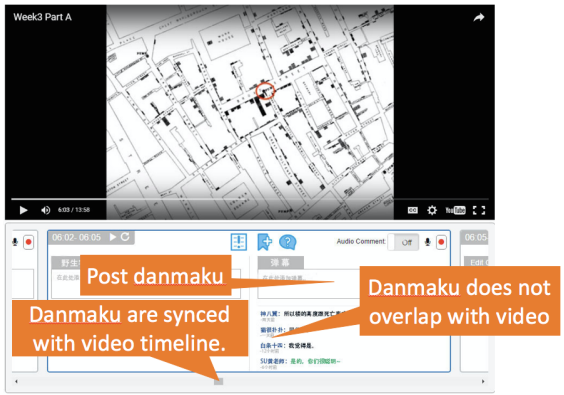

Figure 4: A proposed design that adopts danmaku's real-time commenting features for online learning. The original screenshot was in Chinese, and we translated to English in this paper.

describe ways to test and apply the knowledge created in this video", the ratings also significantly increased. In addition, participants made several suggestions to improve the design. For example, one participant noted, *"Danmaku in this setting should be limited to course-related content. There should be some kind of filter in place."*

Discussion and Future Work

In this paper, we present the ways in which danmaku video comments are currently perceived and an idea towards the ways in which they can be used to great benefit in a new design, modified for online learning environments. Our results show that participants largely seek and enjoy the benefits of danmaku, including sharing and receiving new information about a video, and in general sharing the experience of watching an online video. Through our qualitative study, we learned more about the reasons why some participants do not perceive and glean these benefits, and it is suggested to provide content monitoring of the comments and allow users to filter certain types of comments.

It is also surprising to find that only 33 participants (15%) never posted danmaku before. Because our participants are all Chinese online users though with different levels of online experience, it is possible cultural background impacts the results. In our future work, we plan to find participants in other countries and re-evaluate the findings.

Additionally, two more insights need further exploration. First, about 40% of the *turn-off* and *indifferent* participants showed positive feedback regarding the new design in online learning. Considering that danmaku is not yet widely adopted in other countries (e.g. the U.S.), we may investigate whether variations of the original danmaku design could be applied successfully more broadly. Second, in our proposed new design, the comments are added with timestamps, thus they could essentially be viewed as deep links [13], which could allow users to quickly access video content in a non-linear fashion, instead of watching or scrolling through the whole video from the beginning to the end. We plan to deploy the new design using our existing system prototype [8] and investigate when people add different "deep links" (danmaku comments) in our future work.

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