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Video-related Pedagogical Strategies in Massive Open Online Courses: A Systematic Literature Review

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***Abstract**: For engineers who work with rapidly changing technology in multi-disciplinary teams, massive open online courses (MOOCs) offer the unique ability to deliver free, convenient professional development by providing up-to-date information spanning a wide range of disciplines. However, the MOOC boom has not been without its criticisms; many question the effectiveness of MOOCs. In response, many research studies are being conducted across the world to explore the effectiveness of various pedagogical approaches in MOOCs for different stakeholders. As videos constitute one of the most prominent features of MOOCs, it is important to analyse the empirical evidence of best practices for MOOC videos. Through a systematic literature review, we identify a series of important considerations and actions for three groups: instructional teams, video production teams, and platform developers. Considerations include instructor actions, content design and navigation, video style and length, production quality, video annotation tools, viewing options, and embedded assessments.*

Context and Research Questions

The rise of online technologies for delivering educational opportunities in recent years has led to open access to educational resources via massive open online courses (MOOCs). The growing popularity of MOOCs is evident in the number of courses and breadth of subject areas offered, and the number of learners and higher education institutions participating across the globe. Surveys tracking online learning showed that the percentage of higher education institutions offering MOOCs nearly doubled between 2012 and 2013 with nearly twice as many additional institutions actively planning to offer MOOCs in the near future (Allen & Seaman, 2014).

In engineering education, MOOCs offer a particularly promising solution for educators coping with the challenges of the rapid development of new academic fields (Rauf, Daud, & Said, 2016). Even as total knowledge grows at an exponential rate, the amount of instructional time for engineering educators to prepare future engineers remains static. As such, dynamic outlets providing relevant, up-to-date information are necessary for engineers to effectively supplement their education and professional development. MOOCs have the potential to do just that—they can be updated from one run of the course to the next within weeks, making them a potentially superior source of cutting edge engineering-related information compared to traditional textbooks, which suffer from long publication and revision timelines. Further, engineering students and professionals have the ability to select the exact courses or units that cover the specific content they require without being bogged down with other course obligations. The usefulness of MOOCs for engineers is easily highlighted by the large number of engineering courses offered on platforms like edX (https://www.edx.org/course) and Coursera (https://www.coursera.org/courses), each of which had approximately 200 courses categorized as relevant to engineering as of March 1, 2017.

Whether the content of a MOOC is engineering or another subject, MOOCs enable the use of unique instructional strategies, including innovative forms of assessment and socialized learning through discussion forums that connect perspectives of diverse learners across the planet. Capitalizing on this potential, over one-third of the institutions with current or planned MOOCs stated intent to “experiment with innovative pedagogy” and/or “provide more flexible

learning opportunities" (Allen & Seaman, 2014, p. 29). While some of these pedagogical strategies vary from platform to platform or course to course, one of the most critical components of nearly every MOOC is the instructional video. Videos excel at promoting acquisition of basic facts and stimulating higher-order thinking while being grounded in more familiar contexts (Bonk, 2008). This strategy of anchoring to previous knowledge and understanding has been shown to improve the meaningfulness of new information (Ausubel, 1978). Further, the on-demand nature of pre-recorded videos, with their ability to be rewound, sped up, slowed down, re-watched, or paused as the learner sees fit, frees learners to personalize their learning experience.

The digital format and massive audiences participating in MOOCs generate enormous quantities of data, contributing to a remarkable increase in MOOC-based research. While MOOC researchers tend to be educationally oriented (Gasevic, Kovanovic, Joksimović, & Siemens, 2014), publications are distributed across a diverse array of journals and conference proceedings (Veletsianos & Shepherdson, 2016). Thus, MOOC stakeholders would benefit from a systematic analysis and synthesis of the literature. A number of studies have synthesized focuses and methodologies of MOOC research (Liyanagunawardena, Adams, & Williams, 2013; Raffaghelli, Cucchiara, & Persico, 2015; Sa'don, Alias, & Ohshima, 2014; Veletsianos & Shepherdson, 2016). However, no studies have specifically investigated empirically-based pedagogical strategies for MOOCs. Out of a general investigation into MOOC pedagogies, we were able to ask the research question: *What are the empirically-based best practices for the development of videos in MOOCs?*

Methodology

We performed a systematic literature review, following the approach outlined by Borrego, Foster, and Froyd (2014) to address the broader question of general pedagogical best practices in MOOCs. Like traditional narrative reviews, systematic literature reviews are intended to synthesize literature covering a given topic, but systematic reviews go further by providing a critical appraisal to direct practice through "transparent, methodical, and reproducible procedures" (Borrego et al., 2014, p. 46). Our results span several major course components, including the use of discussion forums, social media, assessment strategies, general instructional materials, overall course design, motivational strategies, and videos. Given the variability of course aspects identified, we narrow our focus here on just videos, expecting to address others in future papers.

Data Collection

We developed our search strategy through consultation with both education and engineering librarians. Guided by the Population, Intervention, Comparison, and Outcome (PICO) framework (Borrego et al., 2014), and despite our research being driven by a desire to focus on engineering-related MOOCs, we included research involving MOOCs from any subject area to prevent an overly limited pool of articles, as long as the research reported some aspect of pedagogy. On April 15, 2016, we conducted our search within the EBSCO databases *Education Source, Education Full Text, ERIC, Education Administrative Abstracts, PsycINFO*, and *Applied Science & Technology Full Text,* using three search string components: MOOC or "Massive* Open Online" (in the title or subject fields), pedago* or teaching or learning or educat* or instruction, and research or qualitative or quantitative or empirical or "case study" or assessment or analy* or evaluat*. The search was limited to academic journals, journals, reports and conference papers. This produced 1,068 records that the system reduced to 504 records by automatically removing duplicates. An identical search was run in *Compendex* and *Inspec*, limiting the search to English language records and the Classification Codes "Education" and "Computer-aided instruction," which produced 776 records after the duplicates were automatically removed. The records were imported into Endnote (1,280 records, in total) and two passes were made to further manually remove duplicates by matches on author/title/year and then by just by title, leaving 1,170 records.

Data Analysis

We applied four major inclusion criteria in our study: (1) the article had to be written in English; (2) the article had to present data obtained from a MOOC or MOOC participants; (3) the study had to investigate some pedagogical consideration (i.e., some consideration for teaching or supporting student learning); and (4) the article had to be empirical (i.e., it had to have a research purpose, outlined methods, and results). Four researchers independently analyzed a common set of 20 titles and abstracts and conducted entire group discussions to reconcile application of these criteria. This was repeated for two more rounds, filtering through 60 records, in total. Next, we applied the inclusion criteria to the remaining 1,110 articles in pairs, using discussions to reconcile any remaining disagreements. This process led to the rejection of 912 articles. Of these rejections, six were identified as duplicates, twenty were excluded for having non-English abstracts, 432 were not being grounded in a MOOC, 306 were not studies of a pedagogy, and 148 were not being empirical. Note that the documented reason for exclusion was based on the first criterion that was violated in the list (i.e., if it was not grounded in a MOOC and not empirical, the documented reason was the lack of grounding in a MOOC). At this stage, we generally erred on the side of retaining articles when inclusion decisions were uncertain.

The remaining 258 articles passed to the full paper stage of analysis and were each read independently by two researchers, again with any disagreements being resolved through discussion. Through this process, we rejected an additional 185 articles (five had English abstracts but non-English full papers, 30 were not based in a MOOC, 88 were not studies of a pedagogy, and 62 were not empirical). We also calculated a quality score for each article based on clarity of purpose, provision of context, trustworthiness, significance, applicability, and theoretical underpinning. Four of the remaining 73 articles were removed for receiving low quality scores. In a series of group research meetings consisting of five researchers conducted in October and November of 2016 and January of 2017, we sorted the remaining 69 articles into categories based on the pedagogical aspect of MOOCs investigated. Fifteen of these articles were selected for this paper based on their inclusion of content related to videos. The findings of these papers were then separately analyzed and qualitatively synthesized by the first two authors. These authors compared and discussed the themes they separately identified until they reached consensus on the reported themes.

Findings

The set of 15 articles included in this study, and whose content related directly to videos, are summarized in Table 1. These employed a wide range of methodological approaches, including surveys (seven studies), interviews (five studies), learner analytics (five studies), and content analyses (three studies). Five studies employed multiple strategies. Collectively, these studies explored a wide spectrum of aspects related to videos in MOOCs that we identified as relevant to three groups: instructional teams, production teams, and platform developers. As a few aspects of videos may be relevant to multiple groups (e.g., content navigation might be relevant to the instructional and production teams), our inclusion within a given group is based on the following definitions. Instructional staff consists of all individuals developing and delivering course materials, including videos. Production teams consist of those who record, direct, and/or edit videos. Platform developers create the platform software that provides the technical capabilities, such as video, made available to producers and instructors. Of course, it is expected that some individuals may span multiple groups.

Instructional team

There were three broad themes of video aspects identified that relate to the instructional staff: instructor actions, learning content design, and content navigation.

Table 1: Descriptive information of included articles

Author (year)	Purpose of study	MOOC platform	Methods	Video aspect(s)
Adams, Yin, Madriz, & Mullen (2014)	To explore xMOOC completers' learning experiences	Not reported	Qualitative (interviews)	Instructor actions
Evans, Baker, & Dee (2016)	To determine course-, lecture-, and student-level factors that best predict engagement, persistence, and completion	Coursera	Quantitative (Learner analytics)	Navigation, length
Grunewald & Meinel (2015)	To explore effectiveness of personal and collaborative video annotations	openHPI	Quantitative and Qualitative (surveys)	Navigation, annotations
Guo, Kim, & Rubin (2014)	To determine which kinds of videos produce the best learning outcomes	edX	Mixed methods (Learner analytics and interviews)	Instructor actions, content design, style, video
Haavind & Sistek-Chandler (2015)	To explore the role of instructors in MOOCs	Not reported	Qualitative (interviews)	Instructor actions
Hew (2015)	To investigate preferences of MOOC learners	Coursera	Qualitative (Content analysis of discussion boards)	Content design, length, viewing options
Kelder, King, Carew, O'Reilly, Robinson, & Vickers (2013)	To understand student perceptions of structure, usability, accessibility, navigation, and support in a pilot MOOC	Not reported	Mixed methods (Surveys, content analysis)	Content design
Kim, Guo, Seaton, Mitros, Gajos, & Miller (2014)	To understand how students watch and interact with videos	edX	Quantitative (learner analytics)	Content design, style, length, viewing options
Kizilcec, Bailenson, & Gomez (2015)	To study the effect of including instructors' faces in videos	Coursera	Quantitative (Surveys, learner analytics)	Style
Lai, Young, & Huang (2015)	To explore learner perceptions of style and quality of videos	NTHU	Quantitative (surveys)	Style

Table 1, continued

Author (year)	Purpose of study	MOOC platform	Methods	Video aspect(s)
Li, Kidziński, Jermann, & Dillenbourg (2015)	To identify the relationship between behaviour and perception of difficulty	Coursera	Quantitative (learner analytics, surveys)	Content design
Lin, Lin, & Hung (2015)	To investigate learner perspectives of implicit platform attributes and learning consequences	Multiple	Mixed methods (interviews, content analysis)	Length
Mamgain, Sharma, & Goyal (2014)	To compare features offered in different MOOC platforms	Coursera and edX	Quantitative (surveys)	Content design, Style, quality, length, viewing options
Tan, Goh, & Sabastian (2014)	To identify the contribution of various factors to student outcomes in a MOOC	Not reported	Qualitative (interviews)	Style, viewing options
Yousef, Chatti, Schroeder, & Wosnitza (2014)	To identify specific criteria related to the successful design of MOOCs	Not reported	Quantitative (surveys)	Instructor actions, content design, navigation, style, quality, length, annotations, viewing options

Instructor actions. In sum, the four articles related to instructor actions suggested that learners desired instructors who were engaging, understandable, and inclusive. Learners claimed to feel more engaged by instructors who spoke “fairly fast” and enthusiastically (Guo, Kim, & Rubin, 2014) and when videos started with “surprise information” (i.e., unexpected or exciting connections to everyday life) to attract them (Yousef et al., 2014). Learners considered instructors to be more understandable when they used good inflection, diction, and articulation (Haavind & Sistek-Chandler, 2015) and when they spoke in shorter sentences (Yousef et al., 2014). Finally, learners said they preferred when instructors used a warm, inviting tone (Haavind & Sistek-Chandler, 2015) and made relevant interjections or directed, encouraging comments (Adams et al., 2014).

Learning content design. The design of learning content spans individual lectures to the entirety of the course, including lecture structure, purpose, and difficulty. In several studies, learners consistently demonstrated a preference for greater structure (Kelder et al., 2013; Kim et al., 2014; Mamgain et al., 2014; Yousef et al., 2014). In one study, learners suggested structure could be reinforced by an introductory video outlining the layout and important features of the learning environment (Kelder et al., 2013). This structure could also be enhanced by the inclusion of a limited number of clearly defined learning objectives in any given video (Kelder et al., 2013; Yousef et al., 2014). These learning objectives and key points should be summarized and made available without having to watch the video (Kelder et al., 2013; Kim et al., 2014).

The research indicates that learners interact differently with videos depending on the video’s purpose (Guo, Kim, & Rubin, 2014; Kim et al., 2014). For instance, instructors should be aware that learners generally watch entire lectures only once, but often return to specific times within tutorial videos (Guo, Kim, & Rubin, 2014; Kim et al., 2014). Also, learners

expressed a desire for videos that directly addressed questions or issues that appeared repeatedly or generated considerable interest in the forums (Hew, 2015).

Finally, the learners felt that the level of detail and difficulty of the presented content, as well as the underlying values demonstrated throughout the lecture, should align with the interests, abilities, and values of the course's primary target audience (Yousef et al, 2014). While the objective of delivering an appropriate level of difficulty may not always be easy to achieve upfront, the literature suggests that retroactive analysis of the moments or segments in videos that are replayed, paused, or sped up, can indicate when material was too easy or too challenging (Li et al., 2015). Regardless of difficulty, however, learners expressed an interest in viewing lectures that took cultural diversity and values into consideration (Yousef et al., 2014).

Content navigation. In general, the studies related to content navigation suggested that MOOC learners want to be able to easily find the specific material in which they are interested and want access to additional resources. One study indicated that accompanying each video with a strong set of keywords and tags would help students locate videos related to specific information they want (Yousef et al., 2014). Additionally, learners indicated that videos should have clear, descriptive titles to help learners decide if the videos are of interest (Yousef et al., 2014). Still, care must be taken with the wording of titles, as it was found that learners are less likely to watch videos with titles including the words "optional," "conclusion," and "exercise," suggesting that such phrases should be avoided for the most important content (Evans, Baker, & Dee, 2016). Two additional studies reported that learners wanted help connecting the content presented within specific videos to other topics or content in the same course (Grunewald & Meinel, 2015) or to related information outside of the course (Yousef et al., 2014).

Video production team

The production team is responsible for directing, editing, and overseeing the general production of videos. The related themes include video style, length, and quality.

Video style. Seven of the fifteen studies explored presentation styles including, but not limited to, recorded standard classroom lecture, Khan-style (i.e., videos emulating the style of Khan Academy videos that simulate text or images appearing on a chalkboard accompanied by spoken explanation), slide-view, and slide-view with a "talking head" (Guo, Kim, & Rubin, 2014; Kizilcec, Bailensen, & Gomez, 2015; Lai, Young, & Huang, 2015; Yousef et al., 2014). Each of these studies suggests that recorded standard classroom lectures are the least engaging approach for most learners, though the styles that were most preferred varied across studies and were by no means definitive. Besides the general format, however, it is important to note that learners claim to be distracted by abrupt visual changes (Kim et al., 2014; Yousef et al., 2014), excessive text on the screen, and poor framing, but benefit from the creative use of different colours to highlight important and useful information (Yousef et al., 2014).

Video length. Video length was the single most discussed aspect of videos across the included articles. Learners' preferences for shorter videos were nearly unanimous, though specific maximum recommended lengths varied. Shorter videos were consistently found to be more engaging (Guo, Kim, & Rubin, 2014; Hew, 2015) and facilitated ease of time management (Lin, Lin, & Hung, 2015). Recommended lengths vary from 6 minutes (Guo, Kim, & Rubin, 2014; Kim et al., 2014), to 10 minutes (Mamgain, Sharma, & Goyal, 2014), to 20 minutes (Yousef et al., 2014). However, while one study showed that dropout rate (i.e., "navigating away from a video before its completion") increased with video length (Kim et al., 2014), another indicated that video length had no predictive power for persistence or completion, so instructors should not feel obligated to divide long concepts (Evans, Baker, & Dee, 2016).

Production quality. Learners were less concerned with a minimum resolution of video than the need for clear sound (Yousef et al., 2014). However, learners who had taken courses through both Coursera and edX preferred the better video quality and clarity in Coursera courses, particularly when the lectures included slides with large amounts of text (Mamgain, Sharma, & Goyal, 2014).

Platform developers

Different MOOC platforms allow for a variety of different technical capabilities in their learning environments. Capabilities addressed throughout the included articles relate to video annotation tools, viewing options, and embedded assessment.

Video annotation tools. While learners wanted access to lecture summaries and notes, they also reported wanting the ability to make video annotations and to see the annotations made by other learners (Grunewald & Meinel, 2015; Yousef et al., 2014). Learners suggested that the ability to embed their own notes within the videos and to construct a group-based annotation would be a motivational learning experience (Grunewald & Meinel, 2015).

Viewing options. Based on the five articles related to viewing options, it is clear that learners find having a full set of these options to be important. For instance, learners appreciate the availability of captions or synchronized transcripts (Hew, 2015; Tan, Goh, & Sabastian, 2014; Yousef et al., 2014), which is a required accommodation under the Americans with Disabilities Act. Three different studies also mentioned the need for learners to be able to play videos on full screen, to replay, pause, rewind, fast forward, slow down, speed up, and stop (Hew, 2015; Mamgain, Sharma, & Goyal, 2014; Yousef et al., 2014). Learners also expressed a desire to download or stream videos using multiple connection speeds (Hew, 2015; Yousef et al., 2014). Further, they were interested in having lecture notes that were synchronized with the lecture (Yousef et al., 2014). Finally, given the different use patterns for tutorial videos, learner behaviour suggested the need for a convenient way to be able to navigate to specific points within videos (Kim et al., 2014)

Embedded assessment. Learners found quizzes that were embedded in the middle of video lectures to be less beneficial than quizzes presented after the lectures (Mamgain, Sharma, & Goyal, 2014). One of the primary reasons for this was that embedded quizzes required the learner to be connected to the internet to watch the videos. Alternatively, post-lecture quizzes allowed the learner to download videos when the internet was available, watch at their convenience, and return to the quizzes at a later point in time.

Conclusions, Recommendations, and Future Work

This systematic literature review provides several important considerations when preparing videos in MOOCs in a practical format for three different groups of developers. However, despite learners expressing similar sentiments regarding instructor actions, content design, navigation, and viewing options, learners' preferences toward aspects such as video style varied across the different studies. This variation supports Kizilcec, Bailensen, and Gomez's (2015) claim that there may not be a "one-size-fits-all approach" for every aspect of a MOOC video. If possible, it might be beneficial to allow different users to customize the presentation style. However, such a solution may be more feasible for some styles than others. For instance, it would be reasonable to allow learners to adjust the presence of the instructor's face, but would require considerably more effort to have both traditional lecture style approaches and the previously described Khan-style approaches for a single topic.

A major takeaway is that MOOCs appeal to a wide, diverse spectrum of users who do not represent any single, unifying perspective and often enrol in MOOCs with their own unique goals. As such, the greater the degree of customization available, the more likely the MOOC will be able to meet the needs of its users. Thus, it would be reasonable for platform developers to build their platforms to have as much flexibility as possible while

accommodating many learners' specific personal and educational needs. Similarly, production teams should consider ways to film videos that would allow maximum versatility for viewers while meeting at least their minimal expectations for quality. All the while, the production team should work with the instructional team to ensure that videos are presented in digestible lengths with coherent structure and easy navigation. Finally, instructors should remember that even though they may be speaking to a camera, they are still addressing human beings with typical human needs for warmth and encouragement.

This paper only reports on a small segment of the literature collected for our systematic literature review. Many other themes have been identified that relate to best practices in MOOCs. As MOOC offerings continue to reach wider audiences, it is becoming increasingly important to organize and synthesize relevant research findings. These syntheses can help develop meaningful metrics for evaluation of MOOC quality, to help course designers and other stakeholders. As Rauf, Daud, and Said (2016) noted, MOOCs represent a promising approach to update, deepen, and broaden the education of practicing engineers. Thus, it is vitally important that future MOOCs be developed using evidence-based best practices to maximize their benefits to these learners.

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