The Video Lecture as an Instructional Method of MOOCS: Impact on the Students' Re-Watching Behaviors

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Abstract: This study examines the relationship between instructional delivery that affects students' engagement with video lectures and the need to re-watch video lectures in the context of Massive Open Online Courses (MOOCs), where video lectures are the predominant mode of instruction. Multiple linear regression was used to investigate the relationships between some key characteristics of video lectures— the arrangement of text and graphs that creates eye scanning behavior, audiovisual support, text-image comprehensibility, professor's speech clarity—with the need to re-watch video lectures. The findings from the study reveal that the arrangement of text and graphs, the professor's speech clarity, and text-image comprehensibility emerge as major factors influencing the need to re-watch video lectures in MOOCs. However, audiovisual support does not significantly influence the need to re-watch video lectures. Consequently, the study sheds light on the positive relationship between the arrangement of text and graphs and the need to re-watch video lectures, highlighting the potential cognitive overload experienced by students when oscillating between textual and graphical information. Similarly, the study also shows how the comprehensibility of text and images impacts students' video lecture rewatching behavior, emphasizing the necessity for clear and comprehensible visuals in instructional materials. Additionally, our findings indicate the significance of speech clarity in video lectures, with clear speech patterns contributing to a reduced need for re-watching video lectures. However, the study notes the limited impact of audiovisual support on students' re-watching behavior, suggesting the need for instructors and content creators to minimize audiovisual distractions in order to create sustained engagement. While previous studies have explored various aspects of student engagement in MOOCs, this research fills a critical gap by specifically investigating instructional delivery affecting engagement behaviors of students and the propensity for such instructional delivery to cause students to re-watch video lectures in Moocs. Thus, these findings highlight key areas for optimizing video lecture design in MOOCs, offering actionable insights for educators and content creators to enhance instructional effectiveness and student engagement in fully online learning environments.

Keywords: Student engagement, Video lectures, Online learning, MOOCs

1. Introduction

Online learning is becoming more prevalent in education, and it comes in a variety of forms, including virtual learning environments (VLEs), Massive Open Online Courses (MOOCs), and learning management systems (LMS) (Bonafini, 2017). It can be referred to as learning experiences that occur in asynchronous or synchronous environments using a variety of devices that can be connected to the internet, enabling students to learn from anywhere, anytime (Cojocariu, et al., 2014; Dhawan, 2020). One way to think of online learning is as an instrument that can help with teaching and learning processes, making learning more adaptable, dynamic, and centered on the needs of the student. The benefits of online learning extend to a broader base of students with similar goals through the use of MOOCs. According to Zhang, Gao and Zhang (2021), MOOCs are communication and collaboration platforms that allow users to share and strengthen their knowledge. MOOCs have gained traction in higher education and have become significant components of the education process (Jin and Shang, 2022). Numerous stakeholders, including students, academics, and corporate professionals have reportedly benefited from MOOCs (Egloffstein and Ifenthaler, 2017). Furthermore, more educational institutions have started embracing MOOCs, which have revolutionized the higher education landscape by providing unprecedented access to a wide range of learning resources through a variety of models (Burd, Smith and Reisman 2015).

Video lectures play a key role in the online learning process, particularly in MOOCs where they are the main form of instruction and student engagement (Atapattu and Falkner, 2018). Overall, video lectures have been

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reported to be helpful in the preparation and facilitation of learning by students (Roehling, 2018). They are considered capable of engaging learners in ways that allow them to take control of their learning processes, giving them access to a number of learner-control options in which the learner can choose how to engage with the video, including the ability to segment, pause, re-watch, and control the speed of the video based on individual learning needs (Hwang, Lai and Wang, 2015). In terms of extant research regarding those learner-control options, conflicting results have been found with rewatching videos in particular. Recently, Palmer, Chu and Persky (2019) and Patel, et al. (2019) demonstrated that students who rewatched video lectures had better performance compared with students who did not rewatch video lectures. In contrast, Martin, Mills, D'Mello, and Risko (2018) revealed that there are no benefits of rewatching video lectures on the retention of lecture content. Another study also noted that the ability to rewatch video lectures can lead to a less engaged learning experience (Guo, Kim and Rubin, 2014). Research has shown that students who frequently rewatch or skip around in video lectures are more likely to experience disengagement and reduced learning outcomes (Kim, et al., 2014).

The way in which instruction is delivered through video lectures may ultimately play a role in how learners engage with the videos, particularly in their decision whether to re-watch videos. Research has reported that one of the main reasons learners feel the need to re-watch video lectures is due to their lack of comprehension during the initial viewing of a video lecture (Le, et al., 2010). Aside from the natural complexity of the content, there are number of purely instructional factors (replaying brief segment, repeating non visual explanation, returning to missed content) that contribute to a lack of student comprehension in regard to the content delivered via video lectures (Kim, et al., 2014), including the inefficient arrangement of textual and graphical information, distracting audiovisuals, ineffective use of text and images to support instruction, and the lack of instructor's speech clarity within the video lecture. However, there is a lack of research investigating the direct relationship between those instructional factors and the need to re-watch video lectures. This study seeks to address this gap by delving into the intricate dynamics of student engagement with video lecture content in MOOCs by using multiple linear regression to examine the relationships between specific behaviors and re-watching videos. These behaviors include scanning between texts and graphs, processing of distracting audio-visual information, utilizing text and images for more efficient processing, and listening to instruction directly delivered from the instructor, which may ultimately influence their decision to re-watch video lectures. .

2. Literature Review

While the video lectures are a prevalent means of instruction in online learning, its optimal instructional design features are often an open question, leading to ongoing debate and uncertainty within the field. This literature review gives an overview of the current body of research investigating the influence of diverse instructional design elements, including content delivery, audiovisual support, instructor clarity, and text-image comprehensibility, on student engagement, cognitive load and the frequency of video lecture re-watching in MOOCs.

2.1 Importance of Video Lectures in MOOCs

MOOCs have been expanding rapidly, and this initiative has received support from numerous prestigious universities and organizations (Albelbisi, Al-Adwan and Habibi, 2023). More than 23 million learners enrolled in at least one MOOC in 2016, bringing the total number of learners to 58 million. There are 6,850 MOOC courses offered by more than 700 universities (Shah, 2018). Different studies have shown that MOOCs have become more and more important in learning and have become increasingly popular in higher education (Aparicio, et al., 2019; Pozón-López, et al., 2020; Tzeng, et al., 2022).

Video-based learning materials are increasingly used in online learning environments around the world (Akcapinar and Bayazit, 2018). The prevalence of video lectures in contemporary education, particularly in hybrid or fully online classes, has surged, marking a significant shift in teaching (Scagnoli, McKinney and Moore-Reynen, 2015). Several research studies have demonstrated that the use of video lectures can be a highly effective instrument for instruction (Rackaway, 2012; Hsin and Cigas, 2013; Stockwell, et al., 2015). Notably, the utilization of video lectures has demonstrated a considerable improvement in student engagement compared to traditional text-based course materials (June, Yaacob and Kheng, 2014), leading to enhanced retention and reduced teacher intervention (Hsin and Cigas, 2013).

With the prevalence of computers and mobile devices and the increase of MOOCs, more learners are favoring video-based lectures over traditional lectures (Banoor, Issack and Frank, 2019). The video lectures are a primary teaching method within MOOCs (Atapattu and Falkner, 2018), therefore understanding its importance is crucial

for unravelling the dynamics between instructional factors affecting student engagement and the subsequent need to re-watch instructional video lectures in an online learning environment. Furthermore, studies revealed that students spend more time watching videos than reading texts (Seaton, et al., 2014). A video lecture within the context of a MOOC constitutes a composite integration of various elements, encompassing instructor-led lectures, quizzes, and presentation slides (Sinha, Jermann and Dillenbourg,., 2014).

One of the main advantages of video lectures is the visual and auditory nature of the content, which enhances the accessibility of complex topics, making education available to individuals who might face barriers in traditional learning environments (Akcapinar and Bayazit, 2018). Besides, it provides students the opportunity to advance in their learning autonomously, enabling them to revisit specific sections at their discretion—a feature that can be delineated as among other noteworthy advantages (Kim, et al., 2014). Furthermore, MOOCs offer students flexibility in the learning process by enabling them to pause, repeat, or skip video lectures (Triay, et al., 2016).

The role of video lectures has been well explored, for example Lange and Costley (2020) studied the challenges and issues arising from media use in online video lectures. The research identifies five primary categories of media delivery problems: pace, intelligibility, quality, media diversity, and congruence. The study examines a random sample of OCU video lectures across various disciplines, revealing how these media-related issues can hinder the learning process. The results emphasize the need for instructors to carefully design and deliver media in online lectures to enhance the learning experience. Instructors can do this by giving autonomy to learners through learner control while at the same time providing access to instructor-learner communication where feedback can efficiently be given outside of the video lectures. For example, results of one another study indicate that perceived active control, perceived synchronicity, and perceived two-way communication significantly influence both the participants' intention to complete the MOOC and engagement on the platform (Shao & Chen, 2021).

Another study of Brame (2016) also explores the effective use of educational videos in higher education, emphasizing their role in flipped, blended, and online classes. The study found that three key principles, cognitive load management, student engagement maximization, and active learning promotion, form the foundation for effective video use. Koh and Ahn (2023) examine the role of video lecture types in motivating students within sustainable flipped learning environments. Using a mixed-methods design, it compared traditional video lectures (TVL) created by instructors with student-engaged video lectures (SEVL), co-created by instructors and students. Findings revealed no significant overall difference in motivation between TVL and SEVL, though SEVL slightly improved attention regardless of student grades.

The study of Kuznekoff (2020) found that while viewing more content positively influenced learning, the effect plateaued with excessive viewing. Only 34% of students completed full lectures, with the majority 60%, either partially watched or disengaged entirely. These findings highlight the need to optimize video length and format to enhance engagement and learning outcomes in online education.

Abakumov, et al. (2018) studied the effect of rewatching video lectures in MOOCs; they use a cross-classification multilevel logistic approach to analyze data from four Coursera courses in social sciences and math. The results revealed that the overall effect of rewatching video lectures on assessment performance varies significantly—sometimes improving, having no impact, or even negatively affecting performance, depending on the course and specific assessment items. This nuanced finding suggests that the effectiveness of rewatching video lectures is not uniform across all students or assessment types, challenging the general recommendation to rewatch videos as a preparation strategy. The study underscores the need for further research to understand the factors contributing to these varying effects, with implications for tailoring instructional strategies to individual learner needs.

2.2 The Impact of Content Delivery on Student Engagement with Video Lectures

The concept of student engagement in online learning environments is multifaceted, encompassing various dimensions that contribute to the overall learning experience. Student engagement is widely recognized as crucial to learning and satisfaction in online courses (Maloney, et al., 2023). Student engagement refers to the level of involvement and active participation that students demonstrate in their online courses (Shao and Chen, 2021). Student engagement can also be said to be associated with positive educational outcomes, such as enhanced academic achievement, improved retention and persistence rates, and increased motivation and satisfaction within the classroom setting (Maloney, et al., 2023). In the context of massive open online courses, student engagement with video lectures is a critical component of the learning experience. While video lectures

are a common feature of MOOCs, research has shown that students may disengage from these materials for various reasons, such as fatigue, loss of motivation, or challenges in effectively processing the content (Li, et al., 2015). Understanding the factors that contribute to student engagement with video lectures in MOOCs can provide valuable insights into the design and delivery of online learning experiences that better meet the needs of diverse learners. For example, Guo, Kim and Rubin (2014) found that shorter videos (less than 6 minutes) were found to be significantly more engaging. Videos that combine an instructor's "talking head" with slides surpass the engagement levels of slides alone.

One critical aspect of students' engagement in MOOCs is the level of interaction with video lectures, which serve as a primary mode of content delivery (Guo, Kim and Rubin, 2014). Although behavioral engagement usually implies watching the video itself, it goes beyond mere passive viewing; it involves active participation, thoughtful reflection, and the application of acquired knowledge (Bonafini, 2017). The impact of student engagement, a critical aspect of effective learning, is intricately connected to various factors related to the incorporation of video lectures. The types of videos used, the organizational integration of videos in teaching methodologies, and the adaptive strategies employed by instructors to accommodate videos all influence student engagement significantly (Guo, Kim and Rubin, 2014). Studies also suggest that supplementary content interaction associated with video lectures can lead to further engagement, ultimately correlating with completion rates. For example, active participation in discussion forums emerges as a strong predictor of MOOC completion, aligning with prior literature on the significance of forum engagement (Bonafini, 2017). Results of another study show a strong correlation between such learning activities as forum engagement and content interaction and student engagement levels (Hussain, et al., 2018). A significant number of studies have explored engagement as it relates to video lectures, for example Costley, Hughes and Lange (2017) investigated the relationship between instructional design and student engagement with video lectures at a cyber-university in South Korea. The study sought to identify how various aspects of instructional design influence the likelihood of students watching and completing video lectures. The study found significantly higher rates of students both watching and completing their video lectures. The findings revealed positive correlations between student engagement and five key instructional design elements: designing methods, setting the curriculum, establishing time parameters, enforcing netiquette, and effectively utilizing the medium. This aids learners and prevents lack of comprehension often associated with video lectures (Le, et al., 2010).

Lackmann, et al. (2021) studied the influence of video format on engagement and performance in online learning. The study compares infographic videos (animated graphics and text) to lecture capture (professor delivering a classroom lecture) and found distinct impacts on engagement and learning outcomes. Lecture capture elicited higher emotional engagement in the short term, while infographic videos sustained cognitive and emotional engagement over longer periods. The study highlights that optimal video formats depend on the desired balance between engagement and learning outcomes.

Cognitive Load Theory and its Effects on Video Lecture

During the design and production process of multimedia instructional materials, including video lectures, cognitive load is considered one of the most important considerations (Afify, 2020). The cognitive load theory proposes that the human brain can process only a finite amount of information and that effective learning occurs when the cognitive load reflects a person's cognitive capabilities (Sweller, 2022). In other words, Sweller (2024) defines cognitive load as the amount of information stored and processed in working memory. This theory is significant in the context of video lectures, where students may be exposed to a large amount of visual and auditory information, thus overloading their cognitive capacities. Research has shown that cognitive load can have an enormous effect on the effectiveness of video lectures in Massive Open Online Courses (Brame, 2016; Costley, et al., 2021; Afify 2020). Specifically, the way in which information is presented in video lectures can impact the cognitive load experienced by students, which in turn may influence their engagement with video lectures, Chen and Wu (2015) found that students who were presented with a voice-over style of video lecture experienced significantly lower levels of cognitive load than those who experienced a visualizer style. Another study found that presenting content in video lectures that prevents learners from processing information unrelated to learning can lead to higher levels of engagement (Lange & Costley, 2020). This suggests that the design of video lectures should prioritize minimizing cognitive load in order to enhance student engagement with video lectures which in turn may influence the need to re-watch the lectures.

2.3 Arrangement of Text and Graphs

By using various formats to deliver information, the application of visual media has been noted to assist students in improving learning outcomes in online learning platforms (Lange and Costley, 2020). The arrangement of text

and graphs in an online learning platform is a key factor in maximizing the comprehension and learning outcomes of the learners. In addition, the layout of text and graphs in online learning has been noted to increase student engagement and understanding of course content (Al-Aghbari, Osman and Al Musawi 2021).

Video lectures include a variety of learner interactional components that are intended to enhance knowledge supplied by various types of media (Alraimi, Zo and Ciganek, 2015). The method in which media is employed in video lectures makes it one of the most important components, because it allows for most types of teaching and learner interaction, and online learning would not work without it (Lange and Costley, 2020). Similarly, research has also shown that visual media such as graphs, images, maps, slides, and text have been found to improve student attention and engagement during video lectures (Kizilcec, Bailenson and Gomez, 2015). Furthermore, when learners have to scan their eyes between texts and graphs, cognitive load is increased (Mayer, 2014), research suggests that the interplay between scanning text and graphs can significantly impact cognitive load (Raney, Campbell and Bovee 2014).

In addition, another study found that the graphical characteristics of printed text and the location and recognition of textual information can affect cognitive load (Zhong, et al., 2011). This is because when a graph is separated from the text that describes it, learners have to retain the textual information in their working memory while they search for the graph, thus increasing cognitive load and decreasing comprehension (Mayer, 2014). Low comprehension can lead to a lack of understanding within video lectures and a lack of understanding in video lectures might create a need to re-watch them. While no research has been found directly linking the arrangement of text and graphs to the need to re-watch videos, implications can be made from extant research. Mutlu-Bayraktar and Bayram (2018) showed greater levels of recall are evident when text is integrated with images as opposed to being physically separated to the point where students are forced to scan between the two sources. It has also been found that students tend to re-watch videos in which they have more difficulty processing information (Li, et al., 2015), thus the difficulty perceived through the increased load that leads to less recall when trying to process information from two physically separated sources may also lead to students re-watching the videos to make better sense of them.

2.4 Audiovisual Support

The use of audiovisuals in video lectures is becoming more frequently utilized in educational contexts. This is because audiovisual strengthens students' learning experiences by engaging a multitude of senses and promoting active learning (Nicolaou, Matsiola and Kalliris, 2019). Similarly, audiovisual media has been noted to facilitate the transmission of information between transmitter, and receiver and they enhance the learning process through representations (Rodriguez, 2007). Furthermore, Mayer (2014) argued that the utilization of both auditory and visual media to present instruction assists learners in comprehending lesson content.

Audiovisual support is the application of media within video lectures that enable learners to process information received through both visual and auditory modalities. While different studies have shown the importance of combining auditory and visual media to improve learning experiences, several studies have shown that learning can be negatively impacted by extraneous processing, which occurs when learners are distracted by the combination of multiple media sources (Lange and Costley, 2019; Leppink, et al., 2013). If the audiovisuals are presented in an engaging and non-distracting way, allowing learners to focus only on content that contributes to learning, it may reduce extraneous processing (Lange & Costley, 2020). However, studies also found that the separation of complementary media sources of information on the screen may lead to additional distractions, affecting the transmission of learning content negatively (Chen and Wu, 2015; Kizilcec, Bailenson and Gomez, 2015; Mayer, 2014). Similarly, the visual and auditory stimulation provided by audiovisual materials may act as a distraction for some students, leading to reduced focus and comprehension of the lecture material (Xiaojun, Zongkui and Zhongfeng, 2010). Considering this, it is important to understand the impact of audiovisual support in video lectures and how audiovisual support can affect the lecture rewatching behavior of the learners.

2.5 Professor's Speech Clarity

Clarity is essential to any good academic communication. To effectively engage students with video lectures in MOOCs, professors/instructors must prioritize clarity in their communication. This means that instructors should communicate their concepts simply, by utilizing suitable language, and avoid complexity or convoluted terminology (Guo, Kim and Rubin, 2014). Studies have indicated that unclear speech can disrupt the learning process, leading students to go back and replay the audio (Cunningham, Fägersten and Holmsten, 2010). Similarly, a study conducted by Leppink, et al. (2013) discovered that unclear explanations or instructions and unclear language contribute to an increase in extraneous load which in turn affects student learning processes.

In addition, when audio is unintelligible, it can result in learners not understanding what is being said by the instructor, which has been demonstrated to decrease comprehension (Pilarski, et al., 2008). Furthermore, the cognitive processes of learners have also been found to be influenced by the speed at which auditory media are delivered (Mayer, 2014). Some researchers found that instructors who speak fast and exhibit high levels of enthusiasm demonstrate higher levels of engagement (Guo, Kim and Rubin, 2014). Thus it can be concluded that while the physical presence of the instructor appears to benefit engagement levels, the way in which the information is delivered by instructors should be done in a way in which learners feel their time is being used in a productive and engaging manner. This falls in line with research that suggests students who do re-watch video lectures tend to focus on only the parts of the lecture relevant to their learning needs, skipping any unneeded information in the learning process (Kim, et al., 2014).

On the other hand, studies have shown that learners may be overloaded by fast-moving speech, which can thereby reduce comprehension (Koumi, 2013). Similarly, another study also stated that students can fail to gain critical information when learning from fast-paced media which can result in learning difficulty (Wildemuth, et al., 2003). When media is delivered at a fast pace it may result in low comprehension. The limited capacity theory explains the reduced level of comprehension when media is displayed at fast rates, stating that the brain's working memory has a limited ability to organize and process modality-specific information, and thus cognitive overload may take place when excessive information is delivered at a fast pace (Mayer, 2014). With different studies providing conflicting perspectives, it is needed to understand how professors' speech clarity in video lectures affects student learning and if the speech clarity for the professor/instructor can necessitate the need to rewatch video lectures. Additionally, although there is a lack of direct quantitative evidence that a relationship exists between instructor clarity and the need to re-watch videos, Fenton and Murphy (2023) did provide qualitative data that suggest that clarity is associated with the re-watching of instructor feedback in video lectures, as students reported higher levels of instructor understanding during the re-watch.

2.6 Text-Image Comprehensibility

In online learning, video lectures have become an essential instrument to deliver instruction to learners (Costley, et al., 2021). These video lectures often contain a combination of text and images to enhance comprehension and engage learners (Brame, 2016). On the other hand, studies have shown that the size of the text and image can affect the instructional delivery in video lectures. When the font size of a text is too small, it makes the content in instructional contexts illegible, thereby negatively affecting the comprehension levels of the learners (Amigud, et al., 2017; Sanchez and Goolsbee, 2010). Similarly, the size of images used in lecture content has also been noted to negatively affect student learning experiences (Al Ghamdi, et al., 2016; Molnar, 2017). When the learners find it hard to understand the content in the instruction due to its size, this may result in a situation where the students might have to rewatch these lectures to understand the lectures better.

Furthermore, research has also shown that when learners are presented with unclear instruction or instructional content that is difficult to understand, it may lead to extraneous load (Costley, et al., 2021; Leppink, et al., 2013; Schmeck, et al., 2015) making it difficult for the student to understand the lecture content. In order to gain a better understanding of the lecture content, students may engage in a variety of viewing strategies, some of which are rewatching the video lectures, splitting attention between text and images, and scanning text to find certain details required to obtain a better understanding of the content (Costley, et al., 2018; Kim, et al., 2014; Le, et al., 2010). Conversely, when the text and images used in video lectures are well-designed and easily comprehensible, students may be less likely to feel the need to re-watch the lectures. There has been no study found that fully explains the relationship between text and image comprehensibility in video lectures and its impact on lecture re-watching behavior by learners; however, given the evidence that unclear text and images lead to a more difficult learning experience (Al Ghamdi, et al., 2016; Molnar, 2017) coupled with the fact that students are more likely to re-watch video lectures that they perceive to be more difficult (Li, et al., 2015), it would make sense that students would be less likely to re-watch videos in which the text and images are easy to understand.

2.7 The Present Study

While previous studies have explored various aspects of student engagement in MOOCs, including the impact of instructional design, content delivery, and various strategies on student engagement, there is a noticeable gap in the literature concerning the direct relationship between specific instructional factors and the need to re-watch video lectures. This study aims to fill this gap by examining the unique instructional environments of the Open Cyber University (OCU) in South Korea, which offers a diverse range of courses with varying levels of instructional scaffolding and visual aids.

OCU's courses provide an excellent case for investigating these dynamics due to their distinctive instructional delivery methods, ranging from teacher-centered lectures with minimal visual aids to those incorporating extensive learner-controlled options and visual supports. Given that OCU primarily offers fully online classes, understanding which video lecture features prompt students to re-watch lectures can provide valuable insights for enhancing online learning experiences in South Korea.

This study seeks to delve into the specific instructional factors at OCU that influence students' decisions to re-watch video lectures. Understanding the video lecture features prompting students to re-watch video lectures is crucial for enhancing the effectiveness of student engagement with video lectures in MOOCs. For these reasons the present study has these four research questions:

- RQ1: How does the frequency of scanning between text and graphs influence the necessity for students to re-watch video lectures in MOOCs?
- RQ2: What is the impact of audio-visual support on the need for students to re-watch video lectures in MOOCs?
- RQ3: How does the ease of understanding textual and visual elements (text and images) affect the likelihood of students needing to re-watch video lectures in MOOCs?
- RQ4: To what extent does the clarity of the professor's speech contribute to students' decisions to re-watch video lectures in MOOCs?

2.8 Hypotheses

There is a positive relationship between the frequency of scanning eyes between text and graphs and the need to re-watch video lectures.

There is a significant impact of audiovisual distraction on re-watching video lectures.

There is a positive relationship between comprehensibility of text and images and the need to re-watch video lectures.

There is a significant relationship between the clarity of the professor's speech on the need to rewatch the video lectures.

3. Research Methodology

3.1 Research Design

In this study's context, survey participants were queried regarding their experiences with courses offered by the Open Cyber University (OCU), which provides approximately 400 different courses to a yearly enrolment of around 120,000 students (Han, 2012). While most OCU lectures feature an instructor appearing as a talking head in front of a plain backdrop without any supplementary visual aids, other OCU lectures incorporate visual aids alongside a range of learner-controlled options, allowing students to tailor their learning experiences to their preferences. From the standpoint of instructional delivery, the level of scaffolding provided varies from one class to another, with some instructors employing more comprehensive sequencing and fading of instruction (gradual reduction of instructional support as students gain mastery over the material being taught.) than others. It's worth noting that OCU primarily offers fully online classes, and it is essential to recognize that fully online classes in South Korea typically adhere to a conventional, teacher-centered approach (Lim, Kang and Park, 2016). This underscores the importance of improving the online learning experience in the form of video lectures for students in South Korea.

3.2 Procedures and Participants

The survey items were originally drafted in English and then translated into Korean. Subsequently, an expert in e-learning and the Open Cyber University (OCU) meticulously verified the translated content for accuracy. The OCU's ethics board, responsible for evaluating the research's ethical merit and its permissible use, granted approval for the survey. The survey link was subsequently included in an invitation extended to students, inviting their participation in the research. The survey was administered over a span of four weeks, following which the collected data was input into SPSS for subsequent analysis. A total of 1545 surveys were submitted, but 7 of these proved to be incomplete, resulting in 1538 usable surveys. An initial data examination focused on identifying outliers using Cook's, Mahalanobis, and Leverage values within the primary variables. In order to detect influential observations and potential outliers, Cook's Distance and Mahalanobis Distance were applied. Cook's Distance identifies points that significantly affect regression results (Cook, 1977), while Mahalanobis

Distance considers multivariate outliers by accounting for correlations between variables (Mahalanobis, 1936). The robustness of the dataset and model was ensured by these metrics As a result of this scrutiny, 9 cases were excluded, leaving a dataset of 1529 valid cases. The tables and figures presented in the forthcoming analysis are based on this refined dataset.

To ensure the validity and reliability of the data collected from the study sample, IBM SPSS Statistics (version 23) software was used to conduct reliability tests on the data by the researcher. Cronbach's alpha test was used to measure the internal consistency among the study variables. The analysis of the data found that the scale had a good internal consistency, with a Cronbach's alpha coefficient of 0.77. Cronbach's alpha is a measure of internal consistency, indicating how well the items on a scale are related to one another. A value of 0.77 suggests that the scale is reliable, meaning that the items are measuring the same construct consistently.

The study participants were requested to respond to the survey in relation to their use of videos while studying and learning at the OCU. The dataset included representations from 126 distinct classes, which could be categorized according to the OCU's classification as follows: lifestyle and health (29%), social science (26%), humanities (11%), business and management (8%), computers and information technology (8%), foreign language (7%), natural science (7%), and mathematics (4%). While each class did not have exactly the same type of teaching materials and number of videos, the OCU operates on a 15 week teaching cycle and most courses had 15 corresponding videos, with each video averaging approximately 20 to 30 minutes in length. The participant composition featured 872 females (56.8%) and 657 males (43.2%), with an average age of 23.7. The youngest participant was 18, while the oldest was 63. It's notable that this distribution of age, gender, and field of study aligns with the typical demographics found in research on e-learning environments in South Korea (Suh and Kim, 2013).

Table 1 describes four constructs reflecting specific features of the video lectures that were created based on the questions where Likert-type scale with the range from 0 to 10, with 0 being 'strongly disagree' and 10 being 'strongly agree'.

Table 1: Table showing the research questions and their constructs.

Questions	Construct
I had to scan my eyes between text and graphs	Arrangement of text and graphs
Audiovisuals are distracting (reversed)	Audiovisual support
The text and images are easy to understand	Text-image comprehensibility
When the professor speaks it's easy to understand him	Professor's speech clarity
Sometimes I had to rewatch part of the video	Video lecture rewatching behavior

4. Results and Findings

4.1 Overview of Main Findings

Multiple linear regression analysis at 95% confidence intervals was used for the data analysis. The dependent variable "Video lecture rewatching behavior" was regressed on predicting variables: arrangement of text and graphs, audiovisual support, text-image comprehensibility, and professor's speech clarity. The independent variables significantly predict "video lecture re-watching" as the analysis showed a good model fit $F_{(4, 1524)} = 42.928$, $p < 0.01$, which indicates that the four factors under study have a significant impact on video lecture re-watching behavior. Variance Inflation Factor (VIF) and Tolerance values were examined. All predictors had VIF values below 3, which is well within the accepted threshold indicating no severe multicollinearity (Hair et al., 2010), and the tolerance values are consistently above 0.1, which further supports the absence of multicollinearity concerns. The Durbin-Watson statistic (1.793) confirmed the independence of residuals.

As shown in Figure 1, H1 evaluates whether there is a positive relationship between the arrangement of text and graphs and the need to re-watch video lectures. The results showed that the arrangement of text and graphs exhibited a significant positive relationship with the frequency of rewatching parts of the video ($\beta = 0.34$, $t =$

12.10, $p < 0.01$). Hence, H1 was supported. These results suggest that increased scanning between text and graphs is associated with a higher likelihood of needing to re-watch parts of the video, potentially indicating comprehension difficulties or cognitive overload during the learning process. H2 evaluates whether there is a significant impact of audiovisual support on re-watching video lectures, the relationship between the distraction caused by audiovisual support and the frequency of rewatching parts of the video was not statistically significant ($\beta = 0.05$, $p = 0.08$), suggesting that this variable has a weaker impact on the need to rewatch video lectures. Consequently, H2 was rejected. The results are presented in Table 2 and Figure 1.

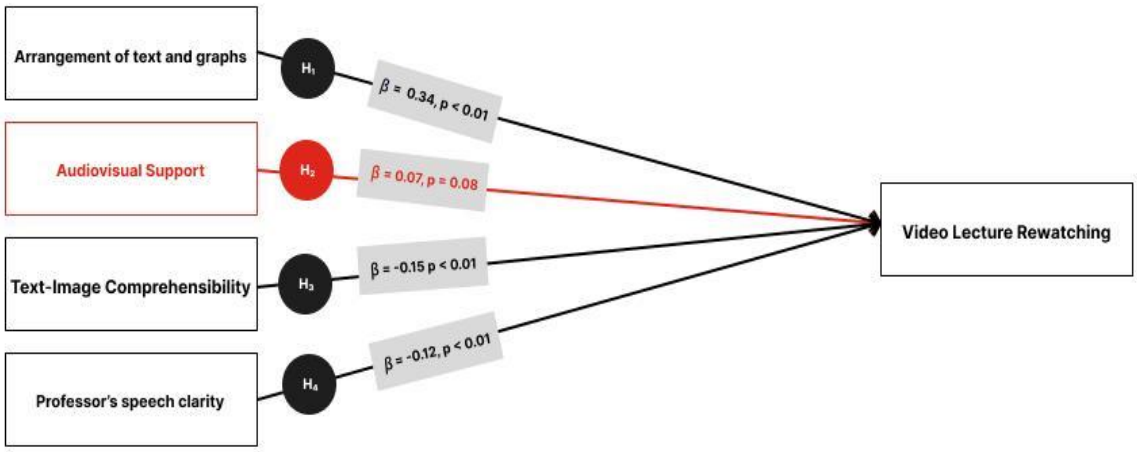

Figure 1: A diagram of multilinear regression analysis performed to evaluate the predictors and dependent variables

Another predictor variable, H3 evaluates if there is a significant positive impact on the comprehensibility of text and images with the need to re-watch video lectures. text-image comprehensibility demonstrated a statistically significant negative relationship with the frequency of rewatching parts of the video lectures ($\beta = -0.14$, $t = -3.39$, $p < 0.01$). Hence, H3 was supported. This shows that when learners perceive the texts and images in the video lectures as easy to understand, there is a decrease in the frequency of re-watching parts of the video lectures. The negative coefficient (-0.15) indicates that as the ease of understanding increases, the need to re-watch parts of the video lectures decreases. This relationship is statistically significant ($p < 0.01$), suggesting that it is unlikely to have occurred by chance.

Lastly, H4 assesses whether there is a significant impact on the clarity of the professor's speech on the need to re-watch the video lectures. The professor's speech clarity also showed a statistically significant negative association with the need to rewatch parts of the video lecture ($\beta = -0.12$, $t = -2.81$, $p < 0.01$). The results showed that when learners find it easy to understand the professor's speech in the video lectures, there is a decrease in the frequency of re-watching parts of the lectures. The negative coefficient (-0.12) suggests that clearer speech patterns contribute to a reduced need for re-watching video lectures. This relationship is statistically significant ($p < 0.01$), indicating its reliability. The results are presented in Table 2.

Table 2: Result of the multiple linear regression performed analysis on the dependent and dependent variables

Coefficients										
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	4.932	.289		17.086	.000	4.366	5.498		
	The texts images and graphs are easy to understand	-.147	.043	-.141	-3.397	.001	-.233	-.062	.341	2.936

Coefficients										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
	When the professor speaks it is easy to understand him	-.120	.043	-.117	-2.807	.005	-.204	-.036	.340	2.944
	audiovisuals are distracting (reversed)	.068	.039	.049	1.767	.077	-.008	.144	.783	1.278
	I had to scan my eyes between text and graphs	.339	.028	.323	12.102	.000	.284	.394	.830	1.205
a. Dependent Variable: Sometimes I had to rewatch parts of the video										

4.2 Discussion

The findings from this study reveal key insights into the factors that significantly influence the need for students to re-watch video lectures in MOOCs, highlighting the multifaceted nature of student engagement with video lectures. Some of the factors that were found to have a significant impact on the need to re-watch video lectures include arrangement of text and graphs, text-image comprehensibility, and the professor's speech clarity. These results suggest that arranging text and graphs to minimize eye scanning, ensure clarity of the professor's speech, and enhance text-image comprehensibility contributes to effective video lecture-watching strategies.

One of the most noteworthy findings is the positive relationship between the arrangement of text and graphs (how frequently students have to eye scan between text and graphs) and the need to rewatch video lectures. This finding suggests that frequent eye-scanning between text and graphs may contribute to cognitive overload, compelling students to re-watch parts of the video. This finding aligns with the cognitive load theory and two of its effects: redundancy effect occurring when the learners are presented with the same information in more than one modality (Sweller, 2024) and the split attention effect that promotes replacing multiple sources of information with one (van Merrienboer and Ayres, 2005). Students' working memory resources are depleted as they scan both the text and graphs and might go back and forth in order to understand the content. Previous studies support this by showing that students expend additional cognitive resources when integrating fragmented information (Mutlu-Bayraktar & Bayram, 2018). As a result of this they might therefore need to re-watch part of the video lectures if they have poor comprehension of the text and graphs used in this type of instructional content. Recent studies corroborate this finding. For instance, Raney, Campbell, and Bovee (2014) demonstrated that integrating text and graphical elements in instructional videos significantly reduces cognitive load and enhances information retention. The results suggest that designers of MOOC content should prioritize the seamless integration of textual and graphical elements to mitigate cognitive strain.

When creating and designing lecture content, instructors should employ strategies promoting optimizing the visual representation of the content to not create additional cognitive load that could impede learning. In addition, educators should strive to design instructional materials that minimize the need for extensive eye-scanning, perhaps by integrating text and graphical information more seamlessly or using annotations to guide students' attention effectively. This finding also suggests that designers of educational content should consider the principles of multimedia learning when creating instructional videos. For instance, placing text next to relevant graphics, rather than separately, can help reduce the cognitive effort required to integrate the two types of information, ultimately leading to greater recall (Mutlu-Bayraktar and Bayram, 2018). Moreover, interactive elements, such as clickable diagrams that provide additional information when needed, could help manage cognitive load by allowing students to access information at their own pace.

In addition, another finding shows that there is a significant impact of the comprehensibility of text and images on the need to re-watch video lectures. According to our findings, when learners perceive texts and images as

easy to understand, they are less likely to re-watch parts of the video lectures. This finding aligns with cognitive load theory's assertion that reducing extraneous load—such as poor visual clarity—can improve learning efficiency (Mayer, 2014).This result underscores the importance of clear and comprehensible visual aids in instructional materials as the visual clarity of instructional content emerged as a critical determinant influencing students' propensity to re-watch video lectures. While Mayer and Moreno (2003) argued that excessive audiovisual elements can lead to cognitive overload, the present findings suggest that audiovisual distractions may not play a pivotal role in students' re-watching behavior. However, another study supports this finding by indicating that poor visual clarity can hinder students' comprehension, necessitating multiple viewings to grasp the content fully (Molnar, 2017). Based on this finding, it has been identified that poor visual clarity can impede students' understanding of video lectures, necessitating the need to re-watch video lectures to achieve a deeper grasp of the content. Low comprehension resulting from poor visual clarity can perpetuate a cycle wherein students feel compelled to revisit lectures in pursuit of deeper understanding. This finding is in line with another research that noted that students struggle to comprehend images and understand text used in media when the media used in instruction is very fast with low visual clarity thereby resulting in low comprehension as this prevents students from obtaining critical information from the media (Wildemuth, et al., 2003). This aligns with the cognitive load theory, suggesting that reducing extraneous cognitive load by enhancing visual clarity can improve learning efficiency (Mayer, 2014). Moreover, the implications of this finding extend to the design of instructional materials in general. Effective visual aids should not only be clear but also well-integrated with the spoken and written components of the lecture. This integration can help prevent the cognitive overload that occurs when students have to mentally integrate disparate sources of information.

Furthermore, creating content aimed at enhancing the visual clarity of instructional materials holds promise for alleviating the burden of repetitive review and empowering students to engage more meaningfully with the course content (Koh and Ahn, 2023). Conversely, when presented with clear and comprehensible text and images, students exhibit a reduced demand for revisiting video lectures. This highlights the pivotal role of clear and comprehensible visual aids in instructional materials and video lectures within MOOCs. Designing content with a judicious balance between complexity and clarity becomes imperative in optimizing student comprehension and minimizing the need for redundant review of course materials.

Furthermore, the current study found that learners' re-watching behavior of video lectures was impacted by the professor's speech clarity. Clear and comprehensible instructor speech reduces the likelihood that students will need to re-watch parts of the lecture. This finding is in line with previous research showing that video lectures with fast- speakers might lead to students becoming confused and overwhelmed, which in turn provokes them to replay parts of video lectures (Guo, Kim and Rubin, 2014). Similarly, another study showed that when the audio is audible and intelligible, students are unlikely to replay the lecture (Cunningham, Fägersten and Holmsten, 2010). Furthermore, it has also been demonstrated that problems with auditory intelligibility can lead to a reduction in comprehension levels because students may be unable to understand what is being said. And when learners find it hard to understand some part of the lecture due to its auditory intelligibility, they may need to rewatch the lecture to understand it better. Results that are more directly tied to the clarity of the instructor specifically support the findings of this study, as it has been found that students perceive more instructor clarity when re-watching feedback portions of video lectures (Fenton, and Murphy, 2023). In practical terms, this means that instructors should aim for a moderate speaking pace and use clear, concise language. Additionally, they can benefit from using subtitles and transcripts, which have been shown to aid comprehension, especially for non-native speakers (Pilarski, et al., 2008). Providing these additional resources can help ensure that all students, regardless of their language proficiency, can understand the lecture content without needing to re-watch it multiple times. These findings, along with the results of the current study, suggest that in the context of MOOCs, learners may not need to re-watch video lectures if once the speech voice of the instructor in the video lectures is clear, and they can understand the speech easily.

Lastly, results from the study also noted that there is little to no significant impact of audiovisual support on the re-watching behavior of the learners on the MOOC platform. The study found that audiovisual support did not significantly impact the need to re-watch video lectures. While cognitive load theory suggests that excessive use of audiovisuals can lead to cognitive overload (Mayer and Moreno, 2003), another study by Lackmann, et al., 2021, found that audiovisual support in video lectures led to better engagement, impact, performance, and learning outcomes, indicating their effectiveness in fostering deeper understanding. The current study's findings imply that the presence or absence of audiovisual support alone may not be a decisive factor in students' re-watching behavior. This discrepancy could be due to the specific context of OCU's courses, where instructional styles and content delivery methods vary. It is also possible that the type and quality of audiovisual materials

play a role in their effectiveness. For example, high-quality visuals that are directly relevant to the content being discussed may be more beneficial than generic or distracting visuals. Additionally, the timing and pacing of audiovisual elements can influence their effectiveness. Well-timed visuals that reinforce the spoken content can help enhance understanding, whereas poorly timed or irrelevant visuals can cause confusion and distraction which might result in a situation where students need to rewatch the video lecture for better understanding.

Other studies confirm that the video lecture style "talking head" in which the instructor speaks directly into the camera while using little to no audiovisuals is the most effective method of video lecture production style (Ilioudi, Giannakos and Chorianopoulos, 2013). This underscores the significance of minimizing audiovisuals in video lectures as the enormous use of audiovisuals can cause cognitive overload and unnecessary distraction which can lead to the learners re-watching the video lectures. Educators and content creators for MOOCs should consider designing courses with a focus on minimizing audiovisual distractions to foster sustained engagement.

4.3 Limitations

While this study sheds light on critical aspects of video lecture engagement and the re-watching behavior of video lectures in MOOCs, certain limitations must be acknowledged. First of all, the survey methodology relies on self-reported data of a limited range of video features. While the internal consistency of the instruments used in this study was confirmed to be reliable, the results of this study could be further validated in future research through experimental conditions. Additionally, the study predominantly examines quantitative aspects, leaving room for further qualitative exploration of student engagement with video lectures and the need to re-watch video lectures in MOOCs. Further research encompassing diverse learning platforms and a mixed-methods approach could provide a more comprehensive understanding of student engagement and re-watching behavior in MOOCs. Finally, in order to conclude whether the phenomenon of re-watching video lectures could serve as a barometer of the instructional efficacy of video lectures, it is important to investigate its impact on the learning outcomes. Furthermore, future research could consider some of the factors mentioned in the present study on different populations to see if the results are generalizable.

5. Conclusion

In conclusion, this research contributes significant insights into the multifaceted nature of student engagement with video lectures in MOOCs and the underlying factors driving the need to re-watch video lectures. Based on the findings of this study the following instructional guidelines are recommended: 1) Present content that minimizes the need for extensive eye-scanning by positioning complementary textual/graphical sources in close proximity to each other. 2) Integrate text and graphical information more seamlessly or use annotations to guide students' attention effectively. 3) Clearly integrate visuals with spoken and written components of the lecture by ensuring that they complement each other rather than provide redundant or distracting information. 4) Deliver instruction in a clear and concise language that only applies to the specific learning tasks to be learned at a given time. Following this framework should help learners avoid the need to re-watch videos.

Our findings underscored the pivotal role of specific video attributes in shaping students' decisions to re-watch video lectures. Notably, the arrangement of text and graphs, the professor's speech clarity, and text-image comprehensibility emerged as significant determinants influencing re-watching behavior. The associations between text-image comprehensibility and professor's speech clarity and the need to re-watch parts of video lectures elucidate the profound impact of clear instructional delivery on student comprehension and retention. Furthermore, the positive relationship observed between the arrangement of text and graphs and the frequency of re-watching underscores the potential challenges associated with cognitive processing and information assimilation in MOOC environments. However, the absence of a statistically significant relationship between audiovisual support and the need to re-watch video lectures suggests a nuanced interplay between various video characteristics and student engagement patterns. Overall, these findings provide valuable guidance for educators, content creators, and instructional designers seeking to optimize student engagement and learning outcomes in MOOCs.

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while all intellectual contributions and final decisions regarding the content were made by us. We confirm that the use of AI was conducted ethically and transparently, in accordance with the guidelines and standards of academic integrity. All sources and references have been appropriately cited, and the originality of the work has been maintained.

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References

Al-Aghbari, M.S., Osman, M.E. and Al Musawi, A.S., 2021. Contextualizing the Global Standards for Designing Online Courses: A Design-Based Research Approach for Developing Small Private Open Courses. International Journal of Educational Methodology, 7(1), pp.1-13.

Abbakumov, D., Kravchenko, D., Kuskin, W. and Urban, A., 2020. How rewatching video lectures impacts students' performance in assessments in MOOCs. https://doi.org/10.35542/osf.io/vcd5g

Afıfy, M.K., 2020. Effect of interactive video length within e-learning environments on cognitive load, cognitive achievement and retention of learning. Turkish Online Journal of Distance Education, 21(4), pp.68-89.

Albelbisi, N.A., Al-Adwan, A.S. and Habibi, A., 2023. A qualitative analysis of the factors influencing the adoption of mooc in higher education. *Turkish Online Journal of Distance Education*, 24(2), pp.217-231. https://doi.org/10.17718/tojde.973956.

Al Ghamdi, E., Yunus, F., Da'Ar, O., El-Metwally, A., Khalifa, M., Aldossari, B. and Househ, M., 2016. The effect of screen size on mobile phone user comprehension of health information and application structure: an experimental approach. *Journal of medical systems*, 40(1), pp.1-8. https://doi.org/10.1007/s10916-015-0381-5.

Akcapinar, G. and Bayazit, A., 2018. Investigating video viewing behaviors of students with different learning approaches using video analytics. *Turkish Online Journal of Distance Education*, *19*(4), pp.116-125. https://doi.org/10.17718/tojde.471907.

Alraimi, K.M., Zo, H. and Ciganek, A.P., 2015. Understanding the MOOCs continuance: The role of openness and reputation. *Computers & Education*, *80*, pp.28-38. https://doi.org/10.1016/j.compedu.2014.08.006.

Amigud, A., Arnedo-Moreno, J., Daradoumis, T. and Guerrero-Roldan, A.E., 2017. Using learning analytics for preserving academic integrity. *International Review of Research in Open and Distributed Learning*, *18*(5), pp.192-210. https://doi.org/10.19173/irrodl.v18i5.3103.

Aparicio, M., Oliveira, T., Bacao, F. and Painho, M., 2019. Gamification: A key determinant of massive open online course (MOOC) success. *Information & Management*, *56*(1), pp.39-54. https://doi.org/10.1016/j.im.2018.06.003.

Atapattu, T. and Falkner, K., 2018. Impact of lecturer's discourse for students' video engagement: Video learning analytics case study of MOOCs. *Journal of Learning Analytics*, *5*(3), pp.182-197. https://doi.org/10.18608/jla.2018.53.12.

Banoor, R.Y., Issack, S.M. and Frank, R., 2019. The Use of Learning Analytics to Improve Online Learning Outcomes: A Systematic Literature Review.

Brame, C.J., 2016. Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education*. https://doi.org/10.1187/cbe.16-03-0125.

Bonafini, F.C., 2017. The effects of participants' engagement with videos and forums in a MOOC for teachers' professional development. *Open Praxis*, *9*(4), pp.433-447. https://doi.org/10.5944/openpraxis.9.4.637.

Burd, E.L., Smith, S.P. and Reisman, S., 2015. Exploring business models for MOOCs in higher education. *Innovative Higher Education*, *40*, pp.37-49. https://doi.org/10.1007/s10755-014-9297-0.

Chen, C.M. and Wu, C.H., 2015. Effects of different video lecture types on sustained attention, emotion, cognitive load, and learning performance. *Computers & Education*, *80*, pp.108-121. https://doi.org/10.1016/j.compedu.2014.08.015.

Cojocariu, V.M., Lazar, I., Nedeff, V. and Lazar, G., 2014. SWOT analysis of e-learning educational services from the perspective of their beneficiaries. *Procedia-Social and Behavioral Sciences*, *116*, pp.1999-2003. https://doi.org/10.1016/j.sbspro.2014.01.510.

Cook, R.D., 1977. Detection of influential observation in linear regression. Technometrics, 19(1), pp.15-18.

Costley, J., Hughes, C. and Lange, C., 2017. The effects of instructional design on student engagement with video lectures at cyber universities. Journal of Information Technology Education: Research, 16(1) .https://doi.org/10.28945/3728.

Costley, J., Fanguy, M., Baldwin, M., Lange, C., & Han, S., 2018. The role of motivation in the use of lecture behaviours in the online classroom. *Journal of Information Technology Education Research*, *17*(1), pp.471–484. https://doi.org/10.28945/4131.

Costley, J., Fanguy, M., Lange, C. and Baldwin, M., 2021. The effects of video lecture viewing strategies on cognitive load. *Journal of Computing in Higher Education*, *33*, pp.19-38. https://doi.org/10.1007/s12528-020-09254-y.

Cunningham, U.M., Fägersten, K.B. and Holmsten, E., 2010. Can you hear me, Hanoi? Compensatory mechanisms employed in synchronous net-based English language learning. *The International Review of Research in Open and Distributed Learning*, *11*(1), pp.161-177. https://doi.org/10.19173/irrodl.v11i1.774.

Dhawan, S., 2020. Online learning: A panacea in the time of COVID-19 crisis. *Journal of educational technology systems*, *49*(1), pp.5-22. https://doi.org/10.1177/0047239520934018.

Egloffstein, M. and Ifenthaler, D., 2017. Employee perspectives on MOOCs for workplace learning. *TechTrends*, *61*(1), pp.65-70. https://doi.org/10.1007/s11528-016-0127-3.

Fenton, A., & Murphy, P., 2023. Student perceptions of video feedback: Preliminary Findings. ASCILITE Publications, 398-403.

Guo, P.J., Kim, J. and Rubin, R., 2014. March. How video production affects student engagement: An empirical study of MOOC videos. In *Proceedings of the first ACM conference on Learning@ scale conference* (pp. 41-50). https://doi.org/10.1145/2556325.2566239.

Hair, J., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L., 2010. Multivariate Data Analysis. 6th (ed.) Upper Saddle River NJ.

Han, S.L., 2012. A study on the development of a course evaluation tool for Cyber University Consortium in Korea. In *International Conference on Human Computer Interaction* (pp. 331-337). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-35270-6_46.

Hsin, W.J. and Cigas, J., 2013. Short videos improve student learning in online education. Journal of Computing Sciences in Colleges, 28(5), pp.253-259.

Hussain, M., Zhu, W., Zhang, W. and Abidi, S.M.R., 2018. Student engagement predictions in an e-learning system and their impact on student course assessment scores. *Computational Intelligence & Neuroscience*. https://doi.org/10.1155/2018/6347186.

Hwang, G.J., Lai, C.L. and Wang, S.Y., 2015. Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies. *Journal of computers in education*, *2*, pp.449-473. https://doi.org/10.1007/s40692-015-0043-0.

Ilioudi, C., Giannakos, M.N. and Chorianopoulos, K., 2013, April. Investigating differences among the commonly used video lecture styles. In *Proceedings of the Workshop on Analytics on Video-based Learning, WAVe* (Vol. 13, pp. 21-27).

Jin, L. and Shang, D., 2022. What drives art education massive open online courses continuance intention? Exploring determinants from value–software–hardware–design perspective. *Interactive Learning Environments*, pp.1-17. https://doi.org/10.1080/10494820.2022.2153146.

June, S., Yaacob, A. and Kheng, Y.K., 2014. Assessing the use of YouTube videos and interactive activities as a critical thinking stimulator for tertiary students: An action research. International Education Studies, 7(8), pp.56-67. https://doi.org/10.5539/ies.v7n8p56.

Kim, J., Guo, P.J., Seaton, D.T., Mitros, P., Gajos, K.Z. and Miller, R.C., 2014. Understanding in-video dropouts and interaction peaks in online lecture videos. In *Proceedings of the first ACM conference on Learning@ scale conference* 31-40. https://doi.org/10.1145/2556325.2566237.

Kizilcec, R.F., Bailenson, J.N. and Gomez, C.J., 2015. The instructor's face in video instruction: Evidence from two large-scale field studies. *Journal of Educational Psychology*, *107*(3), p.724. https://doi.org/10.1037/edu0000013.

Koh, T. and Ahn, J., 2023. The effects of student-engaged video lectures on motivation for sustainable flipped learning. Sustainability, 15(5), p.4617.

Koumi, J., 2013. Pedagogic design guidelines for multimedia materials: A call for collaboration between practitioners and researchers. Journal of Visual Literacy, 32(2), pp.85-114.

Kuznekoff, J.H., 2020. Online video lectures: the relationship between student viewing behaviors, learning, and engagement. AURCO Journal, 26, pp.33-55.

Lackmann, S., Léger, P.M., Charland, P., Aubé, C. and Talbot, J., 2021. The influence of video format on engagement and performance in online learning. Brain Sciences, 11(2), p.128.

Lange, C. and Costley, J., 2019. The negative impact of media diversity on self-regulated learning strategies and cognitive load. *Issues in Educational Research*, *29*(1), pp.158-179. http://www.iier.org.au/iier29/lange.pdf

Lange, C. and Costley, J., 2020. Improving online video lectures: learning challenges created by media. *International Journal of Educational Technology in Higher Education*, *17*, pp.1-18. https://doi.org/10.1186/s41239-020-00190-6.

Le, A., Joordens, S., Chrysostomou, S. and Grinnell, R., 2010. Online lecture accessibility and its influence on performance in skills-based courses. *Computers & Education*, *55*(1), pp.313-319. https://doi.org/10.1016/j.compedu.2010.01.017.

Leppink, J., Paas, F., Van der Vleuten, C.P., Van Gog, T. and Van Merriënboer, J.J., 2013. Development of an instrument for measuring different types of cognitive load. *Behavior research methods*, *45*, pp.1058-1072. https://doi.org/10.3758/s13428-013-0334-1.

Li, N., Kidzinski, L., Jermann, P., & Dillenbourg, P., 2015. How do in-video interactions reflect perceived video difficulty?. Proceedings of the European MOOCs stakeholder summit 2015, 112-121.

Lim, K., Kang, M. and Park, S.Y., 2016. Structural relationships of environments, individuals, and learning outcomes in Korean online university settings. *International Review of Research in Open and Distributed Learning*, *17*(4), pp.315-330. https://doi.org/10.19173/irrodl.v17i4.2500.

Mahalanobis, P.C., 2018. On the generalized distance in statistics. Sankhyā: The Indian Journal of Statistics, Series A (2008-), 80, pp.S1-S7.

Maloney, S., Axelsen, M., Stone, C., Galligan, L., Redmond, P., Brown, A., Turner, J. and Lawrence, J., 2023. Defining and exploring online engagement fatigue in a university context. Computers and Education Open, 4, p.100139.

Martin, L., Mills, C., D'Mello, S.K. and Risko, E.F., 2018. Re-watching lectures as a study strategy and its effect on mind wandering. Experimental Psychology.65(5), pp.297-305.

Mayer, R.E., 2014. Multimedia instruction. *Handbook of research on educational communications and technology*, pp.385-399. https://doi.org/10.1007/978-1-4614-3185-5_31.

Mayer, R.E. and Moreno, R., 2003. Nine ways to reduce cognitive load in multimedia learning. *Educational psychologist*, *38*(1), pp.43-52. https://doi.org/10.1207/s15326985ep3801_6.

Molnar, A., 2017. Content type and perceived multimedia quality in mobile learning. *Multimedia Tools and Applications*, *76*, pp.21613-21627.

Mutlu-Bayraktar, D., & Bayram, S. (2018). Evaluation of situations causing split of attention in multimedia learning environments via eye-tracking method. In Digital Multimedia: Concepts, Methodologies, Tools, and Applications (pp. 348-372). IGI Global.

Nicolaou, C., Matsiola, M. and Kalliris, G., 2019. Technology-enhanced learning and teaching methodologies through audiovisual media. *Education Sciences*, *9*(3), p.196. https://doi.org/10.3390/educsci9030196.

Palmer, S., Chu, Y. and Persky, A.M., 2019. Comparison of rewatching class recordings versus retrieval practice as post-lecture learning strategies. American Journal of Pharmaceutical Education, 83(9), p.7217.

Patel, B., Yook, G., Mislan, S. and Persky, A.M., 2019. Exploring the consequences on memory of students who know they have access to recorded lectures. American journal of pharmaceutical education, 83(5), p.6958.

Pilarski, P.P., Johnstone, A. D., Pettepher, C.C. and Osheroff, N., 2008. From music to macromolecules: Using rich media/podcast lecture recordings to enhance the preclinical educational experience. *Medical teacher*, *30*(6), pp.630-632. https://doi.org/10.1080/01421590802144302.

Pozón-López, I., Kalinic, Z., Higueras-Castillo, E. and Liébana-Cabanillas, F., 2020. A multi-analytical approach to modeling of customer satisfaction and intention to use in Massive Open Online Courses (MOOC). *Interactive Learning Environments*, *28*(8), pp.1003-1021. https://doi.org/10.1080/10494820.2019.1636074.

Rackaway, C., 2012. Video killed the textbook star?: Use of multimedia supplements to enhance student learning. *Journal of Political Science Education*, *8*(2), pp.189-200. https://doi.org/10.1080/15512169.2012.667684.

Raney, G.E., Campbell, S.J. and Bovee, J.C., 2014. Using eye movements to evaluate the cognitive processes involved in text comprehension. J*ournal of Visualized Experiments*, 83. https://doi.org/10.3791/50780.

Rodriguez, S., 2007. *A practical model for multimedia development*. *Society for Information Technology & Teacher Education International Conference.* Texas, USA. March 6 2027. North Carolina: Association for the Advancement of Computing in Education.

Roehling, P.V., 2018. *Flipping the college classroom: An evidence-based guide*. Springer. https://doi.org/10.1007/978-3-319-69392-7_7.

Sanchez, C.A. and Goolsbee, J.Z., 2010. Character size and reading to remember from small displays. *Computers & Education*, *55*(3), pp.1056-1062. https://doi.org/10.1016/j.compedu.2010.05.001.

Sinha, T., Jermann, P., Li, N. and Dillenbourg, P., 2014. Your click decides your fate: Inferring information processing and attrition behavior from mooc video clickstream interactions. In *Proceedings of the EMNLP 2014 Workshop on Analysis of Large Scale Social Interaction in MOOCs.* pp. 3-14. https://doi.org/10.3115/v1/w14-4102.

Scagnoli, N.I., McKinney, A. and Moore-Reynen, J., 2015. Video lectures in eLearning. In *Handbook of research on Innovative Technology Integration in higher education.* pp. 115-134. https://doi.org/10.4018/978-1-4666-8170-5.ch006.

Seaton, D.T., Bergner, Y., Chuang, I., Mitros, P. and Pritchard, D.E., 2014. Who does what in a massive open online course?. *Communications of the ACM*, *57*(4), pp.58-65. https://doi.org/10.1145/2500876.

Schmeck, A., Opfermann, M., Van Gog, T., Paas, F. and Leutner, D., 2015. Measuring cognitive load with subjective rating scales during problem solving: differences between immediate and delayed ratings. *Instructional Science*, *43*, pp.93-114. https://doi.org/10.1007/s11251-014-9328-3.

Shah, D., 2018. By the numbers: MOOCs in 2018 central's MOOC report. [Online]. Available at https://www.classcentral.com/report/MOOCs-2015-stats/ [Accessed January 1, 2024].

Shao, Z. and Chen, K., 2021. Understanding individuals' engagement and continuance intention of MOOCs: the effect of interactivity and the role of gender. *Internet Research*, *31*(4), pp.1262-1289. https://doi.org/10.1108/intr-10-2019-0416.

Stockwell, B.R., Stockwell, M.S., Cennamo, M. and Jiang, E., 2015. Blended learning improves science education. *Cell*, *162*(5), pp.933-936. https://doi.org/10.1016/j.cell.2015.08.009.

Sweller, J., 2022. The role of evolutionary psychology in our understanding of human cognition: Consequences for cognitive load theory and instructional procedures. Educational Psychology Review, 34(4), 2229-2241.

Sweller, J., 2024. Cognitive load theory and individual differences. *Learning and Individual Differences*, *110*, p.102423. https://doi.org/10.1016/j.lindif.2024.102423.

Suh, S. and Kim, S., 2013. Study on policy for an entrance quota of cyber universities. *Korea Educational Information and Research Service.*

Triay, J., Sancho-Vinuesa, T., Minguillón, J. and Daza, V., 2016. Analyzing non-linear video usage in an introductory x-MOOC about basic linear algebra.

Tzeng, J.W., Lee, C.A., Huang, N.F., Huang, H.H. and Lai, C.F., 2022. MOOC evaluation system based on deep learning. *International Review of Research in Open and Distributed Learning*, *23*(1), pp.21-40. https://doi.org/10.19173/irrodl.v22i4.5417.

Van Merrienboer, J.V. and Ayres, P., 2005. Research on Cognitive Load Theory and Its Design Implications for E-learning: Introduction to the special issue. *Educational Technology Research and Development*, 53, pp. 5–13. https://doi.org/10.1007/bf02504793.

Wildemuth, B.M., Marchionini, G., Yang, M., Geisler, G., Wilkens, T., Hughes, A. and Gruss, R., 2003. How fast is too fast? Evaluating fast forward surrogates for digital video. In *2003 Joint Conference on Digital Libraries, 2003. Proceedings.* pp. 221-230 . IEEE. https://doi.org/10.1109/jcdl.2003.1204866.

Xiaojun, L., Zongkui, Z. and Zhongfeng, X., 2010. The Effect of Audio-visual Teaching on Learning Burnout. In *2010 International Conference on E-Business and E-Government.* pp. 1669-1671 . IEEE. https://doi.org/10.1109/icee.2010.422.

Zhang, J., Gao, M. and Zhang, J., 2021. The learning behaviours of dropouts in MOOCs: A collective attention network perspective. *Computers & education*, *167*, p.104189. https://doi.org/10.1016/j.compedu.2021.104189.

Zhong, N., Li, M., Wu, Y. and Lu, S., 2011, May. The impact of different forms of statistical information on reading efficiency, effect, and mental workload: An eye-tracking study. In *The 2011 IEEE/ICME International Conference on Complex Medical Engineering.* pp. 97-102. IEEE. https://doi.org/10.1109/iccme.2011.5876712.