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A systematic review for identifying instructional design strategies and principles in extended massive open online courses (xMOOCs)

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Abstract

Extended massive open online courses (xMOOCs), which follow traditional university learning models, have become a popular platform for structured learning over the past few years. Despite this popularity, xMOOCs are generally poorly designed, which has caused dramatic drop-out rates; therefore, they require extensive revision using instructional design strategies and principles. Hence, the purpose of this study is to conduct a systematic review of empirical studies that present best practices in the instructional design of xMOOCs and inductively identify effective instructional principles with the aim of improving the effectiveness of xMOOC instruction. We used the Population, Intervention, Comparison, Outcome, and Study Design (PICOS) framework as a guide to design our research question, we followed the PRISMA framework to conduct a robust systematic review through Covidence, and we finalized 16 related articles to be included in this study. There are four main findings: 1) this study explores effective xMOOC instruction-related research design methods and approaches and will provide future researchers deep insight into conducting empirical research on xMOOC instructional design; 2) this study provides insight into xMOOC participants and intervention characteristics for future researchers and instructors to understand the most common course design patterns and participant features; 3) this study identifies xMOOC typical instructional design strategies to promote the understanding of the best practices for designing high-quality xMOOCs; and 4) instructional design principles are inductively extracted from instructional best practices to provide researchers, policymakers, instructors and xMOOC platform providers with deep insights for promoting effective teaching and learning as well as for offering recommendations for future designers to avoid design drawbacks and promote design strengths.

Keywords

Massive open online courses, MOOCs, instructional design, instructional design principles, instructional design strategies, best practices, systematic review

Summary for Lay Audience

Massive open online courses (MOOCs) are now widely used, and their free and open nature attracts students from all over the world, but as the popularity of the courses increases, more and more problems arise, such as high dropout rates and low quality. In order to find ways to improve the quality of the courses and how to do so, this study extracts specific instructional strategies and principles from existing articles that are based on empirical evidence. From the perspective of the problems analyzed and solved, more implications of the MOOCs are explored, which provide great guidance for the design of future MOOC revisions.

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Chapter 1

1 Introduction

A massive open online course (MOOC) is a powerful, web-based model of learning that serves as a "middle ground for teaching and learning between the highly organized and structured classroom environment and the chaotic open web of fragmented information" (Siemens, 2013, p. 6). Over the past decade, MOOCs have become popular models of online learning, in part, due to three main attributes: "massive," "open," and "online course." First, a MOOC is an "online course" and therefore gives geographically dispersed learners across the world access to remote, structured learning opportunities. Second, the "open" nature of a MOOC provides learners, especially those who may be financially or geographically restricted, such access electronically, with both minimal constraints and costs. Lastly, a MOOC is "massive," thereby enabling large numbers of learners, usually a few hundred to a few thousand, to simultaneously access these learning opportunities.

Further, a few other elements have contributed to MOOCs' increasing popularity in both students and professional populations. According to Castaño-Muñoz et al. (2017), the dominant group of people who enrol in MOOCs are unemployed or under employed, and MOOCs award certificates of completion at a relatively low cost to those who request them for prospective employment purposes. Additionally, MOOCs also allow working professionals to advance their careers by providing them with opportunities to acquire additional professional knowledge and skills and learn from and work with colleagues (other learners) and experts (educators) in their respective fields. In any case, MOOCs usually emphasize learners' autonomy to self-manage their progress towards course completion at their own pace at minimal pressure. This form of independent learning, which is unusual in other modes of learning, has potential to improve learner engagement, understanding, and completion of course content (Rafiq et al., 2019).

1.1 Classification of MOOCs

MOOCs are usually classified by both the nature of course content as well as the characteristics of the target population. Currently, MOOCs can be classified in one of five main configurations: extended MOOC, connectivist MOOC, blended MOOC, hybrid MOOC or quasi-MOOC.

1.1.1 "eXtended" MOOCs (xMOOCs)

xMOOCs, the focus of the systematic review, are underpinned by cognitive-behaviorist pedagogical approaches, which emphasize minimal learner-educator interactions. As such, xMOOCs usually follow traditional, outcomes-based university models where learners consume knowledge taught by experts (educators). In a typical xMOOC, course content is transmitted through asynchronous lectures, assignments are computer-graded, and instructor feedback is rarely provided. Coursera, edX, and Udacity, are examples of popular xMOOC delivery platforms.

1.1.2. cMOOC

A cMOOC (Connectivist MOOC) is described as a course that concentrates on the collaborative development of learning activities and emergent learning outcomes based on "autonomous learners connecting with each other across open and connected social media and sharing knowledge through their own personal contributions" (Beats, 2016). The connectivist pedagogy underpins cMOOCs (Simens, 2013). cMOOCs concentrate on improving the "knowledge, creativity and communication" of learners (Seidametova, 2015); autonomy of learners; diversity, interactivity and openness (Downes, 2014); and interaction between students and students and instructors (Seidametova, 2015). One of the most popular cMOOCs is Duolingo.

1.1.3. Quasi-MOOC

A quasi-MOOC is described by Siemens (2013) as “asynchronous learning resources” that “provide Web-based tutorials”. Quasi-MOOCs enable non-certificate teachers to design the courses (Seidametova, 2015). One of the most popular quasi-MOOCs is Khan Academy.

1.1.4. hMOOC

An hMOOC (hybrid MOOC) is a course that incorporates aspects from both c and x MOOC types together. Based on the use of a specific e-learning platform for formal training (the x- dimension of the MOOC) and a social network for informal training (the c-dimension of the MOOC) (Koutsakas, et al.).

Some researchers treat hMOOC as a hybrid or flipped class, as they believe that a hybrid MOOC is a course that combines an online program and a face-to-face classroom together (Seidametova, 2015), which is similar to a bMOOC.

1.1.5. bMOOC

Youself et al. (2014) described bMOOC (blended MOOC) as a blended learning environment that incorporates both “in-class interaction” and “online learning components” together. Some researchers call bMOOCs hybrid MOOCs, mixed MOOCs, or flipped classrooms as well.

The most complex of these configurations is that of xMOOCs, which require extensive instructional design. Smith and Ragan (2005) define “instructional design” as “the systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation” (as cited in Brown & Green, 2016, p. 4). Thus, employing a set of exemplary instructional design strategies congruent with underlying instructional design principles is imperative when developing and delivering xMOOCs.

1.2 Problem Statement

Instructional design determines the pedagogic effectiveness of course. It has been defined as a pedagogic process of translating instructional principles as an underpinning pedagogical organization of learning plans and thereby provide significant learning experiences (Margayran et al., 2015; Smith & Ragan, 2005; Nilson & Goodson, 2017). Instructional design principles are among the main factors that influence the course quality, learners' attrition rate, students' outcomes, and motivations in xMOOCs (Mayer, et al., 2015; Oh, et al., 2019). It can be defined as "relationship that is always true under appropriate conditions regardless of program or practice" (Merril, 2002, p.43), the center of instructional design by offering instructors or course designers an "organization of the structures, functions and processes that allow us to learn, think and solve problems associated with the biologically secondary knowledge" (Chen et al., 2017, p.295). Furthermore, integrating instructional design principles into xMOOCs can enhance students' learning experiences (Clark & Mayer, 2011).

Despite the importance of instructional design principles, many previous studies have focused on exploring the use of specific principles in MOOCs rather than investigating what the most effective principles for xMOOCs instructions are. For example, some studies revealed the absence of any specific principles applied in xMOOCs (Mayer et al., 2015; Margaryan, et al., 2015). Although several studies deductively integrated and exemplified a set of particular established design principles into their studies (Oh, et al., 2019; Margaryan, et al.,2014; Yilmaz, et al., 2017; Hollebrands & Lee, 2020), surprisingly, little research concentrate on inductively synthesizing xMOOC instructional design principles.

Furthermore, effective xMOOC instructional strategies play a significant role in enhancing learning and course quality through helping focus students' expectations, motivations

and engagement (Rezaei, et al., 2017). Despite the importance of instructional design strategies, many previous studies have placed an emphasis on investigating the process of how instructional strategies influence learners' learning experiences (Jung et al., 2019; Liu, et al., 2016) rather than identifying what best practices can be applied in extended MOOCs. For instance, learners' attitude and behaviors are affected by the strategies used in MOOCs (Waston, et al., 2016); intermittent presence of teacher is a significant instructional strategy to enhance students' learning satisfactions (Yi, et al., 2019). Notably, these empirical results vary from study to study within a particular research context, and little research has concentrated on identifying a set of synthesized empirical based instructional design strategies in xMOOCs. As such, this systematic review can provide a synthesized view of xMOOC's instructional design strategies and principles.

1.3 Purpose of Statement

Thus, the purpose of our prospective study is four-fold: to systematically identify how exemplary instructional design strategies, or best practices[1], are employed in developing and delivering xMOOCs, to identify a set of underlying, influential instructional principles that future instructional designers should apply to develop and deliver xMOOCs effectively, to explore effective xMOOC instruction-related research design methods and approaches, and to identify xMOOC intervention patterns and participants' characteristics. The research question of this systematic literature review is: "What instructional design strategies and principles lead to well-

[1] "Best practices" can be defined as the "actions, procedures, techniques, strategies, and such, underpinned by epistemologically sound theories when applied/implemented properly result in a predefined and preidentified intended outcome where the efficacy of the outcome cannot be realized by most other means effectively and efficiently" (Puvirajah, 2021).

developed xMOOCs, as demonstrated by empirical-based best practices in xMOOC instructional design?"

This thesis is structured into five chapters. In chapter 2, we provide the theoretical lens of instructional principles for structuring appropriate instructional strategies in online education based on existing literature. We also provide a deep insight of the relationships between each principle and strategy. In chapter 3, we outline the entire research method and process of conducting this robust systematic review. Further, in chapter 4, we describe the results and findings of this review and categorize three groups of instructional design according to theoretical models in the literature review section. We also report the characteristics of xMOOC intervention characteristics and research patterns. In chapter 5, we discuss the best practices of instructional design in xMOOCs and extract effective instructional principles of designing xMOOCs from reported findings. We will also discuss the significance of instructional principles and strategies in xMOOC development, effectiveness and future direction.

Chapter 2

2 Literature review

In this chapter, we introduce the instructional principles adapted in this study. We summarized these principles based on Merril's (2002) "First Principles of Instruction (FPI)," Margayran et al.'s (2015) "Merril +" criteria, and Chickering and Gamson's (1987) "Seven Principles for Good Practice (SPGP)." These three sets of principles are systematically summarized from existing educational theories and have been applied in numerous studies (e.g., Badali et al., 2020). We combine evidence from previous studies in online learning to show the appropriateness of using these principles as supportive instructional models for our study on instructional design in MOOCs.

2.1 First Principle of Instruction (FPI)

The First Principles of Instruction (FPI) were identified by Merril (2002) based on a systematic review of many instructional theories and pedagogical models. The FPI provide an effective instructional structure for teachers in the design and delivery of their courses in any educational context (Merril, 2002; Lo et al., 2018). It is worth noting that the concept of the first principles of instruction was identified by Merril (2002) from the description of the instructional basic methods categorized by Reigeluth (1999). As Merril (2002) noted, the definition of basic methods emphasizes a relationship that is "always true" (p.43) in a particular context without paying close attention to various practices or implementations, which was also called principle by Merril (2002). A principle can be implemented through many activities and strategies (Merril, 2002).

Merril (2002) reviewed a variety of instructional design theories and identified that problem-centeredness was stressed as important to instruction, and four instructional phases were also identified as important to the learning process of students: "activation of prior experience, demonstration of skills, application of skills and integration of these skills into real world activities" (p.44). This is an instructional cycle beginning with activation and proceeding through to integration and is centred on real-world, problem-based learning context, as shown in Figure 1.

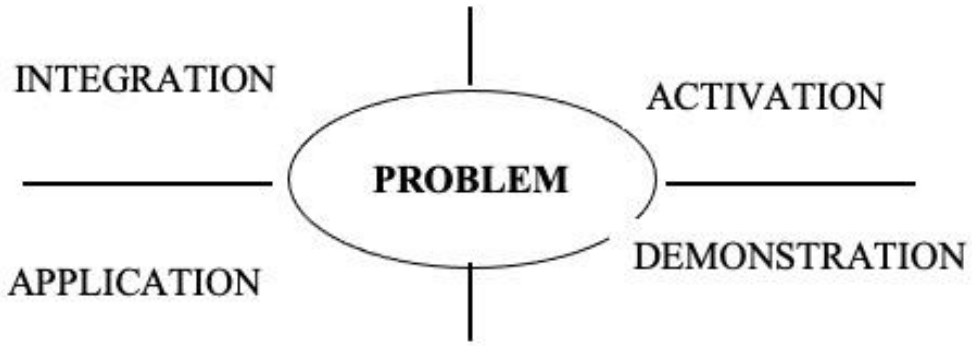

Figure 1 Merril's Four Instructional Phases for Effective Instruction.

Accordingly, problem-centeredness is the main instructional principle in FPI. Four more principles were extracted for each of these four phases for effective learning and teaching (Merril, 2002). As such, these five principles make up the FPI (Table 1) and are widely accepted by numerous studies.

Table 1 First Principles of Instruction (Merril, 2002)

Principles	Major implications
Problem-centered	Learning is promoted when learners are engaged in solving real-world problems.
Activation	Learning is promoted when relevant previous experience is activated.

Demonstration	Learning is promoted when the instruction demonstrates what is to be learned rather than merely telling information about what is to be learned.
Application	Learning is promoted when learners are required to use their new knowledge or skill to solve problems.
Integration	Learning is promoted when learners are encouraged to integrate (transfer) the new knowledge or skill into their everyday life.

The core features of the FPI are effectiveness, engagement, design-oriented, and applicable to any system (Merril, 2002; Collins & Margaryan, 2005). Specifically, the FPI note the importance of integrating new skills into real life and encouraging students to solve problems by using their new knowledge, which effectively enhances learning outcomes. Additionally, the FPI facilitate meaningful learning and build on the foundation of prior knowledge, which promotes learners' engagement of their learning performance by activating their previous learning experience. It is worth noting that demonstration and application are essential principles in FPI that emphasize the process of creating and designing learning atmospheres for students to acquire knowledge rather than simply telling learners how to acquire skills. In other words, the implementation of the FPI directly promotes the effectiveness of learning and teaching (Merril, 2002).

Building on Merril's (2002) FPI, Collis and Margayran (2005) created new principles, which they referred to as "Merril +" criteria, for problem-based learning. They structured an initial framework of the "Merril +" criteria and examined their ideas through empirical research. In 2008, Margayran et al. proposed a more effective "Merril +" model, with five additional

principles (Table 2). These ten principles have been perceived by many educators (e.g., Badali et al., 2018; Hendriks, et al., 2020; Margaryan, et al., 2014) as primary course instructional principles, particularly in online learning.

Table 2 "Merril +" Instructional Principles (Margaryan et al., 2014)

Principles	**Major implications**
Collective knowledge	Learning is promoted when learners contribute to the collective knowledge.
Collaboration	Learning is promoted when learners collaborate with others.
Differentiation	Learning is promoted when different learners are provided with different avenues of learning, according to their need.
Authentic resources	Learning is promoted when learning resources are drawn from real-world settings.
Feedback	Learning is promoted when learners are given expert feedback on their performance.

2.1.1. Evidence for the First Principles of Instruction

Many researchers have applied the FPI when designing and delivering their courses (e.g., Badali et al., 2020; Kuba et al., 2021; Collins & Margaryan, 2005) or when assessing the quality of their courses (e.g., Badali et al., 2016; Jalilehvand, 2016; Chukwuemekaet al., 2014). Lee and Koszalka (2016) demonstrated that the implementation of the FPI has a positive impact on promoting undergraduate students' cognitive engagement. They concluded that "greater implementation of the First Principles of Instruction in courses significantly increases students' use of deep cognitive strategies such as elaboration, organization, and critical thinking strategy

and self-regulated strategies" (p. 371). Badali et al. (2020) identified that using FPI as course design theoretical frame can enhance learner's satisfaction and engagement. Gardner et al. (2019) incorporated the FPI into the design and delivery of online courses for students and found a positive correlation between FPI and effective learning as well as the enhancement of learners' "achievement of complex skills" (p. 513). In addition, Frick et al. (2009) and Jalilehvand (2016) also studied the application of the FPI and concluded that the FPI have a significant impact on students' learning expectations, satisfaction, and creativity. Further, Klein and Mendenhall (2018) have empirically examined how designers have applied the FPI to design MOOCs and identified what specific factors affect the implementation of FPI (e.g, time constraints and designers experiences). We explicitly described particular First Principles of Instruction (Merril, 2002) and "Merril +" model (Margaryan, 2008) below.

2.1.2. Problem-centered

Learning is promoted when learners are engaged in solving real-world problems. Merril (2002) deeply integrated the existing theories and found that a problem-centered instructional model plays an important role in creating a beneficial learning environment for learners. Specifically, as the core instructional principle in the FPI, problem-centered principles encourage students to improve their skills or knowledge through solving real problems and dealing with tasks, thereby promoting effective learning (Jalilehvand, 2016; Badali et al., 2016).

The problem-centered principle provides a sequence of tasks for students to deal with, which promotes meaningful learning by guiding learners to foster knowledge and solve problems through real practices (Merril & Gilbert, 2008). The problem-centered principle is related to the learning model of cognitive processes. In cognitive processes, associative memory and mental models are two primary cognitive models.

Associative memory is defined in the following way: “items are linked together in memory such that when one item is presented the learner can recall the other item” (Merril & Gilbert, 2008, p. 201). Specifically, associative memory has a negative impact on long-term memories because it requires a large amount of practice to build associations to prior experiences or skills (Merril & Gilbert, 2008). In contrast, the mental model plays a positive role in meaningful learning, which is defined as an evidence-based real practice for a complete problem. Users of the mental model “tend to be more stable and resist forgetting” (Merril & Gilbert, 2008, p.201).

The problem-centered principle is a process of interacting with problems, promoting problem-solving skills and developing new mental models for learners (Merril & Gilbert, 2008). As such, the problem-centered principle is associated with the mental model, which promotes students’ long-term memory and effective learning. Specifically, objective demonstration, task level and setting progressive tasks are recognized as three important instructional strategies in the problem-centered principle (Merril, 2002), as presented below.

2.1.2.1. Objective demonstration

Merril (2002) identified objective demonstration, task level, and progressive tasks as three effective principles of course instruction according to earlier theorists. Objective demonstration is different from traditional abstract objective introduction, as it shows task examples to effectively provide paths for learners to follow instructions and improve the learning completion rate. Similarly, Perkins and Unger (1999) noted that explicit descriptions of course goals, content, and knowledge before the curriculum starts promote meaningful learning by supporting students to understand abstract general concepts and information. In the application

of online education, the demonstration of the objectives in each session directly affects learners' satisfaction in massive open online courses (Badali, et al., 2020).

2.1.2.2. Task Level

Task level is another principle that instructors should focus on. In the FPI (Merril, 2002), task level refers to creating a learning atmosphere in students' real life. In other words, the problem sets in the course should be relevant and interesting to students' lives to more effectively engage their attention. Perkins and Unger (1999) stressed the importance of connecting the task level to learners' understanding in their guideline on Teaching and Learning for Understanding, as they state that "topics should be accessible and interesting to students" to effectively generate "students' construction of the understanding". In Reigeluth et al.'s (2016) instructional design theories and models, they identified this principle as a primary course instruction, in which relevant topics or problems effectively engage learners' attention and interests. It is worth noting here that allowing learners to choose preferred problems that are relevant to their real life enhances the responsibility of learners and hence promotes the course completion and effective learning.

2.1.2.3. Progressive tasks

A highly effective course task is designed for students progressively. Merril (2002) argued that only giving students simple tasks is not effective; instead, setting problems from simple to complex has a more positive impact on students' learning performance because "the students' skills gradually improve until they are able to solve complex problems" (p.46). As such, the problem-centered principle is comprised of the course objective, task level, and sequence setting, which impact the course quality and effectiveness.

2.1.3. Activation

Learning is promoted when relevant previous experience is activated (Merril, 2002), and the same is true for online education. Internet-based learning provides students with platforms and opportunities for searching for content or knowledge beyond the course, which promotes knowledge construction (Grant &Thornton, 2007). In addition, Hathaway (2014) emphasized that online learning promotes active learning because online databases or websites provide opportunities and enrich information for learners to self-direct and self-monitor their research or study; as such, internet-based courses promote learning activation. Merril (2002) categorized prior experience, new experience, and knowledge organization as part of the activation phase, as presented below.

2.1.3.1. Prior experience

In the FPI (Merril, 2002), activation is relative to learners' experience; specifically, connecting learners' prior experience is important to motivating them to grasp new knowledge. This is because connecting students' prior experience or knowledge promotes effective learning by promoting learners' understanding (Perkins & Unger, 1999; Jalilehvand, 2016; Badali, et al., 2016).

In addition, Reigeluth et al. (2016) also stressed the importance of recalling prior knowledge or experience as significant instructional strategy for promoting effective learning. Specifically, this means that encouraging learners to discuss what they are learning is much more efficient than just having them memorize the knowledge (Hathaway, 2014). Accordingly, providing relevant experience has also been noted as an important instructional principle by Merril (2002) and Chicking and Gamson (1987), who identified that learning is promoted by activating students' prior knowledge. Activating learners' prior learning experience and knowledge in real life helps support the application of new skills (Badali, et al., 2020).

2.1.3.2. New experience and organization

To promote instructional effectiveness, creating appropriate mental models for students is necessary. Specifically, the course instruction needs to connect with students' real-life experience, which means setting relevant and interesting course themes is important for helping students organize the new knowledge into their daily experience. The course structure is relevant to this area, as Merril (2002) stressed that mental models are effective instructional interventions for promoting meaningful learning and teaching; accordingly, a reasonable course structure can supply the lack of a mental model in the delivery of a course and thereby facilitate learners' acquisition of problem solving skills. Collins et al. (1987) also documented the necessity of embedding practices into the real social context to help learners grasp the characteristics of different best practices, as this can promote students' understanding of abstract conceptual models.

2.1.4. Demonstration (Show me)

Learning is promoted when the instruction demonstrates what is to be learned rather than merely talking about information that needs to be learned. Merril (2002) elaborated on how this principle is an explicit portrayal of works and tasks, which is the first step in course instruction. In particular, meaningful learning takes place through observing and imitating others, and demonstration has long been recognized as a foundational effective instructional principle by many educators (Cooper & Higgins, 2015; Gog, et al., 2009). Skill and knowledge acquisition are promoted when learners construct their behavior and implementation strategies through observing experts' "error-free movements" (Wouters et al., 2007).

Demonstration has a significant role in promoting the understanding of learners by presenting opportunities for observation and imitation, which is the basic principle of priming the

operation of the same action (Gog, et al., 2009). In the learning environment of online education, the principle of demonstration seems to be more easily implemented (Badali, et al., 2018). The reason for this is that computer-based learning relies on technological tools and the massive resource of the internet, which facilitates the use of graphics, animations or videos for learners for effective demonstration (Badali, et al., 2018).

In relation to the demonstration phase, Merril (2002) emphasized the principles of the consistency of demonstration, learner guidance and media setting. It is worth noting that the cognitive model and cognitive load theory have been associated with the principle of learner guidance and multimedia in the process of instruction.

2.1.4.1. Demonstration consistency

Different learning activities result in different learning outcomes, and keeping demonstration consistent with the intended course content is vital to improving effective learning. Gazzola et al. (2007) stressed that observing action is a vital prerequisite for meaningful learning.

2.1.4.2. Learner guidance

In addition, explicit guidance is important for learners as well. Merril (2002) identified two effective methods for providing learning guidance. First, learning navigation plays an important role in promoting learning effectiveness by improving students' attention. Second, offering diverse perspectives on a given topic has a positive impact on promoting students' cognitive load.

Presenting learning guidance not only can keep learners from missing important information, but can also promote students' construct schemas (Kalyuga, et al., 2003). In particular, an efficient instruction structure reduces the cognitive load on working memory.

Specifically, for novice learners, a lack of learning guidance means more time is wasted on seeking extra resources or finding support to deal with issues, which increases their working memory load and reduces their effective learning (Kalyuga, et al., 2003).

In addition to the working memory load, mental models are another important cognitive process for meaningful learning. However, without learner guidance, students can have difficulty connecting and associating new knowledge with their existing mental model, which is not suitable for new positions (Merril & Gilbert, 2008). Specifically, the activation of new mental models for new experiences and knowledge is ignored by learners. As such, providing guidance for students is an important instruction principle.

2.1.4.3. Media

Media demonstration also improves learners' cognitive load. Merril (2002) emphasized the importance of utilizing multimedia, such as combining audio and videos together to promote effective learning. The multimedia principle was first emphasized by Mayer (2009), who stated that the purpose of multimedia instruction is to promote learning through presenting words and pictures. Animation, graphics, video, and onscreen texts are common components of multimedia instruction (Mayer, 2017). The application of multimedia instruction in online learning has a positive impact on effective learning and teaching because students are able to foster knowledge through computer-based words and graphics (Mayer, 2017). Dynamic visualization has been recognized as an effective form of instruction in any type of learning by "assisting students to perceive the temporal changes" (Gog, et al., 2009, p.24).

The importance of designing a multimedia learning environment should be emphasized. According to Mayer and Moreno (2010), the goal of presenting multimedia instruction is to "reduce extraneous cognitive processing, manage essential cognitive processing, and foster

generative processing" (p.134). Specifically, extraneous cognitive processing has a negative impact on learning; essential cognitive processing aims at "mentally representing the essential model", and generative processing is "cognitive processing that contributes to learning" (Mayer & Moreno, 2010, p.133).

Reducing extraneous cognitive processing has a positive impact on preventing learners from exhausting their cognitive capacity, which ensures that students can avoid the condition of residual competencies for the generative processes required for effective learning (Mayer & Moreno, 2010). Furthermore, the particular purpose of managing essential cognitive processing is to help learners manage their cognitive capacity and avoid unnecessary waste caused by "essential overload" (Mayer & Moreno, 2010, p.135). The first two steps are a prerequisite to fostering generative processing (Mayer & Moreno, 2010).

2.1.5. Application

Learning is promoted when learners are required to use their new knowledge or skills to solve problems. This principle stresses the importance of knowledge application opportunities and positions (Badali, et al., 2018), as meaningful learning takes place when new skills can be practiced to handle issues (Greitzer, et al., 2004). Generally, the principle of application involves practicing skills or knowledge in real life. Consistent practice, the scaffolding teaching model and respecting diversity are three instructional models in this instructional phase.

2.1.5.1. Consistent practice

Consistent practice has been emphasized by Merril (2002) within this principle. He identified that inconsistent practice with instructional goals does not contribute positively to promoting effective learning. Many theorists documented this principle as an important aspect of

instruction as well. Perkins and Urgon (1999) encouraged course designers or instructors to provide opportunities for students to “develop and apply understanding through practice”.

2.1.5.2. Scaffolding

In addition, to reinforce the principle of application, the principle of scaffolding is also emphasized by Merril (2002), who stated that, “early in learning students need considerable support, but as the learning progresses this support is gradually taken away leaving the students eventually on their own.” (p.49). Feedback and error solving are two main principles of ensuring effective scaffolding. Learners acquire experience and meaningful learning through receiving or providing feedback and understanding the reasons for errors as well as the process of problem solving. Specifically, teachers should present the practice of knowledge and course practices first. As time goes on, instructors’ help, such as reminders, demonstration and support, should be incrementally reduced. Throughout this process, learners should execute and practice the entire learning process and skills by themselves, while teachers should give feedback or comments on students’ learning performance only.

It is helpful to introduce an original theory that emphasized scaffolding. In 1987, Collion et al. introduced the theory of Cognitive Apprenticeship, which identified the importance of scaffolding in the process of teaching and learning. In particular, Cognitive Apprenticeship not only emphasizes the importance of practice for acquiring new knowledge and skills, but also focuses on when and where to apply new knowledge into practice and thereby generate new skills (Collion et al., 1987). In the model of Cognitive Apprenticeship, students are able to acquire three types of knowledge: declarative knowledge, procedural knowledge, and conditional knowledge (Peeples, et a., 2019). Regarding the definition of these three types of knowledge, declarative knowledge is the particular information involved in knowledge, how to implement

the knowledge is the core content of procedural knowledge, and knowing the best place and condition for knowledge application is the main feature of conditional knowledge (Alexander et al., 1991).

2.1.5.3. Respecting diversity

Merril (2002) encouraged the provision of adequate practices for diverse learners; thus, multiple problems are elaborated on as the primary instruction for different situations in students' real life. In addition, Collins et al. (1989) and Reigeluth et al. (2016) documented the significance of providing diverse opportunities for learners to assess different learning models, which has a positive influence on effective learning. Accordingly, the expertise of peers or instructors has gained attention. Similarly, Chickering and Gamson (1987) noted the importance of diversity, as they stated that "There are many roads to learning" and recognized that the diversity of learners' goals, backgrounds, and talents cannot be ignored by course designers and instructors. The same principle has been identified by Reigeluth et al. (2016), who stated that instructors should respect individual differences, which means that students' different competencies should be respected and focused on by teachers. Accordingly, teachers should "think about how to further support their learning" (p.195). It is worth noting that this principle was also emphasized by Margayran (2008), who stated that the diversity of learners and their different requirements should be respected, and thus providing multiple opportunities can enhance meaningful learning.

Accordingly, instructors are required to provide multiple opportunities for learners to integrate their new knowledge, such as by posting multiple problems and activities on a given topic, and the same is true for online education. Learning is promoted through maintaining diversity through various "online resources, web-based activities and other content expanding

sources" (Grant &Thornton, 2007, p. 352). It is necessary for instructors and designers to pay attention to and respect the features of diversity. As Hathaway (2014) noted, maintaining diverse characteristics in internet-based courses plays a significant role in engaging students "in being more interested in the course and in learning more about other cultures" (p.10). Many theorists have stressed that providing multiple learning methods or styles for different students can be an effective instructional strategy for promoting understanding (Perkins & Urgon, 1999). In particular, respecting diversity is an efficient approach for dealing with learners with diverse learning preferences, which effectively enhances the course quality in online learning (Hathaway, 2014). As such, effective learning and teaching will be promoted through this instructional principle.

2.1.6. Integration

Learning is promoted when learners are encouraged to integrate (transfer) the new knowledge or skill into their everyday life. Learners are often motivated to learn through integrating new knowledge into their real life (Merril, 2002), and effective learning takes place when students connect skills to their real life (Greitzer, et al., 2004). Similarly, Collins et al. (1989) noted in the theory of Cognitive Apprenticeship that effective learning occurs within the context of its use and the process of problem solving. Specifically, offering an appropriate learning context for learners can have a significant impact on helping learners understand abstract concepts and make connections between real life and learning models, thereby resulting in memorable and in-depth learning outcomes (Collin, et al., 1989). The same instructional principle was identified by Margayran (2008), who stated that authentic resources that connect with real life can have a significant impact on meaningful learning.

Opportunities for learners to perform their learning outcomes, reflect on peers' postings and assignments, and provide appropriate feedback or comments are core parts of the instructional model in the phase of knowledge integration. Accordingly, new knowledge will be created through the above procedures.

2.1.6.1. Performance

It is worth noting that differences in the application design and integration can affect learners' learning performance. Merril (2002) stressed that designing opportunities for students to perform their new skills is an important principle in promoting effective learning. Performance has been recognized as a crucial approach in promoting learners' understanding of knowledge and content (Perkins and Urgen, 1999). It is also worth noting that many theorists emphasized that providing diverse opportunities for students to practice and perform new skills helps motivate students to explore new knowledge in-depth (Perkins & Urgen, 1999).

2.1.6.2. Reflection

Collaborative works with peers or instructors are another important principle for learners in integrating their new knowledge into real life, and they need opportunities to "reflect on, defend, and share what they have learned if it is to become part of their available repertoire" (Merril, 2002, p.51). Challenging tasks or assignments promote learners' reflection and thereby facilitate understanding (Perkins & Urgon, 1999). Accordingly, peer feedback and formative feedback have a positive impact on effective learning in online education (Shahalizade, et al., 2019).

Specifically, understanding what you know and do not know helps focus learning (Chickering & Gamson, 1987). Students need appropriate and prompt feedback on their performance to benefit from courses. Chickering and Gamson (1987) identified that feedback

promotes effective learning and teaching as the fourth principle of their instructional model. Internet-based learning effectively provides web technological tools that support the implementation of receiving prompt feedback from peers or instructors, such as through e-mail or chatrooms (Kontos, 2015). Specifically, Hahaway (2014) noted that the e-mail system in online courses parallels Chickering and Gamson's (1987) principle and efficiently enhances the course delivery. In particular, e-mail systems in online learning help ensure that students receive prompt feedback and reports from peers, instructors, or grading mechanisms (Hathaway, 2014).

Specifically, learners can benefit from comments and corresponding suggestions from peers or instructors as well as self-evaluation. Providing prompt feedback for learners enhances students' involvement in the online environment because feedback directly conveys information for learners, which thereby impacts the students' retention rate (Grant & Thornton, 2007; Ritter & Lemke, 2000).

As such, providing adequate opportunities for learners to demonstrate their knowledge is an efficient strategy for reflecting their understanding and further improving effective learning and teaching (Chcikering & Gamson, 1987). Similarly, Collins, Brown, and Newman (1989) emphasized that reflection is a process of students recognizing their difficulties through their learning performance and incrementally diagnosing their weaknesses and adjusting their learning performance until reaching competence. Reflection is an important phase of cultivating learners' conceptual model, which serves as "an internal model", a fundamental component of promoting self-monitoring and self-control (Collins, Brown, & Newman, 1989).

2.1.6.3. Creation

In Merril's FPI (2002), learning occurs when students modify learned skills by incorporating their own knowledge and applying it in the real world, which is also a significant learning event to prove their effective learning.

2.2 Seven Principles for Good Practice (Chickering and Gamson, 1987)

The Seven Principles for Good Practice (SPGP) were first proposed by Chickering and Gamson in 1987. Built from constructivist perspectives (Hathaway, 2014; Triiel & Quick, 2012), the aim of the SPGP was initially to improve undergraduate teaching and learning effectiveness and thereby enhance the quality of instruction and assure accreditation (Anyatasia & Junus, 2020). Chickering and Gamson (1987) identified seven principles (Table 2), which were supported by empirical research and evidence-based good practices and experiences of both teacher and student populations in online learning (Fernandez, et al., 2009; Liu et al, 2015; Grant & Thornton, 2007).

Table 3 Seven Principles for Good Practice (Chickering & Gamson, 1987)

Principles	Major implications
Encourages Contact Between Students and Faculty	Frequent student-faculty contact in and out of classes is the most important factor in student motivation and involvement.
Develops Reciprocity and Cooperation Among Students	Learning is enhanced when it is more like a team effort than a solo race.
Encourages Active Learning	Learning is promoted by activating students' prior knowledge.

Gives Prompt Feedback	Knowing what you know and do not know focuses learning.
Emphasizes Time on Task	Time plus energy equals learning.
Communicates High Expectations	Expect more and you will get more.
Respects Diverse Talents and Ways of Learning	There are many roads to learning.

2.2.1. Evidence for the Seven Principles for Good Practice

The adoption of Chickering and Gamson's SPGP (1987) is widespread and reliable. Although the SPGP are designed for traditional classroom education, many studies have shown that the SPGP can be adopted as common-sense instructional principles in the design and delivery of online education (Anyatasia & Junus, 2020; Crews, et al., 2015; Hathaway, 2014; Kontos, 2015). For instance, using Chickering and Gamson's (1987) SPGP, one study (Ritter & Lemke, 2000) assessed the quality of online learning by surveying 236 students. Through analyzing the survey result, they identified that internet-based education effectively enhance "students-instructor communication, encourage student collaboration, encourage active learning and respects diverse ways of learning" (p.107). Further studies (e.g, Bali, 2014; Çakýroðlu, 2014; Crews et al., 2015; Grant & Thornton, 2007) have found that implementing the SPGP in an online learning context promotes effective learning. Further, a similar study by Jonhson (2014) concluded that "The seven principles of good practice with an emphasis on technology provide a cohesive framework for quality online instruction" (p. 48).

The First Principles of Instruction (Merril, 2002) and Seven Principles for Good Practice (Chickering & Gamson, 1987) have similar provisions, which we described in the previous

section. We describe the content of these three principles that do not overlap in the next section below, respectively, reciprocity and cooperation, emphasize time on task, and encourage contact between students and faculty.

2.2.1.1. Reciprocity and Cooperation

Learning is enhanced when it is more like a team effort than a solo race (Chickering & Gamson, 1987). Chickering and Gamson (1987) stressed that cooperation is an important instructional principle. The nature of learning should involve sharing and collaboration rather than competition and isolation. Effective learning occurs when learners share, interact, discuss, and reflect others' views because cooperation ensures students' involvement (Grant &Thornton, 2007; Kontos, 2015), and the same is true for e-learning. Internet-based learning tools and activities provide students with opportunities for cooperation (Hathaway, 2014), such as by categorizing students into different discussion forums; in this way, learners can receive discussion posts from peers and share comments on them asynchronously and synchronously. In particular, discussion forums in massive open online courses have an effective role in promoting learners' engagement and motivation and thereby determine the course retention rate (Tseng, et al., 2016; Cagiltay, et al., 2020). As such, online learning effectively reduces students' isolation and promotes cooperation and collaboration, which thereby promotes effective learning (Hathway, 2014).

In addition, Collins et al. (1989) emphasized the necessity of creating reciprocity learning platforms for students and thereby promoting interaction among students-students and students-instructors. Specifically, the teaching and learning model of reciprocity offers students opportunities for summarizing and performing their internal understanding of knowledge and skills. This description is similar to the principle of collaborative knowledge identified by

Margayran (2008), who stated that “Learning is promoted when learners contribute to the collective knowledge” (p.79). Collins et al. (1989) emphasized that students should comment on or share their views on others’ work through a reciprocal learning atmosphere, which is a process of transferring their internal knowledge to external understanding. Margayran (2008) also stated that expert feedback from peers can promote learners’ understanding.

It is worth noting that many theorists indicate that this principle is a primary intervention in massive-size classrooms (Reigeluth et al., 2016). Specifically, categorizing learners with similar interests or different understandings and expertise levels into the same group ensures that students receive prompt and appropriate feedback, which reinforces social tutoring. This learning phase has a positive impact on promoting students’ knowledge construction by peers and hence reinforces their understanding in massive-size curricula.

2.2.1.2. Emphasizes Time on Task

Time plus energy equals learning (Chickering & Gamson, 1987). Time management is not only important for learners but is also vital for course designers. Chickering and Gamson (1987) stressed that course time management is related to students’ workload. Specifically, assigning appropriate workloads and tasks for learners promotes students’ effective learning as well as instructors’ teaching. In particular, Hathaway (2014) indicated that successful students in online courses usually know how to control and manage their time spent on learning tasks. Accordingly, encouraging students to focus on time on task helps them improve their time management skills (Grant & Thornton, 2007). Many effective time management tools such as course syllabi, weekly reminders (Hathway, 2014), course calendars, and weekly tests (Grant &Thornton, 2007) are perceived as high-quality technological tools that support learners to stay on track with course tasks. It is important to note that in online learning, the assignment of time

on each task should be flexible, which means that learners should have the free time necessary to prepare and access the virtual classroom (Grant &Thornton, 2007).

It is worth noting that there is a close relationship between time management and the FPI (Merril, 2002) in that “Time had a major impact on the application of FPI” (Klein & Mendenhall, 2018; Mendenhall, 2012).

2.2.1.3. Encourages Contact Between Students and Faculty

Frequent student-faculty contact in and out of class is the most important factor in student motivation and involvement (Chickering & Gamson, 1987). Specifically, reinforcing the connection between students and faculty promotes the engagement of students and helps students stay on track and in control of their learning performance and progress (Knotos, 2015). As such, effective learning will take place if students receive support from faculty (Chickering & Gamson, 1987). It is worth noting that the SPGP is a constructivist-based learning theory, and the learning tools or instruments based on these seven principles are usually perceived as effective instruction for assessing online courses (Tirrel & Quick, 2012). Comparatively, the online learning model offers learners more interaction opportunities among students and faculty than traditional classroom learning (Grant &Thornton, 2007; Watson & Sutton, 2012). Specifically, Hathaway (2014) stressed that students can benefit from the interaction between faculty and learners, such as by receiving help with navigating a website or guidance in handling difficult materials from instructors. Additionally, prompt course announcements such as changes of due dates or learning resources from faculty are stressed as efficient instructions for promoting meaningful teaching and learning (Hathaway, 2014). As such, some learning technological tools in online courses, such as synchronous/asynchronous discussion forums/chatrooms, e-mails, websites, and concept maps are perceived as effective instructions for providing a safe and comfortable virtual

community in which learners are able to evaluate and monitor their learning progress (Hathaway, 2014; Grant &Thornton, 2007; Ritter & Lemke, 2000; Watson & Sutton, 2012).

Regarding the importance of student-faculty connection, many studies documented the high effectiveness of this principle. Tirrel and Quick (2012) emphasized that online instructors perceived student-faculty relationships as a primary instructional principle in their study, in which they paid more attention to providing opportunities for establishing connections between students and faculty.

As such, the First Principles of instruction (FPI) (Merril, 2002), "Merril+" model (Margaryan, 2014) and Seven Principles for Good Practices (Chickering & Gamson, 1987) are accepted widely as theoretical frameworks in academic online learning and teaching atmosphere. Accordingly, we integrated these three theoretical principles as research structure to explore findings.

Chapter 3

3 Method

In this study, we systematically reviewed and synthetically analyzed the principles and best practices of xMOOC instructional design and delivery. We chose to conduct a systematic review because of its characteristics. A systematic review is a review of a clearly formulated research question with pre-specified eligibility criteria for studies that uses comprehensive and reproducible methods to critically appraise the relevant research literature; collect and analyze data from included studies; and discuss knowledge gaps, limitations, and future directions (Lasserson et al., 2021).

3.1 Developing the research question

Developing a research question is the most important step in conducting a robust systematic review (Gupta et al., 2018), as it limits the scope and defines the target population of the review. Several question formulation tools can be utilized; we used the "PICOS" model (Liberati et al., 2009) to develop our research question: "What instructional design strategies and principles lead to well-developed xMOOCs, as demonstrated by empirical-based best practices in xMOOC instructional design?" (Table 4).

Table 4 The PICOS model (Liberati et al., 2009)

Parameter	Descriptor
(P) Population	Extended massive open online courses (xMOOCs)
(I) Intervention	Empirical-based best practices in instructional design
(C) Comparator	Not applicable
(O) Outcomes	Instructional design strategies and principles
(S) Study design	All

3.1.1. Evaluating the quality of the research question

To ensure our research was relevant, novel, and feasible, we evaluated the quality of our research question before we conducted the search.

Published studies on xMOOC instructional design have abundantly highlighted that employing exemplary instructional design strategies and principles has potential to lead to effective pedagogical methods, increase students' motivation to enrol in and complete coursework, and achieve meaningful student learning experiences (Hone & El Said, 2016; Jung et al., 2019; Rezaei, 2017). Nonetheless, minimal empirical research has been conducted on the pedagogical effectiveness of xMOOC instructional design to identify such strategies and principles (Conole, 2015; Margaryan et al., 2014; Siemens, 2013; Stracke, 2017). Furthermore, several studies (Oh, et al., 2015; Margaryan et al., 2014) have deductively applied and examined well-established instructional design principles as part of a course design and delivery theoretical structure to assess particular xMOOC quality and students' learning attitudes to further explore the effectiveness of these well-established principles. Little research have inductively summarized instructional design principles and strategies, especially for xMOOCs. Hence, this study is significant to the extent that it addresses these gaps in the literature.

3.2 Developing the research protocol

A protocol is designed to guide researchers to conduct a robust systematic literature review without missing any steps. Specifically, the pre-defined methods in the protocol have significant impacts on enhancing transparency and reducing individual biases by allowing peers to review the study steps in advance.

3.3 Establishing inclusion and exclusion criteria

We established two main criteria for inclusion in this review. First, this study focuses on xMOOC design and implementation. Hence, included studies must have evaluated a MOOC that offers fully online post-secondary learning opportunities to students in a traditional university model, as opposed to other types of MOOCs or any other forms of online learning.

Second, identifying the strategies and principles of xMOOC instructional design typically requires recognizing best practices in xMOOC design and/or implementation through empirical inquiry. As such, this research focuses exclusively on empirical studies that have evaluated MOOC instructional design and/or implementation. Therefore, theoretical articles, all types of literature reviews, and comparative studies of MOOCs and other online learning models have been excluded. All types of study designs were eligible for inclusion, and no comparators were required.

In addition, we limited our search to peer-reviewed studies published in English in scholarly journals for feasibility purposes. Further, since pedagogical approaches and online technologies have been dramatically enhanced over the past few years, we limited our search to studies published in the past five years, between January 2015 and December 2020.

3.4 Searching terms

Two reviewers (JJ and MA) completed the 10-unit online training of systematic review on Cochrane (Higgins et al., 2019). Next, on December 5, 2020, we had an online workshop facilitated by an academic librarian at our institution. With the librarian's support and guided by our research objectives, we conducted our search. We tentatively identified 18 search keywords: MOOC; MOOCs; massive open online course; massive open online courses; design, practise, practice, practises, practices, principle, principles, plan, plans, strategy, strategies, quality, effectiveness; and, instructional, and we formulated the following Boolean search string:

("MOOC" OR "MOOCs" OR "massive open online course" OR "massive open online courses") AND (("design" OR "practise" OR "practice" OR "practises" OR "practices" OR "principle" OR "principles") OR ("plan" OR "plans" OR "strategy" OR "strategies" OR "quality" OR "effectiveness")) AND ("instructional")

3.5 Selecting the databases

Using our search strategy, we conducted searches of six electronic databases: (1) Education Resources Information Center; (2) Scopus; (3) Canadian Business & Current Affairs Education; (4) Education Database; (5) PsycINFO (ProQuest); and (6) Academic Search Ultimate. These six databases were chosen because they provide extensive coverage of educational and pedagogical research.

3.6 Filtering the studies

Two main steps were conducted in this phase. First, we screened topics and abstracts, and then we filtered full-text articles. We filtered the studies using the inclusion and exclusion criteria. Two reviewers (JJ and MA) independently screened the studies, discussed, identified and included peer-review, empirical-based English studies in the field of xMOOC instructional strategies and principles ranging between January 2015 and December 2020.

We uploaded 539 identified studies onto Covidence (Veritas Health Innovation Ltd, 2021). Covidence removed 190 duplicates automatically, and we manually verified that they were removed. Next, two authors (JJ and MA) independently screened the 349 articles' titles and abstracts according to our inclusion and exclusion criteria. In this phase, we emphasized on screening titles and abstracts of each of the study under the evaluation of inclusion and exclusion criteria, two reviewers focused on key terms in titles such as xMOOC, instructional design, principles and strategies etc. Additionally, we emphasized filtering the abstracts by identifying

peer-reviews, empirical studies as well as English articles are included. Comparatively, other studies such as empirical studies of xMOOC but not peer reviewed, or peer reviews of xMOOC instructional design without empirical best practices were excluded because they were irrelevant to the criteria. 237 studies were recognized as irrelevant and were removed in this phase. JJ and MA further independently screened 137 included articles' full texts for eligibility. In this filtering phase, we focused on screening the full text of studies to ensure that they met the inclusion criteria of empirical peer-review xMOOC instruction design published in English, we focused more on the part of methodology, discussion and conclusion section of each of the studies to make sure the filtering results were correct and accurate. Specifically, studies which are relevant to xMOOC instructional development but not empirical best practices, or studies are peer-review but is not in the field of xMOOC instruction design as well as studies include investigating both of xMOOC and other types of MOOCs such as hMOOC were excluded in this phase. This process excluded 96 irrelevant articles and finalized 16 extracted studies. Both reviewers compared their results and resolved any disagreements by discussion until a consensus was reached. For example, when we screened title, abstracts, and full text of each of the study, we left the voting reasons in Covidence to conveniently resolve the conflicts. When we faced conflicts, we organized meetings and discussed the main reasons for two reviewers' separate votes for each of the studies, after identification and discussion under the guidance of inclusion and exclusion criteria, two reviewers finally reached the consensus of each of conflicts. This process of the systematic review is summarized in PRIMSA format in Figure 2. The 16 included studies are summarized in a table found in the Appendix.

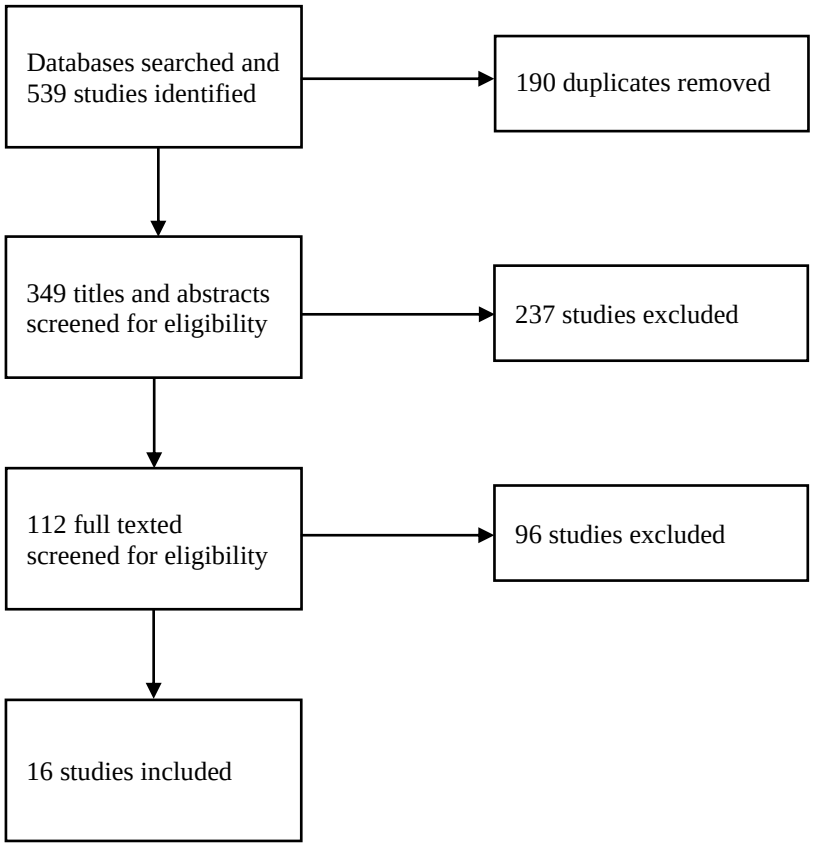

Figure 2 PRISMA flow diagram (Moher et al., 2009) of the screening process.

3.7 Data extraction

To ensure the credibility of the results, JJ and MA independently extracted the data from the selected studies. Covidence (Veritas Health Innovation Ltd, 202) was used as an effective data collection tool in this phase. After we extracted the information, we cross-checked the final extracted data and resolved conflicts. We (JJ and MA) independently extracted the data (see Table 5) from the 16 included studies and resolved any inconsistencies by discussion until a consensus was reached.

The extracted data can be found in Appendix 1.

Table 5 Data to be extracted from included studies

Publication	Article title

	Study ID (e.g., Author et al., 2018)
	Journal name
Methodology	Research approach (e.g., mixed methods)
	Research design (e.g., phenomenological)
	Theoretical framework
	Year of study
	Data collected (e.g., survey data)
	Data analysis methods (e.g., inferential statistics)
Intervention	Institution where course is offered
	Country of origin
	Education level (e.g., undergraduate)
	Discipline
	Course title
	Platform provider (e.g., Coursera)
	Duration
	Participant's demographics
	Sample size
	Limitations of the study
	Recommendations for future research
Results	Outcome measures (e.g., student-oriented, best practices)

3.8 Analysis and synthesis of results

We presented the extracted data in tables and used narrative synthesis, comparative analysis, and descriptive statistics methods to present the similarities and differences within and

between included studies. Lastly, we undertook qualitative thematic coding of the extracted best practices to identify the exemplary instructional design strategies and corresponding principles in developing and delivering prospective xMOOCs.

Chapter 4

4 Findings

4.1 Profiles of Included Studies

A total of 16 included studies were systematically analyzed in this study (see Appendix). Mixed methods was the most popular research approach used, with almost half of reviewed studies (*n* = 7; 44%) employing such methods, followed by quantitative methods (*n* = 6; 37%), and qualitative method was the least used research method (*n* = 3; 19%). The most popular study designs were case studies (*n* = 6) and observational studies (*n* = 6), whereas the study design in four of the included studies was not reported (Table 6).

Surveys (*n* = 9; 56%) were the most common method for collecting data. Interviews (*n* = 4; 25 %) were the second most popular data collection method among these studies. Additionally, data was also collected through questionnaires (*n* = 3; 19%), and students' online discussions (*n* = 3; 19%) (Table 6). One study (6%) collected data from the Network Canvas and GamiTool platforms, Network Canvas is an online data gathering platform that provides researchers with a publicly available and free resource for investigating personal networks. Further, GamiTool is an online game design platform developed specifically for researchers to gamify the online course or research procedure to achieve a user-friendly learning experience or effective research process.

Table 6

Profiles of included studies (*N* = 16)		
Category	n	%
Research approach		
Quantitative	6	37
Qualitative	3	19
Mixed methods	7	44
Research design		

Case study	6	37
Observational studies	6	37
Post-course survey and follow-up survey one year later	1	6
Convergent parallel	1	6
Post-intervention questionnaire design	1	6
Between-subjects design	1	6
Survey design	1	6
Unreported	4	25
Data collection		
Survey	9	56
Interview	4	25
Students' posts, comments and views from xMOOC sites	3	19
Questionnaire	3	19
Observation	2	13
Canvas Network and GamiTool platforms	1	6

Of the 16 studies reviewed, 14 studies clearly identified a theoretical framework. The most popular theoretical framework reported, which was utilized by a group of the same researchers in almost one-third of the reviewed studies, was attitudinal learning (*n* = 5; Table 7). Attitudinal learning can be defined as an individual's psychological evaluations about an object, person, or event (Gagne et al., 1992; Thomas & Znaniecki, 1919; Zimbardo & Leippe, 1991), and is constructed of affective, cognitive, and behavioral components (Kamradt & Kamradt, 1999; Simonson, 1979; Zimbardo & Ebbesen, 1970). (Watson et al., 2016, p. 84).

Table 7

Characteristics of theoretical framework

Category		
Theoretical framework (n=16)	n	%
Attitudinal learning	5	31
Cognitive load theory	1	6
Learning analytics	1	6
Engagement theory	1	6
Universal design of learning	1	6
Flow theory	1	6
The self-determination theory	1	6

Self-directed learning	1	6
Community inquiry model	1	6
Human Trafficking (HT)	1	6
Three generations of distance education pedagogy	1	6
Seven Principles for Good Practice	1	6
Tools or tool mediation (one of the six related elements in Activity Theory)	1	6
Unreported	2	13

4.2 Demographics of Participants

There was a total of 115,199 registered learners (μ = 7199; range: 320 - 30,207) in the xMOOCs implemented in the reviewed studies. Despite this large number of registered learners, the response rates to the studies' data collection instruments were much lower (*N*=7,184; μ =553; range 26 - 1,324). Of 7,184 respondents, 2,367 were female (33%), while 1,871 were male (26%), whereas the gender for the remaining 41% was not reported. Lastly, only a few studies (*n* = 6) reported the countries of the participants, with Australia being the most represented (*n* = 3), followed by Canada (*n* = 2), India (*n* = 2), the United Kingdom (*n* = 2), and the United States (*n* = 2). The number of respondents by country was not reported.

Figure 3 Countries of Participants

Chabot et al. (2003), *Tableau* (Version 2021.2). Salesforce. https://www.tableau.com/#products

4.3 Characteristics of Interventions

We identified 16 studies and, within them, 38 sample xMOOCs were reported. The most popular xMOOC platforms were CourseTalk (n=18; 47%); Coursera (*n* = 12; 32%), edX (*n* = 3; 8%), and Canvas platform (*n* = 2; 5%). The other three platforms collectively accounted for the remaining 8% (Figure 4).

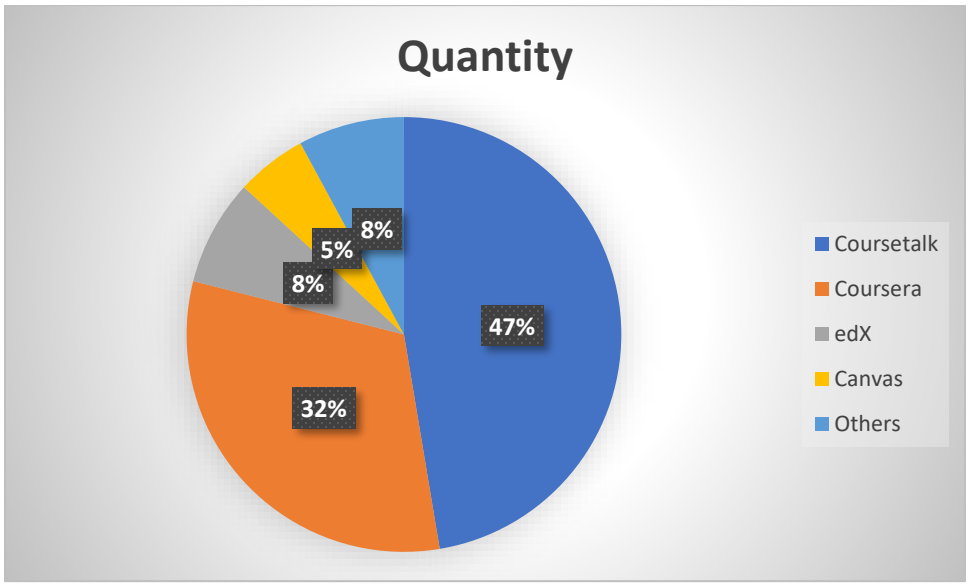

Figure 4 xMOOC Platforms.

Some studies (*n* = 6) reported the institutions where the xMOOCs were offered. These were the United States (*n* = 12), Canada (*n* = 2), Australia (*n* = 2), Turkey (*n* = 1), Norway (*n* = 1) and Belgium (*n* = 1). In addition, the xMOOCs involved three broad fields of study (Figure 5): natural sciences (*n* = 17); social sciences (*n* = 15); and humanities (*n* = 5).

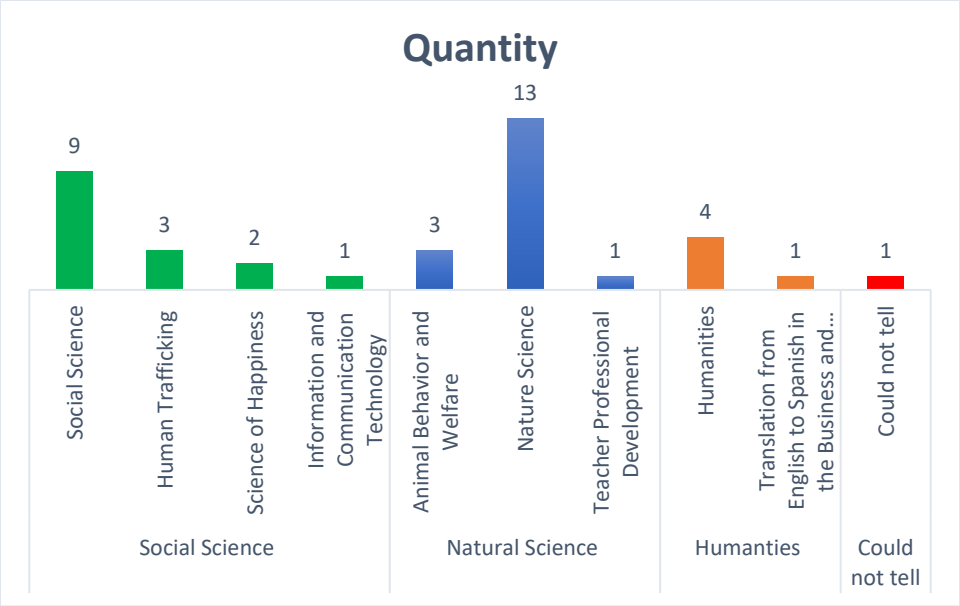

Figure 5 Fields of Study Distribution in xMOOCs

Further, most courses (*n* = 4) were either six weeks or ten weeks in duration. The third most popular duration was four weeks long (*n* = 3; Figure 6). Some studies (*n* = 4) did not report course duration.

Figure 6 Length of xMOOC Courses.

Length of xMOOC Courses in Weeks											
NO.	Study	1	2	3	4	5	6	7	8	9	10
1	Kizilcec et al., 2015	■	■	■	■	■	■	■	■	■	■
2	Trust & Pektas, 2018	■	■	■	■	■					
3	Watson et al., 2018	■	■	■	■	■	■	■	■	■	■
4	Engeness et al., 2020	■	■	■	■	■	■	■	■	■	■
5	Watson et al., 2016	■	■	■	■	■	■				
6	Ortega-Arranz et al., 2019	■	■	■	■	■	■	■	■		
7	Janakiraman & Watson, 2018	■	■	■	■	■	■	■	■	■	■
8	Watson, 2017	■	■	■	■	■	■				
9	Watson et al., 2016	■	■	■	■						
10	Kim et al., 2016	■	■	■	■	■	■				
11		■	■	■	■						
12		■	■	■	■	■	■				
13	Watson & Kim, 2016	■	■	■	■						
14	Liu, Kang & McKelroy, 2015	■	■	■	■	■					

Out of these 16 studies, xMOOC navigation, instructors' attributes, interface design, and course tools were impactful course instructional communication methods (n = 2, 13% each). xMOOC videos or lectures (n = 10, 63%) were the most impactful course design, followed by course readings, resources and materials (n = 7, 44%), learning activities (n = 6, 38%), learning atmosphere (n = 5, 31%), and course duration (n = 4, 25%), learning tools were the least impactful design in xMOOCs (n = 2, 13%). Quizzes and discussions were most popular assessment methods in xMOOC design and delivery (44% each), the influence of assignments (n = 2, 13%) were lower than the above two assessment methods, providing certificates and rewards were the least helpful methods in xMOOC design (n = 1, 6% each).

Table 8

Characteristics of Instructional design		
Category	n	%
xMOOC videos or lectures	10	63
Course readings, resources and materials	7	44
Quizzes	7	44
Discussion	7	44
Learning activities	6	38
Learning atmosphere	5	31
Course length/ workload/ structure	4	25
xMOOC navigation	2	13
Instructor attributes	2	13
Assignments	2	13
Notification	2	13
Personal project	2	13
Interface design	2	13
Course tools	2	13
Collaborative opportunities	1	6
Feedback	1	6
Certificate	1	6
Rewards	1	6

4.4 Instructional Design

Instructional design strategies in xMOOCs in this study aligned with the First Instructional Principles (Merril, 2002) and Seven Principles for Good Practices (Chickering &

Gamson, 1987) literatures that provided problem-centered instructions for promoting effective learning and teaching through interactive and high-quality course content and structure. Further, aligning with Canada educational policy for online learning that emphasizes a friendly, authentic, engagement online learning context and a close connection between students and faculty, we were able to identify three distinct instructional design strategy groups in the reviewed literature. These are discussed below.

4.4.1 Clear Instructional Communication

Simple, interactive, and user-friendly interface designs were identified to facilitate easy navigation of and engagement with the xMOOC platforms. Setting up a Home Page, where the course is introduced and links to separate course materials are provided, was suggested to enhance navigation of the course site. Further, setting clear learning objectives was identified as an effective method to offering students a clear self-controlled learning process. Specifically, the drop-out rate of xMOOCs was high, especially in the first week, and thus providing clear learning objectives were assessed as effective intervention for students to grasp main course content and tremendously sustain retention rate in the design and delivery of xMOOCs. Similarly, frequent announcements and reminder notifications were found to facilitate learning and enable students to stay on top of course content and assessment for successful completion. Different time zone is one of the main reasons for students dropping out xMOOCs, timely announcements and notifications effectively provided learners a sense of connection from faculty and peers, which encouraged students to actively participate in course content and thereby reduced the attrition rate and promoted the completion rate. Lastly, students typically enjoyed progressing through course content when the instructor provided constant and timely feedback and presented with the course material with humor, expertise, and passion.

4.4.2. Course Design and Materials

Course durations ranging between six weeks and ten weeks was found to work best for learners. Any course that ran for less than four weeks would either exhibit intensive workload or not provide enough content to incentivize learners to register; similarly, any course that runs for more than ten weeks would be too long to keep learners motivated to complete the course. No matter the course duration, studies emphasized the importance of creating an inclusive and diverse learning atmosphere for satisfying students' different learning needs and styles.

Tools such as Tableau, Adobe Illustrator, and Excel were found to be effective in promoting learners' understanding of course content and visualization of abstract knowledge. Incorporating experiential learning activities and interactive, real-world applications in course content, whereby course objectives are aligned with and linked to professional goals, was found to promote motivation, deeper understanding of course content, and course completion. Students typically enjoyed learning activities that comprised gamification, humor, and exploration.

Further, the use of short videos, especially those ranging between five and ten minutes, were found to be an effective instructional strategy in xMOOCs. This strategy was found to raise learners' attention to and engagement with content. Further, there was contradictory findings relating to whether the instructor should show their face in the video. Students were more likely to engage with and complete the videos when they can saw their instructor because learners were easy-to-follow lectures and better to link course content. Even so, the instructor's face and screen background images were found to potentially distract some learners and called the value of instructor's face in videos into issues because of the tedious process of explaining the course content.

4.4.3. Assessment Methods

The use of both quizzes and assignments to assess student learning were found to enable learners to have control over own their learning processes, promote learners' understanding rather than memorization of course content, and maintain learners' engagement with and attention to course content. Further, students typically preferred flexible dates and times to schedule their quizzes and/or complete their assignments, which were most effective when closely aligned with the course objectives and addressed different levels of educational complexity (e.g., basic recall; understanding; application; analysis; etc.). Even so, quizzes were also identified as less impactful than other assessment methods (e.g., Liu et al., 2015 & Watson et al., 2016), mainly because the design of quizzes was not challenging enough and lack of difficulties.

Online discussions among learners were found to be ineffective, mainly because learners experience difficulties when navigating, posting, and replying on the discussion forums. This form of assessment was found to be especially irritating when learners are not divided into smaller groups. Further, disinterest to engage in a particular discussion stemmed from limited interactions among learners who live in different time zones, causing the discussion to carry on for days. Even so, providing learners with the space to share their thoughts and experiences with others was suggested to enhance learner motivation and increase retention and completion rates.

Lastly, awarding certificates and badges of completion were effective in motivating only those students who were originally motivated by other means, such as the strategies discussed above.

4.5 Limitations of Included Studies

Twelve studies (75%) reported limitations. The most common limitations were non-generalizability of the findings (n = 6; 38%), low response rates to surveys (n = 4; 25%), and use

of only pre-intervention surveys (*n* = 4; 25%). Other reported limitations include potential to generate biases due to xMOOC short-lived duration, small sample sizes, and use of non-validated data collection instruments.

Chapter 5

5 Discussion

This study was conducted to explore the findings on xMOOC instructional best practices from the existing empirical-based xMOOC research literature. The purpose of this study was to systematically review previous studies and summarize the best practices of instructional strategies in the development of xMOOCs and thereby deductively identify the underpinning instructional principles of xMOOC delivery.

5.1 xMOOC Characteristics

Regarding xMOOC platforms, we have identified that Coursetalk (Hew et al, 2018) is the most popular xMOOC platform which 17 courses from Coursetalk are reported in their study, followed by Coursera, which are 10 sample xMOOCs from Coursera (Kizilcec et al., 2015; Watson et al., 2016; Watson, 2017; Watson et al., 2016; Cohen & Holstein, 2016; Kim et al., 2016). Accordingly, we assert that the courses quality in these two popular and common xMOOC platforms allow students to select them as effective xMOOC developers, which provides the participants with certain benefits. Although in our collected result, Cousetalk was found to be the most common xMOOC platform, we cannot deny other xMOOC platforms' effectiveness. A similar conclusion was reached by Hicks (2017), who stated that "different MOOC platforms allow for a variety of different technical capabilities in their learning environments" (p.7).

Regarding course duration, we found that most xMOOC course durations are within a maximum ten-week course duration (Kizilcec et al., 2015; Watson et al., 2018; Engeness et al., 2020; Janakiraman & Watson, 2018) and a minimum of four-week-long courses (Watson et al., 2016; Kim et al., 2016; Watson & Kim, 2016). Specifically, 10 weeks course duration

encourages students to progressively grasp the skills (Engeness et al., 2020), provides students enough duration for cultivating their behaviours (Kizilcec et al., 2015), indicates that ten weeks is maximum course duration they can accept because the heavy workload (Watson et al., 2018). In addition, in the study of Watson et al., 2016; Kim et al., 2016; Watson & Kim, 2016 also linked the relationship between four weeks course duration to students' attitudinal changes and learning outcomes, which identified that course with four weeks only also can provide students enough course content with learning activities, quizzes, tasks and assignments. We asserted that a length between four weeks and ten weeks for xMOOCs has a positive impact on promoting effective learning and teaching in the context of the synchronous and asynchronous learning atmosphere, with a mean duration of seven weeks. We have this similar conclusion with Dreisiebner (2019), who found that the average effective xMOOC duration is 7.3 weeks.

The number of female participants is higher than the number of male participants. In the study of Kizilcec et al (2015), the number of female and male users is 1028 and 949. Additionally, females users doubled male users in Watson et al. (2018)' study, 547 female and 245 male respectively; the proportion of gender is 77.2% female and 22.8% male (Engeness et al., 2020) and 172 female users and 148 male users in the study of Liu, Kang and McKelroy (2015), thereby, the number of female users is obviously higher than male users. In addition, the results indicate that females users prefer 10-week course duration (Kizilcec et al, 2015, Watson et al., 2018&Engeness et al., 2020) as well as social science (Kizilcec et al, 2015, Watson et al., 2018 & Liu, Kang and McKelroy (2015).

Regarding the theoretical framework for online education, attitudinal learning was perceived as an effective theory for promoting meaningful learning and assessing learning outcomes in our results (Watson et al., 2018; Watson & Kim, 2016; Watson et al., 2016; Watson,

2017; Watson & Kim, 2016). They identified that attitudinal learning has positive influence on students attitudinal learning outcome, attitudinal change and attitudinal dissonance which can be components for improving xMOOC learning activities for students. Previous research utilized this theory as a framework to identify the relationship between learning achievement and attitudinal perceptions in online education (Cheon, et al., 2015, Hudson, et al., 2019). It is worth noting that while the theory of attitudinal learning was adapted by five included studies, we found that the authors of these five studies are relevant, as we asserted that they came from the same academic team. As such, we highly recommended that other theories we collected in this study are meaningful to be chosen as a structure for designing and delivering massive open online courses for different purposes.

We also found that mixed-methods and quantitative approaches (Kizilcec et al., 2015; Aydain & Yazaicai, 2020; Watson et al., 2016; Ortega-Arranz et al., 2019; Kim et al., 2016; Watson & Kim, 2016) rather than qualitative methods were the most common research approaches employed for conducting xMOOC instructional design investigations. However, we cannot combine the relationship between xMOOC instructional intervention topics and specific research approaches because the research objectives overlap among these three research approaches, such as the examination of learners' perceptions of positive course activities, learning experiences and instructors' perceptions of xMOOC challenges through these three research approaches. In other words, we found that quantitative methods, mixed methods and qualitative research methods all contribute to the xMOOC instruction development field.

5.2 Instructional Best Practices and Principles

In this section, we inductively asserted instructional principles in the design and delivery of xMOOCs by analyzing the effectiveness of best instructional strategies (Table 9).

Table 9

Instructional principle	Instructional best practice
Optimize self-directed learning experience	Simple, interactive, and user-friendly interface designs Setting up a Home Page Setting clear learning objectives Flexible dates and times to schedule their quizzes and/or complete their assignments
Enhancing the participation of faculty	Frequent announcements and reminder notifications Instructors provided constant and timely feedback
Globalizing learning atmosphere	Creating an inclusive and diverse learning atmosphere Learning activities that comprised gamification, humor, and exploration.
Visualizing instructional process and learning outcomes	Tools such as Tableau, Adobe Illustrator, and Excel Incorporating experiential learning activities and interactive, real-world applications Providing learners with the space to share their thoughts and experiences Awarding certificates and badges of completion
Easy-to-follow course structure	Course objectives are aligned with and linked to professional goals Course durations ranging between six weeks and ten weeks Short videos ranging between five and ten minutes Videos with instructor's face Aligned with the course objectives and addressed different levels of educational complexity

5.2.1. Optimize Self-directed Learning Experience

Students in xMOOCs prefer to study by self-directed learning model, student autonomy is the main factor determines course retention rate and completion rate. The design and delivery of xMOOCs are encouraged to provide learners an easy and clear navigation and interface design to facilitate self-learning model in xMOOCs. Learners who learn under a high-quality self-

directed learning experience are able to improve their learning engagement and self-control learning capabilities.

5.2.2 Enhancing the Participation of Faculty

In addition, a close connection between faculty and students is essential in promoting significant learning and teaching in xMOOCs. We found that learners who got a sense of "abandon" from course platforms usually drop-out courses and quit the course, such as never receive feedback or automated messages from instructors or platforms. The absence of faculty participation makes students feel unappreciated or even neglected, and the large number of dropouts directly affects the public's judgment of the quality of the course itself. Further, we identified that announcements and notifications from faculty are best practices which effectively enhance learners' engagement and make students feel like they are no longer learning from a computer. Notifications and certificates from MOOC developers or course affiliation institutions for learners are positive factors for engaging students and extending their continuous study intentions. Previous research has shown that xMOOC certificate earners actively performed and participated in MOOC discussion forums or chat boards (Breslow et al., 2013). Providing certificates for students helps reduce the drop-out rate and increase the retention rate (Goopio & Cheung, 2021). As such, this instructional principle dramatically enhances learning outcome by sustain learners' engagement and thereby maintain completion rate.

5.2.3. Globalizing Learning Atmosphere

One obvious characteristic of xMOOC is massive size students from all over the world with different time zones, cultures, learning needs, and behaviours determine the global feature of courses. Because of this feature, it is impossible for instructors to meet the expectations or needs of every student. The best practices of solving these issues and promoting effective

learning for xMOOC students is designing an inclusive and diverse learning atmosphere and keep the course fun and attractive. The design and particular xMOOC instructional strategies should discard *one-size-fits-all* interventions; instead, multiple learning materials, resources, activities and assignments are essential to organizing a successful course with practical value for handling problems.

The same conclusion was reached by Phan (2018), who found that providing a relevant and global learning context to international MOOC students can effectively encourage learners' learning engagement. Meyer et al. (2015) also recognized that a multicultural learning atmosphere has a positive impact on satisfying students' needs and provides learners with diverse backgrounds with equal opportunities to access "educational environments." Students are usually attracted to what they are familiar with, which will significantly increase retention rates. It is noted here that through a respectful and reciprocal learning context, students can learn from peers who are experts by sharing opinions with each other; additionally, students construct new knowledge socially. Studies have shown that social influence plays a crucial role in promoting learners' engagement and learning outcomes (Goopio & Cheung, 2021). More specific instructions of enhancing inclusive learning atmosphere can be an investigated as a future direction.

5.2.4. Visualizing Instructional Process and Learning Outcomes

Further, we asserted that visualizing instructional process and learning outcomes is a vital principle in the design and delivery xMOOCs for promoting deep understanding of course content. Applying appropriate course tools, linking to real-world problems, encouraging students to communicate and interactive with other peers, and offering awards are best practices of facilitating students "escape" from abstract knowledge. Through in-depth exploration of the

findings, we identified that the purpose of learning is to better serve life; accordingly, learning skills aim to solve problems in real life. As such, this instructional principle facilitates students' deep understanding through connecting real life and prior experience.

5.2.5. Easy-to-Follow Course Structure

Easy-to-follow is an essential requirement of designing a xMOOC for global students. This principle refers not only to the content of the course itself, but also to the structural design of the course. Evidenced-based course duration, video length and progressive content delivery determine the level of difficulty of the course content, these best practices closely relate to students' workload. A reasonable course workload can reduce students' cognitive load and promote their understanding.

5.3 Limitations and Future Directions

There are several limitations of this study. First, in this systematic literature review, we used well-defined search techniques to search the literatures for relevant research question. However, depending on the searching criteria, there is no guarantee that all relevant literature can be searched. Typically, gray literature and technical reports are not included, which may cause bias in the results. Accordingly, future research can complement more types of studies to improve the validity of the results.

Second, we only included English articles as targeted literatures, relevant literatures in other languages were excluded by us, so this would be one of the limitations in this study as well. Accordingly, it is valuable for future studies include xMOOC instructional design literatures in multiple language to broaden the scope of the results and findings.

Lastly, some data are missing in this study, such as the description of participations' level of education, age, gender and nationalities, xMOOC institutions and course duration, and data

collection and analysis methods. Future research can broaden the scope of investigated objects to avoid missing details. Further, some studies also reported that they lacked a comparation between pre-survey and post-survey which leaded to biased results. Accordingly, researchers can take this recommendation into consideration and set survey before and after course.

5.4 Conclusion

This research was a systematic review of 16 studies to identify the best practices and principles of the design and delivery of xMOOCs to promote the effectiveness of teaching and learning in online education. We screened and extracted best practices from 16 evidence-based studies so that our research results had a high validity. Further, five inductive instructional principles were extracted from the best practices. The purpose of this study was to provide researchers, instructors and policymakers a clear framework for offering effective instruction for xMOOCs students through analyzing and summarizing xMOOC design patterns, which can benefit xMOOC institutions and faculties.

Online education plays an indispensable role in current society, especially during the pandemic situation, and many countries and institutions have opted to use online courses due to safety concerns. However, online education has been developing since the late 20th century and has played an important role in driving the development of teaching and learning in remote areas. Today, online education continues to grow, with free large-scale public online courses becoming one of the most popular online courses chosen by the public. The main reason for this is the two main attributes of the courses, which are open and free, providing an excellent platform for people with a low income. In addition, compared to traditional paid online courses or small-scale offline courses, the large-scale and diverse learning atmosphere of xMOOCs provides students with broader insights and space to learn and communicate. This study aims to provide xMOOCs

designers, developers, and policymakers with effective instructional design strategies and principles with the aim of avoiding common instructional design risks and enhancing the strengths of instructional design in the future.

Specifically, the diversity of course learners has led to the inability of xMOOC designs to satisfy all students and therefore to a large number of dropouts and poor participation, thus leading students to be concerned about the quality and value of the course. Accordingly, this study also points out that the high dropout rates are not indicative of the quality of the course; instead, they indicate that the design of the course does not meet the needs of the students or the students do not find certain course design aspects useful for them, e.g. discussions. Therefore, the significance of this study also applies to the ability of students to evaluate the instructional value of xMOOCs in a rational manner. Additionally, course designers can ascertain which specific instructional design strategies are the main drivers of student dissatisfaction through this study, and thus can maintain retention rates by appropriately avoiding some design risks.

In addition, the instructional design of xMOOCs is currently based on existing design principles, e.g. the First Principles of Instruction (Merril, 2002). Although the value and effectiveness of these instructional theories and principles have been confirmed and applied in practical design by many scholars, the driving force of time and social development has led to a conflict between many design concepts and actual operational results. Therefore, this study starts from the best practices design approach and thus extracted inductive design principles. This study starts with the aim of maximizing the effectiveness instructional design strategies and derives instructional principles that correspond to the current situation of xMOOC development and can therefore be used by policymakers, instructors, and course development platforms.

On the other hand, the findings of this study reveal the learning outcomes resulting from the strengths and weaknesses of xMOOC instructional design and thus facilitate the best practices for future designers to consider. In addition, the instructional principles identified in this study are closely linked to the screened instructional strategies, and, unlike previous deductive research, to prove the validity of a principle the instructional design principles of this study are more practical and applied.

The extent to which the pedagogical principles identified in this thesis impact learning outcomes and what differences and similarities each of these design principles have in instructional design will need to be studied in depth in the future. However, we are certain that the xMOOC learning model will not decline in the future, and we predict that the design of xMOOCs will become more inclusive and versatile and that future xMOOC learning models and third-party support platforms will be gradually optimized and improved as the demand for xMOOCs increases.

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Appendices

Appendix A: Extracted information from 16 included studies

Study ID (e.g., Author et al., 2020)	Article title
Kizilcec et al., 2015	"The instructorâ€™s face in video instruction: Evidence from two large-scale field studiesâ€• : Correction to Kizilcec, Bailenson, and Gomez (2015)
Shukor & Abdullah, 2019	Using learning analytics to improve MOOC instructional design
Trust & Pektas, 2018	Using the ADDIE Model and Universal Design for Learning Principles to Develop an Open Online Course for Teacher Professional Development
Watson et al., 2018	Attitudinal learning and its relation to gender, age, ethnicity, enrolment purpose, and most impactful learning activity in a science of happiness MOOC
AydÄ±n & YazÄ±cÄ±, 2020	DROP-OUT in MOOCs
Engeness et al., 2020	Use of videos in the Information and Communication Technology Massive Open Online Course: Insights for learning and development of transformative digital agency with pre- and in-service teachers in Norway
Watson et al., 2016	Learning outcomes of a MOOC designed for attitudinal change: A case study of an Animal Behavior and Welfare MOOC.
Hew et al., 2018	Understanding Student Engagement in Large-Scale Open Online Courses: A Machine Learning Facilitated Analysis of Studentâ€™s Reflections in 18 Highly Rated MOOCs
Ortega-Arranz et al., 2019	To reward and beyond: Analyzing the effect of reward-based strategies in a MOOC.
Janakiraman & Watson, 2018	Adult Learners Use of Self-directed Learning Strategies in a Massive Open online Course
Watson, 2017	Facilitating attitudinal learning in an animal behaviour and welfare MOOC.
Watson et al., 2016	Instructional design, facilitation, and perceived learning outcomes: an exploratory case study of a human trafficking MOOC for attitudinal change.
Cohen & Holstein, 2016	The Characteristics of Successful MOOCs in the Fields of Software, Science, and Management, According to Students' Perception
Kim et al., 2016	Perceived learning in three MOOCs targeting attitudinal change.
Watson & Kim, 2016	Enrolment purposes, instructional activities, and perceptions of attitudinal learning in a human trafficking MOOC.
Liu, Kang & McKelroy, 2015	Examining Learners' Perspective of Taking a MOOC: Reasons, Excitement, and Perception of Usefulness

Journal name	Research approach	Research design
Journal of Educational Psychology	Quantitative	Longitudinal Observational Study
International Journal of Emerging Technologies in Learning (iJET)	Qualitative	Undefined
Journal of Digital Learning in Teacher Education	Qualitative	post-course survey and follow-up survey one year later
International Journal of Learning Technology	mixed-methods	convergent parallel
The Turkish Online Journal of Educational Technology	Quantitative	Case study
Policy Futures in Education	Mixed methods	post-intervention questionnaire design
Computers & Education	Quantitative	case study
International Review of Research in Open and Distributed Learning	Qualitative	Undefined
Computers & Education	Quantitative	Between-subjects design
Journal of Ethnographic & Qualitative Research	Mixed methods	Undefined
Open Learning: The Journal of Open, Distance and e-Learning	mixed-methods	case study
Educational Technology Research and Development	mixed-methods	case study
Interdisciplinary Journal of e-Skills and Lifelong Learning	Mixed methods	Undefined
Educational Media International	Quantitative	case study design
	Quantitative	case study
Educational Media International	Mixed methods	survey design

Research question
Study 1: The goal of this observational study was to shed light on learnersâ€™ informed choices of presentation style and the reasoning underlying their choices. --- Study 2: Research Question 1: Is cognitive load higher in the strategic or the constant condition? Research Question 2: Is social presence higher in the strategic or in the constant condition? Research Question 3.1: Will learning outcomes be higher in the strategic or in the constant condition? Research Question 3.2: Are learners more likely to take assessments in the strategic or in the constant condition? Research Question 4: Is attrition lower in the strategic or in the constant condition? Research Question 5: Do individual differences in learning preference moderate the effect of the strategic presentation relative to the constant presentation of the face on (a) cognitive load, (b) social presence,(c) learning outcomes and assessment taking, and (d) attrition?
How learning analytics can be used to improve instructional design in MOOC?
(a) What factors influenced participantsâ€™ learning experiences in the open online course? (b) What did the participants learn from the course? (c) How did engagement in the course influence participantsâ€™ teaching practice?
RQ1 How was the SOH MOOC designed and facilitated for attitudinal learning? RQ2 To what extent do learnersâ€™ enrolment purposes and preferred learning activities influence their attitudinal learning gains? RQ3 RQ3 How do learnersâ€™ attitudinal learning gains differ by gender, age, and ethnicity?
Within the scope of this study, the reasons as to why the students who participated in the AKADEMA platform to obtain new information later dropped the courses were examined and their suggestions to continue the courses were also questioned.
RQ1: What did the pre- and in-service teachers say about the types of support the video resources in the ICTMOOC provided and what length of videos was preferred by the learners? RQ2: What are the implications of the support provided by the videos for enhancing participantsâ€™ agentic capacity to learn and transformative digital agency?
Research question 2. What did learners perceive as the most impactful instructional strategy in the MOOC?
What elements pertaining to the course design or the instructor did students find enjoyable, helpful in learning the materials, or motivational (motivating them to take part in the activities)?
To analyze the effects of badges and redeemable rewards on student retention and engagement.
We examined how adult learners interpreted their experiences while applying self-directed learning (SDL) strategies in a science of happiness (SOH) massive open online course (MOOC).
(a) RQ1. How did an instructional team design the MOOC?, (b) RQ2. How did an instructional team facilitate the MOOC?, (c) RQ3. What were the learnersâ€™ enrolment purposes and preferred learning activities? and (d) RQ4. What were the learnersâ€™ perceptions of attitudinal learning gains?
RQ1. How did an instructor and instructional designer design and facilitate a MOOC for attitudinal change around the social issue of human trafficking? RQ4. What were learnersâ€™ perceptions of instructional activities within the MOOC?
1. What are the characteristics that contribute to the success of MOOCs in the fields of software, sciences, and management, according to the studentsâ€™ perception? 2. What types of learners predominate, based on their descriptions of characteristics, for course success in the collected reviews?
(1) Are there differences in learnersâ€™ perceptions of attitudinal change (general, cognitive, affective, and behavioral) according to instructional method? (2) How and to what extent do learnersâ€™ perceptions of attitudinal change (general, cognitive, affective, and behavioral) differ according to what MOOC they participated in? (3) How and to what extent do learners perceive components of attitude change (general, cognitive, affective, and behavioral) influence one another?
Q3: What instructional strategy did learners perceive as the most effective in the MOOC?
(4) What aspect(s) of this MOOC do they find most helpful to their learning and why?

Theoretical framework	Year of study
Cognitive Load Theory (Sweller, 1988; Sweller et al., 1998).	2013
Learning Analytics	Undefined
Universal Design for Learning (UDL) principles (CAST, Inc., 2012)	2015
Attitudinal learning	2015
Undefined	2018
A cultural-historical perspective (Clara &Barbera, 2013; Engeness, 2020). Vygotsky (1980) was the first to suggest that the source of learning and development of the human mind lies on the external (social) plane. Tools (material and linguistic) that mediate these activities are initially directed outwards, connecting the learner with the surrounding world and, by acquiring a particular meaning, transform into signs directed inwards, to the mental plane of the learner (Arievitch and Stetsenko, 2014). In our case, videos embedded in the ICTMOOC act as material mediational tools that connect learners with the public meanings that are valued in cultures.	2014â€“2018.
attitudinal learning	2014
Engagement Theory. Student engagement may take many forms, such as attending classes (behavioral engagement), asking questions (cognitive engagement), and/or expressing enjoyment towards the course activities or instructors (Fredricks et al., 2014).	Undefined
Flow Theory (Csikszentmihalyi, 1991) and the Self-Determination Theory (Ryan & Deci, 2000).	2018
Kirwan et al. (2010) self-directed learning pertaining to academic tasks and practice	2015
Attitudinal learning	2014
attitudinal learning	2014
Garrison et al. (2000) Community of Inquiry (CoI) model. This model that represents the process of cre-ating a deep and meaningful (collaborative-constructivist) online learning experience through the development of three interdependent elements: social, cognitive, and teaching presence.	Undefined
Undefined	fall 2014â€“spring 2015
attitudinal learning HT	Undefined
Anderson and Dronâ€™s â€œThree Generations of Distance Education Pedagogyâ€ (2011) and Chickering and Gamsonâ€™s â€œSeven Principles for Good Practice in Undergraduate Educationâ€• (1987)	2013

Data collected	Data analysis method	Institution where course is offered
Observations	Undefined	Undefined
Undefined. Content analysis?	Data was analyzed by conducting descriptive statistical analysis in comparing MOOC A and MOOC B	Undefined
survey	thematic analysis	University of Massachusetts
instructor interviews; learner interviews; online post-course survey	thematic coding and MANOVAs	Undefined
two open-ended questions	Content analysis	University of Massachusetts
online questionnaire	thematic analysis	Ã˜stfold University College
learner post-course survey	descriptive statistics; MANOVA	Undefined
student comments/reviews from MOOC sites	content analysis	Rice University; The University of Queensland; Caltech; Dartmouth College; University of Pennsylvania (n=2); Rochester Institute of Technology; Massachusetts Institute of Technology (n=3); Undefined (n=1); The World Wide Web Consortium (W3C; n=1); The University of Newcastle, Australia; University of Colorado Boulder; Harvard University; Trinity College; UniversitÃ© catholique de Louvain; University of British Columbia.
from the Canvas Network and GamiTool platforms	chi square tests, Wilcoxon signed-rank tests, pairwise z-tests	Undefined
surveys, interviews, observations and document analysis	axial coding methods	UC Berkeley
interview with instructors, a review of course materials, announcements/forum posts, attitudinal learning gains survey and interviews with learners.	structural analysis	Undefined
(1) instructor and instructional designer interviews, (2) course syllabus and activities, instructor discussion posts, announcements, and blog posts, (3) learner discussion posts and assignments, (4) end-of-course, open-ended learner survey, and (5) a follow-up learner questionnaire sent 7 months after the conclusion of the course.	structural analysis	Undefined
none	Content analysis	Undefined
Survey	ANOVA; multiple linear regression	Undefined
survey	frequency analysis	Undefined
survey data	descriptive statistics; thematic coding.	University of Texas

Country of origin	Education level	Discipline
Undefined	Undefined	social sciences (sociology)
Undefined	Undefined	social science (n=2)
USA	Undefined	Teacher Professional Development
USA	Unddefined	science of happiness (SOH)
Turkey	higher education	Undefined
Norway	The pre-service teachers took the ICTMOOC as a part of their teacher training programme and the requirement to enrol in the course was a General Certificate of Secondary Education. The in-service teachers engaged in the course to enhance their professional development.	Information and Communication Technology
Scotland	Undefined	Animal Behavior and Welfare
Belgium (n=1); Canada (n=2); USA (n=11); Australia (n=2); Undefined (n=1); The World Wide Web Consortium (W3C; n=1).	Undefined	Natural sciences (n=9); Humanities (n=4); Social sciences (n=5);
Spain	Undefined	translation from English to Spanish in the business and economic field
USA	Undefined	science of happiness (SOH)
Scotland	Undefined	animal behaviour and welfare (ABW)
USA	Undefined	Human trafficking
Undefined	Undefined	Natural sciences (n=4); Social sciences (n=1).
Scotland; USA; USA.	Undefined	Human Trafficking (HT), US Food System, and Animal Behavior and Welfare
USA	Undefined	human traficking
USA	woking professionals	Social sciences (journalism).

Course title	Platform provider	Duration
Undefined	Coursera	10 weeks
Undefined	OpenLearning	Undefined
Designing Digital Media for Teaching & Learning	Umass blog (authors replied my email)	5 weeks
SOH MOOC	edX	10 weeks
Undefined	AKADEMA	Undefined
and Communication Technology Massive Open Online Course (ICTMOOC).	Canvas platform	10 weeks
Animal Behavior&Welfare MOOC	Coursera	6 weeks
An Introduction to Interactive Programming in Python; The science of everyday thinking; The science of the solar system; Introduction to environmental science; Design: creation of artifacts in society; Modern and contemporary American poetry; Cybersecurity fundamentals; The analytics edge; Finance: time value of money; HTML5 coding essentials and best practices; u.lab: leading from the emerging future; Drawing nature, science and culture: natural history illustration 101; Introduction to biology-the secret of life; Comic books and graphic novels; Justice; Mobile computing with app inventorâ€"CS principles; International human rights law; Climate change: the science.	CourseTalk	Undefined
Undefined	Canvas Network	8 weeks
Science of Happiness	edX	10-week period
an ABW MOOC for attitudinal learning	Coursera	6 weeks
Human trafficking	Coursera	4 weeks
Introduction to Interactive Programming in Python; Epidemics - the Dynamics of Infectious Diseases; The Science of the Solar System; Introduction to Environmental Science; An Introduction to Operations Management.	Coursera (n=4); edX (n=1).	Undefined
Undefined	Coursera	6 weeks; 4 weeks; 6 weeks.
HT MOOC	Coursera	4 weeks+Q18
Introduction to Infographics and Data Visualization	Moodle	5 weeks

Sample size	Nationalities	Age
1977; 67% response rate=1324	Undefined	Average: 37.6
MOOC A: 141; MOOC B: 59.	Undefined	Undefined
480 registered; 48 completed the course. 53 participants filled out the post-course survey and 15 of these individuals completed the follow-up survey.	USA (n=41), Mexico (n=2), one each in Australia, Brazil, Malta, Ghana, Canada, Romania, and Thailand; undefined (n=3).	Undefined
53,491 registered learners; 792 respondents to survey. 20 interviewed.	Total: 191 countries. The five countries with the most learners enrolled were the US (33.9%), India (6.6%), the UK (4.8%), Canada (4.2%), and Australia (3.3%).	Undefined
325	Turkish	Undefined
501	mostly Norwegian, some Swedish.	20-65 years old
22,955 registered learners; 3043 participants completed the course; 227 learners from the MOOC completed the survey.	Undefined	Undefined
18 MOOCs; participants unknown.	Undefined	Undefined
648	53.9% were from Latin America	Undefined
792 respondents to survey; 16 final participants.	Undefined	Undefined
22,955 registered learners; 3043 participants completed the course; 10 learners were interviewed. all six intructors were interviewed.	Undefined	Undefined
30,207 registered learners; 1253 participants completed the course. Participants included the instructor, instructional designer, and learners within the course.	Undefined	Undefined
5 MOOCs; 2,580 + 330 + 254 + 230 + 109 reviews	Undefined	Undefined
22,955 registered participants; 30,207; 9442. 3043 participants completed the course; 1,253; 645. A total of 749 respondents to the study survey.	undefined;	Undefined
30,207 registered learners; 1253 participants completed the course;	Undefined	Undefined
320 respondents; 8% response rate.= 27+Q18	30% USA; 5% Spain; 5% Netherlands, 4% Brazil; others (1-3% per country) were from Australia, Canada, Italy, Ukraine, United Kingdom, Columbia, Germany, India, Finland, and Kenya.	Graduates stduents and older

Gender	Level of study
1028 female; 949 male.	Undefined; 75% had 4â€“6 years of university education.
Undefined	Undefined
Undefined	Participants were educators. Participants were prekindergarten (n=6; 11%), elementary school (kindergarten to fifth grade) (n=11; 21%), middle school (sixth to eighth grade) (n=11; 21%), high school (ninth to 12th grade) (n=13; 25%), and college/university teachers (n=8; 15%). Additionally, two participants were graduate students, one was a professional development specialist, and one worked at a Kâ€“12 school.
547 female and 245 male.	Undefined
Undefined	Undefined
22.8% male; 77.2% female.	Pre-service teachers (20.6%). In-service teachers (73.4%). Others (8.8%).
Undefined	Undefined
Undefined	Undefined+V11
538 female; 110 male.	56.2% were undergraduate students
Undefined	Undefined
Undefined	Undefined
Undefined	The instructional designer had prior experience designing and facilitating MOOCs in both hard and social science courses. The learner participants for this study included respondents to an end-of-course survey (n = 54) and a follow-up questionnaire (n = 319).
Undefined	Undefined
Undefined	Undefined
Undefined	Undefined
172 female; 148 male.	267 participants were working professionals.

Study ID (e.g., Author et al., 2020)	Instructional design strategies
Kizilcec et al., 2015	Although the majority of learners preferred lectures with the face, one-quarter to one-third of learners chose to watch lectures without the instructorâ€™s face. Around 8% of learners actively used both versions. Those who watched videos with the instructorâ€™s face reported liking the lectures better, needing to exert less effort, and learning more than those who watched videos without the instructorâ€™s face. Many learners reported that following the lecture and paying attention was easier with the face. (instructors' face in videos)
Shukor & Abdullah, 2019	The importance of â€˜first impressionâ€™ in MOOC. Based on learning analytics, this study found that Home Pages in both MOOCs were frequently viewed. Home Page is the page where students get any course update and the first page that they visited once they enrolled in the course. *(interface design)* Problem based learning activities in MOOC. The page contains video that presents students with problem solving activities which the course instructor relates to the problem. The course also provides the element of "fun" in the page where to unlock the provided .pdf document, students have to watch the video until the end to get the password. This results in better learning retention which in line with the importance of learner centered approach that change the learners as active participants to promote student empowerment and engagement. *(problem based learning activities)*
Trust & Pektas, 2018	Fifty-one out of the 53 post-course survey participants (96%) rated the course design as â€œvery goodâ€ or â€œgoodâ€ and 94% of the participants (n=50) rated the accessibility of the course as â€œvery goodâ€ or â€œgood.â€ A number of participants indicated that the following course features were very helpful: learning activi*ties (n=48; 91%), course website (n=45; 85%), multimedia (n=44; 83%), Google+ community (n=38; 72%), and (feedback) from course facilitators (n=34; 64%).* (Feedback). Many participants indicated that the feedback from course facilitators was a critical component that encouraged them to stay engaged in the course and also helped deepen their learning experience. Overall, participants felt that receiving consistent and timely feedback was a notable experience that *shaped their learning and encouraged their participation in the open online course.* *(Course Navigation).* Some participants praised the design of the course website, stating that the content was easy to access and the website was easy to navigate. The Web designers applied visual and multimedia design principles, as well as learning strategies, such as chunking, to create a website that was user-friendly, simple, and easy to explore. As a result, a number of participants felt that the course website supported and facilitated their learning experience. *(Personalized Learning Activities).* A number of participants commented on the *flexibility and personalized nature of the course learning activities.* These participants appreciated having multiple means of engagement, representation, and action and expression, thus highlighting the importance of using the UDL principles when developing virtual open online courses for educators. *(Course Community*). A number of participants (n=40; 75%) commented on the value of being part of a learning community. Twenty (38%) of the participants even noted that by engaging in the course they were able to expand their professional learning network. As opposed to traditional online courses where students submit assignments directly to the instructor, in this course, participants posted their assignments on a public course Google+ community where anyone could comment or â€œ+1â€ (i.e., â€œlikeâ€) the post. Additionally, the weekly Twitter chats provided a space for participants to connect and learn with educators outside of their local workplaces. (Suggestions for Improvement). While, overall, the participants felt that the course was well designed, a few of the participants identified challenges that limited their engagement with the course: namely, that the course was too fast-paced, the Google+ community was overwhelming and needed better organization, and there was not enough time to actively participate in the course. Since teachersâ€™ responsibilities are very time-consuming, it is important to offer learning experiences that can fit within their schedule. We could improve the course by offering it over a longer period of time, by providing training on how to use the Google+ community, and by creating a better organizational structure for Google+ community posts. While â€œlack of timeâ€• was one of the main obstacles to completing the course, many of the participants were able to overcome this challenge.
Watson et al., 2018	Quantitative data: 54% of survey respondents perceived (video lectures) as most powerful. The course (readings and reflection exercises) were also identified as impactful with 18.1 and 20.5% of respondents ranking them as most impactful, respectively. Qualitative data: Seamless design and roadmap videos. A core design choice focused on facilitating learnersâ€™ transition between topics through a seamless design. This was mostly realised through videos, highlighting what had been covered and what was being covered next, thus encouraging learners to continue, and giving detailed instructions for learning activities. Effort was taken to produce small â€œchunksâ€ of videos that provided focused learning opportunities. Learners described the MOOCâ€™s design, delivery and structure as well laid out, noting only initial difficulty with course navigation. In particular, learners were highly positive about the course videos; although, a few noted the videos might be more effective if they were shorter. Learners also recognised the level of work required in the course was significant and sometimes problematic. (Reflection exercises)= (learning activities). The course offered learners research-based, practical exercises throughout the course for promoting happiness in their daily lives. The exercises included internalising awe by looking at surroundings, trying out the essentials of forgiving, writing a letter of gratitude to someone, being more mindful about actions, performing a loving kindness meditation, reading books and articles written by psychologists, and most importantly, practicing self-compassion. Learners indicated that the practice activities were very helpful in producing changes in their lives and were easy to follow. (Discussion and engagement). While discussions were ungraded, learners were encouraged to participate in discussions facilitated by teaching assistants. The forums did not present specific questions, but instead asked learnersâ€™ to share their experiences. Learner interviews indicated, however, that the discussion forums were challenging to use and â€œdifficult to stay on trackâ€• due to the massive size of the class. While attempts were made in the beginning of the course to establish smaller groups of learner communities for stronger engagement, these attempts were unsuccessful. (Course length and workload). Many learners shared their conflicted feelings about the course length, indicating that the 10-

	week MOOC was lengthy for some. The intensity and workload of the SOH MOOC was overwhelming for many learners. MOOC discussions. Both instructor and learners noted the limitations of MOOC discussion forums. All participants in some way discussed the need for more effective designs for discussions. (Inclusion and diversity).The need to design a more inclusive or diverse course was also reflected in several learner interview comments. The course was viewed as primarily focused on the Western perception and practices of happiness.
AydÄ±n & YazÄ±cÄ±, 2020	1. Managerial Suggestions (in decreasing order): Courses shou*ld (be diversifie*d); Learners should b*e informed= (notification)a*bout the start and end dates of the courses; Learners should be *certified (certificate)* upon completing the program; AKADEMA should be promoted more; Learners should be offered flexibility about starting and ending classes*;(Course notifications)* should also be given with the help of the mobile application; (*Course durations)* should be extended; AKADEMA courses can be opened for more than one semester during the year. 2. Suggestions for Content Design (in decreasing order): *Videos* should be used more effectively; Learners should be given *feedback* on time; Learnerâ€“instructor *interaction* should be provided; Lectures should be more detailed and interesting. 3. Suggestions for *Interface Design*: The use of interface should be simpler and easier.
Engeness et al., 2020	Quantitative data: 96.5% of participants were very strongly satisfied or strongly satisfied with the support the videos provided in the MOOC. Most participants (82.5%) considered the *length of the videos (average 6 minutes and 3 seconds) t*o be appropriate. The students preferred the vW4ideos in the range of 5â€“6 min (37.3%) and the *videos* in the range of 7â€“10 min (40.7%). Qualitative data: four themes. 1. Orienting support â€¢ Se*tting up the learning process-course length and duration* â€¢ Creating an overview of the target material and the assigned tasks= *clear learning goals* â€¢ Introducing t*he assignments* to the participants â€¢ Outlining the criteria of the learning outcomes â€¢ Revealing the potential of the functions in the available software 2. Executive support â€¢ Facilitating participantsâ€™ engagement with the tasks *by providing step-by-step guidance about how to complete the task=nnavigation* â€¢ Adjusting to individual learning needs= *diverse and inslusive* (tempo and multiple viewings) â€¢ Support to engage in learning new concepts 3. Controlling support â€¢ Clarifying the criteria of the learning outcomes â€¢ Support to compare and *evaluate learning outcomes against the criteria outlined in the videos (quizzes)* â€¢ *Revision and reflection learning activities* 4. Other support â€¢ As a starting point to search other video resources available on the Internet â€¢ Videos as useful learning resources in online environments â€¢ The need for updated videos â€¢ The need to establish coherence between the content of the webpage and the content of the videos
Watson et al., 2016	The majority of learners (85.90%) who took the MOOC perceived *lectures and videos* as the most impactful instructional method for their learning in the MOOC.
Hew et al., 2018	a) The most frequently mentioned theme was *instructor attributes. The* other commonly mentioned themes were *course content and resource*s, *assignment* and *assessment*, and s*tructure and pace.* b) Two particular instructor attributes stood out among the many student comments: instructorâ€™s passion about the subject as well as teaching it, and instructorâ€™s sense of humor. c) Students enjoy course *content and resources that emphasized real-world application or problem-solving.* d) Students desire moderately challenging courses assignments that require them to apply the contents learned. Easy assignments or questions that merely test factual recall are disliked. Assignments that are fun and enjoyable (e.g., building simple games) make the tasks more engaging to students. e) Student prefer short *lecture videos ranging f*rom about five to ten minutes long. Videos consisting of different instructors were perceived to be more engaging. Guest speakersâ€™ appearances in videos are generally welcomed and appreciated by students. f) Use o*f in-video quizzes* helps sustain studentsâ€™ attention to lecture content. g) Students prefer a course structure that builds on each lesson progressively from simple to difficult, and provides options for students to do either the minimum or go deeper into the subject.
Ortega-Arranz et al., 2019	Thus, the overall results suggest that those learners who are unlikely to complete the MOOC due to external reasons (e.g., lack of time, lack of previous knowledge, or lack of interest on the course contents), will neither be motivated or engaged with the reward strategies (regardless of the reward type used). However, it seems that reward strategies (badges and redeemable rewards) can potentially encourage learners who are already motivated to complete the course (e.g., interest on course topic and contents) to perform the optional tasks that would otherwise not be fulfilled.
Janakiraman & Watson, 2018	One set of activities that adult learners seemed to prefer included *exams and problem sets*. This preference is because, in their own words, it allowed them to set goals, self-assess, maintain focus, verify learning, and get feedback. *Discussion Forums.* Adult learners did not participate in the discussion forums as much as the instructor/designer expected. Although learners considered the discussion forums as potentially useful, many of them did not participate because they *were not deriving any direct benefit from it owing to limited interaction*. Learners either did not want to share their â€œpersonal experiencesâ€• or they found it ineffective as an SDL strategy because of the massive audience and differences in time zones. Tryi*ng to navigate the forums was d*ifficult and the number of posts reduced gradually after the initial week of introductions. All the learners we interviewed tried their best to complete activities that gave them direct benefits, such as watching lecture

	videos and interview videos, reading the material, and participating in happiness practices. They ignored discussion forums, happiness teams, and social media that involved team work or sharing opinions and experiences. This outcome showed that not all activities in the MOOC were perceived as beneficial by self-directed learners.
Watson, 2017	*Clear learning goals.* The importance of clear learning goals was a central theme of the MOOC design and facilitation. The team had identified three core messages that they wanted to embed in all course materials. [One] What we can measure, we can manage which relates to ABW is a science; it is not a fluffy, cuddling, cute animals discipline. [Two] Small changes can make a big difference: small change to an animalâ€™s life can make a large difference in the way it feels. And the third one, a common ABW message: it is what the animal experiences, which dictates its welfare. These key messages were evident in the announcement, course materials and discussions. The materials for the first week was particularly focused on these in order to reach the largest possible number of learners, as instructors were aware that MOOC learner numbers would drastically decrease after the first week. *Interactive learning activities. wanted the activities to be interactive. Th*ird, they wanted a visually different look. The desire to try a new approach from the traditional â€˜talking head lookâ€™ had them settle on â€˜documentary style, short videosâ€™, and this was achievable due to the filming support the university provided. The videos showed the instructors in their homes or in various ABW contexts, â€˜taking students on a little ajourney that would allow them to actually get a feel for what it was like to be an animal on a farm.â€™ The team also decided against lengthier assignments and instead focused on short quizzes as the primary graded activity. This choice was made to encourage learners to explore the i*nteractive materials and videos to facilitate deeper understan*ding, rather than spending time on busy assignment work. *Collaborative design and facilitation*. A collaborative team of instructors completed the design of the MOOC. The alignment of their professional goals and the support received from a variety of sources allowed them to offer it. Each of these collaborative aspects created a rich environment for creating a MOOC, with each of the instructors taking responsibility for one or two weeks of the course design, dividing the workload across the team.
Watson et al., 2016	RQ1. +W10:W13Cognitive dissonance: *readings.* The instructional design choices in the HT MOOC reflected the use of dissonance as suggested in the attitude change literature. Course elements were designed to introduce dissonance in all three attitudinal components. In order to raise awareness, *readings and resources* for knowledge gain were provided, introducing cognitive dissonance. Presentation of statistics and facts related to global HTâ€”as well as the realities of victims expressed via narrativesâ€”prompted learners to understand the global state of HT. Affective dissonance*: videos* While documentary and undercover videos provided information on HT, they also fostered dissonance in the affective domain, allowing *learners to experience a strong feeling of empathy.* These videos included the internal course lecture videos, as well as links to external undercover reports, PSAs, documentaries, and survivor testimonies to the UN. The oftentimes upsetting nature of the videos provided disturbing details of how individuals were kidnapped, enslaved and forced to witness the murder of peers who resisted. Behavioral dissonance: p*ublic service announcement= notification* (PSAa) The third design decision comprised the incorporation of an activism project, introducing behavioral dissonance. This instructional design strategy asked learners to perform a targeted behavior. As part of their course score that was used to determine course completion, learners were expected to use a self-selected medium to develop a PSA related to any form of HT, with the intent of raising awareness in a real world context. Learner needs. In response to the global audience and the differing experiences learners brought to the course, the instructional team chose to establish a broad and general learning objective in order to embrace a *variety of learner needs =diversity and inclusive.* *A safe space=communication*. The most prominent facilitation strategy identified by both Melanie and Jon was to create a safe space for learners to share personal experiences. They strove to integrate this message throughout the entire course. Instructor authenticity. An instructional designer should have three core attributes necessary for MOOCs that involved a socially sensitive topic: passion, engagement, and authenticity. RQ4. Learners had the most positive perceptions of the lectures/videos (35 %) and readings/resources (29 %) as impactful *instructional activities* within the MOOC. *Quizzes* were considered the least impactful (2 %).
Cohen & Holstein, 2016	The group that perceived the importance of *atmosphere for course* success: This group of students emphasized the importance of the atmosphere characteristic. The students mentioned the importan*ce of humor, fun, and games in improving their* learning capabilities; the teacherâ€™s in-depth knowledge which helped engage students in learning; the importance of eng*aging the curiosity of the studen*ts. All of these contributed to enjoyment, which students emphasized as a significant factor in learning engagement. A variety of methods contributed to studentsâ€™ enjoyment of the different courses. The group that perceived the importance of exercise for course success: This group represents students that perceived the importance of the exercise characteristic. Students mentioned that *exercise=learning activities*, which includes building games, is a motivator for learning. Some mentioned the importance of games and animation as motivators to complete the exercises and learn during the course. It can be concluded that the courses that had exercises involving games resulted in po*sitive student engagement, extensive investment, and deep understanding of the material.* The group that perceived the importance of teacher for course success=instructor attributes: This group emphasized the importance of the teacher characteristic. The instructor was found to be a dominant factor for MOOC success in all the courses used for this study. Students stated the importance of teachers who use entertainment and humor in their teaching for the purpose of e*ngaging studen*ts; additionally, the creation of a challenge, clear explanations, and creation of the feeling that the tasks are feasible were important. Some mentioned the added value in the variety of instructors. They also emphasized the importance of the teachersâ€™ expertise, their enthusiasm, and the quality of their explanations. They mentioned the thorough coverage of subjects and the combination between theory and practical examples. Some mentioned the fact that the teacher explained complex ideas in a simple manner, created a pleasant atmosphere, and was available to respond to questions in the forum. The group that perceived the importance of exam for course=quizzes success: Some students mentioned the complexity of the quizzes, which prepared them for higher quality learning. The same is true for the alignment between the quizzes and the projects, which enabled the students to learn the subject, build the project, and understand the course material. Others mentioned the flexibility of the schedule for completing the tests al-lowed the students to close the learning gap. Some liked that the quizzes tested their understanding thoroughly and did not simply repeat the lecture content.

Kim et al., 2016	There were statistically significant differences of learnersâ€™ perceptions of general, cognitive, and affective learning according to instructional method, only excepting learnersâ€™ perceptions of behavioral learning. Learnersâ€™ perceptions of general learning with *lectures/videos* were higher than those with *readings/resources*, with *quizzes*, and with other methods. Learnersâ€™ perceptions of cognitive learning with lectures/videos were also higher than those in personal projects and other methods. Learnersâ€™ perceptions of affective learning with other methods were lower than those with readings/resources, with discussions, with personal projects, and with lectures/videos. These differences were statistically significant. Learners perceived lectures and videos as the most impactful instructional method in their MOOC. Students also perceived readings/resources, *discussions,* quizzes, and *personal projects* as effective instructional strategies.
Watson & Kim, 2016	L*ectures and videos (35.40%)* were the instructional strategy that learners viewed as the most effective within the MOOC. *Readings and resources (29.50%) r*anked second highest by learners. Frequencies of learners reporting *personal projects (12.50%)* and *discussions (12.20%*) as the most impactful strategy were lower. The q*uizzes (1.60%)* received the lowest reports as the most effective instructional strategy.
Liu, Kang & McKelroy, 2015	The topic most commonly noted was related to the skills on how to develop data visualization and infographics and how to evaluate a completed project. Further analysis revealed the parts of the course that the participants found to be most or least helpful to support their learning that included the activities and assignments, course tools, and materials. Activities and *assignments.* Participants found that the assignments and activities were helpful to their learning as they provided them the opportunities to practice design principles and understand how to develop graphical representations of the data. The hands-on nature of this MOOC was noted a top feature that students liked the most about the course. Students indicated they were able to â€œapply their knowledge,â€ and were allowed the â€œfreedom to exploreâ€ on a topic new to many participants. *Course tools*. The findings also showed using the tools and softwares (i.e. Tableau, Adobe Illustrator, and Excel) were helpful in l*earning data visualization and how to produce infographic*s. Through the use of these tools, the participants w*ere able to understand* how to organize and produce good data visualizations. Course materials. The participants considered reading materials and *videos* helpful, but were less positive about discussion forums and quizzes. Participantsâ€™ open-ended responses corroborated the quantitative results in that the videos and reading materials were informative and high quality. Many indicated that the materials would be a good resource they could refer to after the completion of MOOC. The expertise of the instructor and many relevant examples provided were also considered valuable. However, the quiz was found to be basic and did not present a challenge.

Study ID (e.g., Author et al., 2020)	Limitations of the study
Kizilcec et al., 2015	An important limitation of this study is the homogeneity of lecture videos in which the presentation style of the instructorâ€™s face was manipulated.
Shukor & Abdullah, 2019	Undefined
Trust & Pektas, 2018	-- While the course we designed was not aâ€œMOOCâ€• since it did not reach a massive audience, it served a similar purpose to MOOCs
Watson et al., 2018	First, this study utilised self-reported survey responses from 792 learners who voluntarily completed the post-course survey and interviews with one instructor and 20 learners. This number is only a small sample of the total number of initial MOOC participants (N = 53,491). Second, no pre-course survey was conducted at the start of the MOOC, therefore we were unable to observe direct changes as a result of the MOOC. Using only a post-survey presents a response bias, specifically social desirability. Finally, a follow up investigation to examine whether learners retained the attitudinal learning as reported in the post-course survey could be a natural next step. It is possible that the learners experienced attitudinal change after the post-course survey whether it positive or negative. The same can be said of learners who did not complete the course or who were not in the original sample.
AydÄ±n & YazÄ±cÄ±, 2020	Undefined.
Engeness et al., 2020	The limitation of this study is that the analyses are based on the pre- and in-service teachersâ€™ reflections about the support the videos provided in the learning process.
Watson et al., 2016	Undefined
Hew et al., 2018	First, it should be noted that highly rated courses may not necessarily be the most effective ones. It is beyond the scope of this study to examine causal effect between course effectiveness (e.g., learning performance) and user ratings. Second, this study did not examine the participantsâ€™ disaffection of using MOOCs. Exploring student disaffection may offer information that can complement our overall understanding of student engagement. We therefore invite other researchers to conduct this investigation. Third, CourseTalk did not provide any indication on which student comments came from students taking the MOOC for course credit or from students who were taking it for other reasons. This precludes an investigation of how the comments from these students may differ. Despite the aforementioned limitations, we believe that the findings of this study provide valuable insight on the specific elements that students find engaging in large-scale open online courses.
Ortega-Arranz et al., 2019	Undefined
Janakiraman & Watson, 2018	One of the main limitations of our study was that the MOOC we studied was not designed using SDL strategies as a framework. We analyzed the data and examined MOOC activities under the lens of SDL strategies, based on the self-descriptions provided by learners in the interviews. Also, the data we collected about learnersâ€™ prior attitudes were from post-course interviews that could also be biased. This circumstance highlights the limitation of not having administered a pre-course survey. It is possible that social desirability may have impacted participant responses making them provide answers that we wished to hear. The present study looked at how adult learners used SDL strategies in a SOH MOOC only, and, hence, the results may not be generalizable to all MOOCs designed to teach socio-scientific topics. Also, the negative results about the group learning activities like discussion forums, happiness teams, and social media may not be generalized to other MOOCs as they may have been unique to this SOH MOOC. Another limitation is that our sample did not include learners who did not complete the end of course survey and those who did not agree to be interviewed. It is possible that we missed rich data from these sources. The low response rate and the self-selection of respondents may have introduced a selection bias by over-representing those who were more engaged in the MOOC. In MOOCs enrollment numbers are high owing to the nature of the learning platform. We also realize the limitation that our findings based on this small sample may not apply to all the learners who originally enrolled in the MOOC.
Watson, 2017	First, this is a single case study focusing on the experiences of the instructors and students that were willing to participate. Secondly, while the survey responses show positive perceptions of learning, it was a short survey with a limited number of survey items. The survey was sent out in addition to other official course surveys and was therefore kept short, possibly resulting in the relatively low Cronbachâ€™s Î± values. Third, the lack of pre and post comparison of attitudes makes it difficult for an accurate examination of the learning outcomes. Itâ€™s possible that the learners who had high interest in advancing ABW largely comprised the learners who enrolled in the MOOC. High-interest students could have been the subset of learners that completed the survey as well, skewing the reported experiences to more positive. Finally, methodology for examining attitudinal instruction within open learning platforms needs further consideration, with special focus on how attitudes may be measured more accurately.
Watson et al., 2016	First, the use of a small data set limits generalization. Using this case study as a starting point, future studies should examine multiple cases of MOOC instruction for attitudinal change, so that these recommendations can be validated in other contexts.

	Second, while learners reported positive perceptions of attitudinal learning outcomes, the lack of pre and post comparison of learner attitudes makes it hard to determine accurate learning outcomes of the MOOC.
Cohen & Holstein, 2016	The main limitation of the research was the small number of courses that it was based on, although the courses included hundreds or thousands of reviews and a high score of 5/5. The research is based on reviews from students that decided to post on the Coursetalk website and does not include all the students that participated in the selected courses. The research is based on reviews from students that decided to post on the Coursetalk website and does not include all the students that participated in the selected courses.
Kim et al., 2016	The findings and implications of this study are limited in several ways,re including the use of a smaller data set considering the mass number of courses and users within MOOCs, which limits generalization. Also, while the learner survey responses showed perceptions of high learning gains in the courses, these responses may have been created by a subset of self-selected learners who were highly motivated to learn the topic and also highly self-regulated learners since the surveys were sent out after the conclusion of the course which may have promoted higher levels of response by those who were engaged longer in the MOOCs. Another limitation of this study relates to the survey instrument that we developed. Although the author-created survey items were based on the literature, we were not able to obtain a high level of reliability, instead results indicated a moderate level of reliability.
Watson & Kim, 2016	This study focused on one specific MOOC which limits generalisation across the population. The learners participating in this MOOC cannot be representative of the entire population of MOOC offerings.
Liu, Kang & McKelroy, 2015	This study is limited in that it primarily relied on MOOC participantsâ€™ self-reported data and one data source. While 4078 people from 145 countries enrolled in the MOOC under investigation, only 320 participated in this study, an 8% response rate.

Study ID (e.g., Author et al., 2020)	Recommendations for future research
Kizilcec et al., 2015	Future research could disentangle the potential benefits and costs of showing the instructorâ€™s face in multimedia learning in a more controlled setting. Another direction for future work could be to *examine the effect of allowing learners to choose a presentation style compared with assigning them one, looking at whether learners tend to choose optimally in terms their subsequent learning outcomes.*
Shukor & Abdullah, 2019	Undefined
Trust & Pektas, 2018	Future research is needed to examine how teachers might fit learning experiences like this open online course into their demanding schedules. Future studies are needed with a broader *audience to examine the effectiveness of this course.*
Watson et al., 2018	For future research, th*e sample size should be enlarge*d to include individual learners who did not complete the course. A larger sample size would allow for better understanding in regards to the differences in learnersâ€™ age as well as clarifying the learnersâ€™ language concerns. Although no bias can be completely removed from a data sample, conducting a pre-course survey would give the research team a basis to rate attitudinal learning. The pre-course survey could be framed in a manner that allows for learner perceptions to be identified prior to participating in the MOOC as well as providing data to focus on specific items in the post-course survey, such as the data regarding discussions in MOOCs and how this could be improved to help stimulate learning. A longitudinal approach may be beneficial for future research, which would allow us to see patterns of retention of attitudinal learning.
AydÄ±n & YazÄ±cÄ±, 2020	Undefined.
Engeness et al., 2020	Further research is therefore needed to examine the actual learning process of the participants in online environments.
Watson et al., 2016	Undefined
Hew et al., 2018	Undefined
Ortega-Arranz et al., 2019	It would be interesting to analyze to what extent this MOOC and gamification design (e.g., number of implemented rewards, type of activities associated with rewards, rewards only visible to students themselves, rewards associated with optional tasks) affected the results of this study, and if the adaptation of this design to other topics and contexts would have similar effects. Further evaluations involving reward-based strategies in other MOOCs with different topics, features, language and target population are needed to generalize the results of this study. In future versions of the same course, we plan to analyze the extent to which the aforementioned gamification parameters would change the effects on retention and engagement reported in this study.
Janakiraman & Watson, 2018	Attitudinal change is required to learn about the SDL strategies applied by adult learners. This research will help enhance MOOC design and, hence, control learner attrition. Because we contacted only learners who completed the course, we do not have the perspectives of learners who dropped out of the MOOC at various stages.
Watson, 2017	Additional studies need to be conducted to allow comparisons between various contexts to understand effective design and facilitation for MOOCs and attitudinal learning. The survey requires further evaluation and adaptation for future studies, by obtaining test-retest reliabilities and assessing the instrument in longitudinal studies. Validities could also be strengthened by examining the survey results and comparing them to other measures of learning outcomes, such as exam grades or other student performance scores. The survey will need to demonstrate further validity for it to be applied in different contexts, courses and course designs. Finally, the development of a conceptual framework for understanding attitudinal instruction may also be helpful, as it could help guide future empirical studies, as well as inform practitioners for the design of attitudinal learning.
Watson et al., 2016	additional research needs to be conducted on the general learning outcomes of the growing number of social science MOOCs being offered. Future studies are needed to provide clearer insights into theory and best practices for attitudinal change instruction, specifically in a variety of different learning contexts.
Cohen & Holstein, 2016	Future research should be expanded to include additional courses.
Kim et al., 2016	Future studies should examine larger numbers of cases of the design of MOOCs for attitude change instruction, so that recommendations can be more generalizable. A qualitative study investigating the relationship between the level of participation in the course and studentsâ€™ receptiveness to the presented content or viewpoint might provide a clearer understanding of the learning data gathered from MOOC participants. Future studies will need to find more objective measures of attitudinal change, as it is possible that there were other factors impacting this. For example, student perceptions of attitudinal change could be *compared pre- and post-MOOC*, analyzing student writing regarding the given topic. Observation and interview data from instructors and learners could be also collected. Future studies should examine how these factors can influence their learning behavior in MOOCs and in topics that discuss controversial topics that aim for goals related to attitudinal change in particular.
Watson & Kim, 2016	Additional case studies that allow multiple comparisons among a variety of MOOCs relate to attitudinal instruction could provide better understandings of learning gains and attitudinal change within more varied learning topics.

Liu, Kang & McKelroy, 2015	In future research, we plan to include multiple data sources such as interviews with selected participants and also course activity data for triangulation.

Curriculum Vitae

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