Design for now, but with the future in mind: a “cognitive flexibility theory” perspective on online learning through the lens of MOOCs

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Abstract

This paper is in response to the manuscript entitled “MOOCocracy: the learning culture of massive open online courses” (Loizzo and Ertmer in *Educ Tech Res Dev* 64:1013–1032, 2016, <https://doi.org/10.1007/s11423-016-9444-7>) from the perspectives of cognitive flexibility theory (CFT), in the context of pandemic-induced emergency remote teaching. Our response focuses on one of the questions raised in the call for this special issue on the latter topic: what are the implications of current, urgent work being done in digital learning for the future of online learning? We argue that much of what is important for a better future of online learning can also be done well now. However, building now with the future in mind involves a fundamental reorientation of the epistemic standpoint of online learning. The need for such a reframing is a tenet of CFT. Therefore, we use CFT as a lens to reflect on the proposal by Loizzo and Ertmer (*Educ Tech Res Dev* 64:1013–1032, 2016, <https://doi.org/10.1007/s11423-016-9444-7>) to combine c-MOOC and xMOOC designs to “foster a flexible, learner-centered culture” (p. 1027). Acknowledging the value of diverse perspectives afforded by the MOOCocracy culture, we also discuss how a CFT-based epistemic stance may further inform the future design and practice of MOOCs and, in a similar manner, online learning in general. We present some examples of ways application of learning and instruction principles of CFT can benefit online learning for the development of adaptive worldviews and the resultant development of adaptive skill that is becoming increasingly essential for life and work. Having this framework in mind as a principled overlay while urgently preparing for current schooling can help us build better, for now, and even more so for the needs that will remain in the longer term as education increasingly incorporates “twenty-first century skills.”

Keywords Cognitive flexibility theory (CFT) · MOOC · Adaptive worldview · Online learning

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We wish to offer a simple, but we think powerful, suggestion. It is related to one of the questions asked in the call for this special issue on the rapid development and deployment of digital learning in the time of the COVID-19 pandemic. That question asks authors to think about implications of (1) the emergency moves made now (2) for the *future* of online learning. We argue that first thinking about (2) independently of (1) can suggest steps that *both* improve what is being done immediately while at the same time speeding developments in online learning that would be desirable for the future in any case, absent the pandemic-induced educational emergency. In other words, much of what is important for a better future of online learning can *also* be done well *now*. Why do something quickly now for expediency when one would want to undo it later once there is more time, when the present and the future can both be served in some aspects, at the same time. That requires that some vision of the future be kept in mind as a desirable framework for changes we make so that “two birds can be killed with one stone,” one related to the present and one to the future, wherever possible. But what might—should—those more future-oriented changes look like?

A primary claim of this short paper is that building now with the future in mind involves a fundamental reorientation of the epistemic standpoint of online learning. We point to a future foundation that addresses educational needs of the near-term future and that thus would serve as a salutary set of cognitive values and illustrative instructional models in directing and coordinating the most immediate imperatives. We will look through the microcosmic lens of just one part of online learning, MOOCs (Loizzo and Ertmer 2016), with the goal of having more general implications for online learning writ large as well. Loizzo and Ertmer examined learners’ experience with a MOOC and proposed the concept of MOOCocracy to portray global social learning democracy as a MOOC culture. What does such a culture mean for the present and the future of learning, and how can it be expanded using existing frameworks for digital learning?

First of all, what do the present and future of learning look like? The COVID-19 pandemic has brought to the fore in exaggerated fashion a world we had increasingly been facing in recent decades, one of increasing ill-structuredness, unpredictability, complexity, and novelty. Preparing to deal with such a world requires instructional features that promote and support the skill in the management of real-world complexity and the ability to deal adaptively with novel, ill-defined problems. Those have always been the main goals of *Cognitive Flexibility Theory* (CFT; Spiro et al. 1988, 1992, 2017, 2019; Spiro and Jehng 1990). According to the World Economic Forum (2016), such skills will be essential for good jobs within five years if not sooner, a trend that will be exacerbated by the exponentially increasing ‘employment’ of artificial intelligence for less novel tasks (Brynjolfsson and McAfee 2014). The above trends are also recognized in the growing “Twenty-first Century Skills” movement (Dede 2010).

So, with learning for an acceleratingly complex and ill-structured world in mind, we ground our response in CFT, a theory of computer-enabled knowledge acquisition for mastery of complexity and situation-adaptive application of knowledge and experience (Spiro et al. 1988, 1992, 2019). After the briefest of introductions to CFT for more general purposes, we use it as a lens to reflect on the specific proposal by Loizzo and Ertmer (2016) to combine c-MOOC and xMOOC designs to “foster a flexible, learner-centered culture” (p. 1027) and discuss how a CFT-based epistemic stance may further inform the future design and practice of MOOCs and, in a similar manner, online learning in general.

CFT concerns learning in ill-structured domains (ISDs) as opposed to well-structured domains (WSDs). In WSDs, regularity can be found in the application of the same concepts and schemas across different cases, to take just one property. For instance, the same

principles of electric circuits remain consistent across different situations. In contrast, knowledge in ISDs is multifaceted, interconnected, contextualized, and has a great deal of variability across cases, requiring a central concern for the *non-routine*, the *non-generalizable*. It is important to note that, even within a predominantly orderly domain, there may be aspects that have ill-structured qualities (Spiro et al. 1987, 1988). In fact, Spiro and DeShryver (2009) pointed out that “all areas of knowledge application in unconstrained, real-world situations tend to have substantial aspects of ill-structuredness” (p. 108). So, while the operation of electrical circuits may be well-structured, trouble-shooting real-world circuit failures may be more ill-structured. The content domain in Loizzo and Ertmer’s (2016) MOOC study—human trafficking—is a good example of an ISD.

Why is the distinction between ill-structuredness and well-structuredness so important for our discussion here? Because this distinction prescribes two *opposite* epistemic stances towards teaching and learning (Feltovich et al. 2001; Spiro et al. 1996). In WSDs, knowledge acquisition and application can be effectively handled with a reductive/additive/similarity-based worldview that allows, for example, a superordinate, generic organization of knowledge to be applied for the overall domain. An xMOOC following a traditional learning model (e.g., lecture-based, compartmentalizing knowledge into pre-sequenced units, chapters, etc.) may often share features of the reductive worldview. However, the reduction of complexity to additive components is antithetical to the epistemic nature of ISDs. Real-world problems or events are not always predictable, determinant, regular, routine. That causes abstraction and generalization not to work so well. Instead, real-world knowledge application and problem-solving requires an adaptive/expansive worldview (Spiro et al. 2019) that considers the whole of a situation to be greater than the sum of the parts and thus emphasizes learning with multiple, interconnected, nonlinear, and flexible representations of knowledge. Most importantly, the central goal of CFT is to prepare people to *adaptively assemble* aspects of prior knowledge and experience into a “schema of the moment” to suit the needs of a novel situation, where reductive retrieval from long-term memory of preexisting schemas will be inadequate (Spiro et al. 2019).

To accelerate the development of learners’ adaptive *readiness* (e.g., preparation for cognitive agency and ability to seek and understand multiple representations of knowledge in varying situation-determined combinations that may occur) and adaptive *performance* (e.g., the assembly of schemas of the moment to solve novel problems in real contexts), CFT advocates for the deliberate practice of case-centered learning (Spiro et al. 2019). A CFT-based case is not a reduced summary or description of a concept. Instead, each case approximates complex reality by constructing rich descriptions from various partially overlapping and non-overlapping perspectives (or by video presentations that can overlay features to increase the fullness of their case-representations; Spiro et al. 2007) and employs various kinds of computer-support and instructional sequencing logics to help manage complexity and minimize cognitive load (Spiro and Jehng 1990). Multiple cases, when woven appropriately, can highlight the *surprising* dissimilarity or similarity across contexts; transcend the artificial separation of concepts so that *knowledge in practice* is emphasized; allow for more situation-specific variables to be identified and introduced to learners’ processing; create a more natural, organic way to help learners master the interconnectedness among variables in knowledge application; and do all of this in a time-accelerated and learner-supported manner (Spiro et al. 1988, 1992, 2019).

Many of the learning and instructional design principles of CFT are immediately applicable to online environments, and very clearly to MOOCs, in ways that can make remote learning *more* effective, for contemporary and future learning goals, than face-to-face (F2F) learning, rather than online learning being a “poor cousin” or temporary substitute

for F2F instruction. For example, in F2F learning, too much talk goes “into the air” and if it needs to be harvested in a new context later for generative, inferential knowledge-building, it is only rarely available in memory with high fidelity and completeness. In online environments, a permanent, searchable, and, ideally, taggable record is left behind. From a CFT perspective, the question to ask is how to capitalize on these technological affordances for adaptive learning. Here is one example: Since any scheme for dividing complex curricula into chapters, units, etc., involves artificial separations, and novel knowledge use requires original syntheses across conceptual boundaries, one implication of CFT that can be implemented in online digital environments is to regularly assign students to find knowledge-generating relationships to material between the current topic and earlier weeks/units. For instance, if the previous discussions or materials, serving as mini-complex cases (Spiro and Jehng 1990), are tagged with their conceptual and contextual attributes, students are supported in crisscrossing previous and current materials through the searching and tagging functions, and thus without the need to pre-store hyperlinks that anticipate possible connections (Spiro and Jehng 1990, discuss the first programs to use tags, called “themes” in CFT, and since the 1980s able to generate exponentially increasing search and combination possibilities). This allows for non-reductively integrative and context-sensitive representations of complex knowledge. This could not be so easily or effectively done in F2F learning.

So, what type of MOOC supports such complex, flexible learning? Loizzo and Ertmer (2016) proposed to combine c-MOOC and xMOOC features to leverage both collaborative and individual learning. From a CFT perspective, we see the following values and limitations of this suggestion. First, Siemens’ (2005) connectivism (see Clarà and Barberà 2013, for critiques) undergirds the original model of c-MOOC and emphasizes the importance of a diversity of opinions, ideas, concepts, and information sources. We appreciate this emphasis. Compartmentalized representations impede knowledge application (Feltovich et al. 1993, 2001). Second, relying on single representations leads to reductive understandings that are counterproductive to complex, real-world learning. This narrowness of knowledge representation may be increasingly broadened via collective cognition where the limits of single representations are more likely to be counteracted by alternative interpretations (Feltovich et al. 1996). As Loizzo and Ertmer (2016) pointed out, regardless of whether a c-MOOC or xMOOC is used, “MOOCs are bringing together thousands of learners from diverse backgrounds” (p. 1016). The collective benefits of multiplicity as mentioned above can be exponentially increased by the scalability of MOOCs to capitalize on “the smartest person in the room [being] the room” (Weinberger 2011), and the larger the ‘room’—as in MOOCs—the better. MOOCs afford more opportunities to derive the benefits of such social learning functions as learning communities, collaborative learning, and crowdsourcing. CFT can also help provide algorithms for ideas at lower, local levels to percolate to the top for more MOOC-wide consideration without there being too much assimilation due to social pressure and attention-seeking that reduces the collaborative value inherent in MOOCs’ diversity (Loizzo and Ertmer 2016). CFT-based approaches promote the harvesting of more expansive and adaptivity-ready ideas for percolation through the network.

Space limitations do not allow more exhaustive elaborations on the large number of other CFT features that promote more complex learning and adaptive proficiency and that are built for digital environments and ideally suited to online learning. See the other papers cited here for more examples, developed in great detail, of ways that MOOCs, and online learning more generally, could benefit from these approaches to designing for the development of adaptive worldviews and adaptive skill in dealing with complex novelty. Having this framework in mind as a principled overlay while urgently preparing for

pandemic-related remote digital learning can help us build better, for now, but also for the longer process of readying learners for the world they are facing, of life and work, that goes beyond and in many ways is so different from much of traditional learning and instruction, in goal and method.

Compliance with Ethical Standards

Conflict of interest We have no potential conflicts of interest to disclose.

Research involving human and/or animals participants The research doesn’t involve human participants and/or animals.

Informed consent The research doesn’t require informed consent.

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