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DIGITAL LEARNING FOR DEVELOPING ASIAN COUNTRIES

Achieving equity, quality, and efficiency in education

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Introduction – challenges of realizing education 2030: a developing Asia perspective

Education – that is, the development of knowledge, skills, and values – is an important means by which to empower individuals in a society. As both a means towards and an outcome of gaining the capabilities necessary to participate in and contribute to society, education is an essential enabler in many social aspects, such as economic growth, poverty reduction, public health, and sustainable development, especially in today's knowledge society. At the same time, however, education can still be a social institution that reflects and reproduces the social, cultural, and economic disadvantages that prevail in the rest of society (Bourdieu & Passeron, 1990). For example, students who are discriminated against socio-culturally or who are economically poor are more likely to receive an education that is characterized by inadequate infrastructure, few qualified teachers and encouraging peers, and outmoded pedagogical practices, which often results in a lower quality of life.

In order to mitigate such social–cultural and economic disparities and to amplify the positive impacts of education, the Sustainable Development Goal for Education (SDG4) was set out by the United Nations to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (United Nations, 2015). This new global priority in education is likewise reflected in the *Education 2030* agenda adopted by the international education community (UNESCO, 2015a).

Achieving the SDG4 globally represents varying degrees of challenge depending on each country's state of development and other national circumstances. For countries in the Global South – and especially those in developing Asia, which is the most populous and disaster-prone region in the world (United Nations ESCAP, 2016) – turning the SDG4 into a reality is a herculean task that requires sustained, broad-based commitment to finding innovative solutions to persistent systemic problems.

One pathway that has gained widespread currency over the past two decades involves the harnessing of information and communication technologies (ICT) (SEAMEO, 2010). The *Education 2030* agenda and its associated *Framework for Action* (UNESCO, 2015a) underscore the potential of ICT, when appropriately and optimally adopted, to 'strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective service provision'. Subsequent to the publication of the *Education 2030* agenda, the *International Conference on ICT and Post-2015 Education Agenda* and its ensuing *Qingdao Declaration* present sector-wide strategies to leverage the power of ICT, specifically (UNESCO, 2015b, p. 2):

> to deliver education and training, including technical and vocational education and training, in both formal and non-formal settings, at all times and in all places, as it can improve and diversify learning pathways, improve quality, and further reach vulnerable and underserved groups including rural youth and adults, women and girls, out-of-school youth, and people with disabilities.

As ICT in education (what we refer to in this chapter as 'digital learning') has increasingly become embedded in development frameworks globally and nationally, the challenge of realizing the potential of ICT to enable demonstrable positive changes in education systems and learning environments has loomed even larger. Despite the global call for technology-driven innovation in the education sector, the lack of a robust body of evidence for or against the adoption of particular digital learning innovations – particularly across a range of diverse developing country contexts – suggests that a more prudent approach to accelerating adoption may be warranted. Sustaining and scaling up a new innovation that does not work may mean diverting scarce resources from an approach that does.

This chapter addresses the question of adoption through the optics of three interlocking goals in education: equity, quality, and efficiency (EQE) (Asian Development Bank, 2011; OECD, 2012; UNESCO, 2014). The chapter begins by outlining EQE. This is followed by a discussion of four modes of digital learning – massive open online courses (MOOCs), intelligent tutoring systems (ITS), digital game-based learning (DGBL), and learning analytics (LA) – as potential enablers of greater equity, enhanced quality, and improved efficiency in education systems in developing countries. Issues of effectiveness, sustainability, and scalability, as well as key research gaps, are also highlighted. The chapter concludes with suggestions for the way forward.

Three goals in education: equity, quality, and efficiency

Equity

As education is a fundamental human right, its equity must be safeguarded and promoted (UNESCO, 2016). Equity in education has two dimensions: fairness and inclusion (OECD, 2007). Fairness basically refers to ensuring that personal and social circumstances (e.g. gender, socio-economic status, or ethnic origin) are not obstacles to achieving educational potential. Inclusion is the goal of ensuring a basic minimum standard of education for all (e.g., that all students should be able to read, write, and do simple arithmetic).

The unfortunate reality is that inequity in education is one of the most serious issues in developing Asia. Although there have been efforts towards universal and free primary and secondary education, 29% of the world's out-of-school children and 53% of its out-of-school adolescents are from the developing Asia region (UNESCO Institute for Statistics, 2015). Here, extreme poverty levels make it difficult for many parents to send their children to school. At

the same time, developing Asia remains the most gender-unequal and gender-insensitive region in the world (UNICEF, 2005). Similar inequity can also be found with children who live with some form of disability (World Health Organization & World Bank, 2011).

Quality

Quality is at the heart of any education system. A quality education is one that satisfies basic learning needs and enriches the lives of learners and their overall living experience. While a growing number of students in developing Asia are in school classrooms, the fact of the matter is that many are not gaining the necessary knowledge and skills. The low quality of education is partly due to the low percentage of qualified teachers, the lack of teaching materials, and outdated/ineffective teaching methods. Consequently, these students are not much better off than their peers who have had no schooling at all. This points to a serious learning crisis and suggests that the quality of education in developing Asia is still in a perilous state.

Efficiency

An education system is considered efficient if it can produce the desired output at minimal cost or if, for a given resource input, the system maximizes the desired output (Tan & Mingat, 1992). Thus, for instance, building and maintaining schools to serve the traditional paradigm of teaching and learning is economically prohibitive, and efficiency may be compromised when enrollment is increased. In developing Asia, this issue is often visible in the relatively large percentage of overcrowded classrooms that are unfit for quality learning. These classrooms produce much lower proportions of timely completion because of the substantial numbers of students repeating or dropping out.

Four emerging modes of digital learning in developing Asia

In this section, we briefly discuss four emerging modes of digital learning in developing Asia: massive open online courses (MOOCs), intelligent tutoring systems (ITS), digital game-based learning (DGBL), and learning analytics (LA). We consider what current research tells us about how these have contributed to the promotion of equity in knowledge access, the delivery of quality learning and teaching, and the enhancement of efficiency in education management. (*See succeeding chapters for full reviews of ITS, DGBL, and LA.*)

Massive open online courses

Educause (2013, p. 1) defines the four elements of massive open online courses (MOOCs) as follows:

> *massive*, with theoretically no limit to enrollment; *open*,[1] allowing anyone to participate, usually at no cost; *online*, with learning activities typically taking place over the web; and a *course*, structured around a set of learning goals in a defined area of study.

The openness of MOOCs in terms of participation as well as their scalability features has great potential to address equity, quality, and efficiency issues in education.

Three of the top MOOC providers are affiliated with prestigious US universities: the for-profit Coursera and Udacity, both founded by academics from Stanford University, and the

Harvard University–Massachusetts Institute of Technology non-profit EdX. While US-based MOOCs are currently dominating the market, homegrown MOOCs are growing in countries such as China, India, Malaysia, and the Philippines. In China, MOOC initiatives include glr. cn (Chen, 2013); Shanghai Jiaotong University's Cnmooc.org; icourse163.com, a joint venture of the government-backed icourses.cn and Chinese Internet company NetEase; and Peking University's Chinese MOOC in partnership with the Chinese e-commerce giant Alibaba (Xiang, 2015). MOOC initiatives are also seen at India's Delhi University, IIT Kanpur, and Human Resource Development Ministry (Pai, 2015). In partnership with the Australian for-profit OpenLearning, the Malaysian government has set up its own national platform for public universities (Bernama, 2014). The Philippines also has several homegrown MOOC initiatives, such as the University of the Philippines' Open University's MODeL (Alfonso, Bandalaria, & Garcia, 2014) and the government's TESDA (Technical Education and Skills Development Authority) Online Program (Espiritu & Budhrani, 2013). Since MOOCs are a relatively new innovation, research on MOOCs is still in its early stages. The research literature may be classified into two categories: evaluation studies and design studies. Evaluation studies typically look at usage issues, such as student behaviors, attitudes, performance, and the use of MOOC resources. Design studies focus on issues related to the design and implementation of platforms and their features and functionalities.

Perhaps the overriding issue surrounding MOOC use that research has revealed is the low completion rates of enrollees. For instance, Jordan (n.d.) has found that the average completion rate for MOOCs is about 13%, although occasionally this can go up to 40%. Reich (2014) presents slightly more encouraging estimates by making a distinction between those who actually intended to complete a particular MOOC (22% completion rate) and those who were browsing courses (6% completion rate). Lack of curriculum structure and inadequate learning support have been found to contribute to the non-completion of courses (Kop, Fournier, & Mak, 2011). Liyanagunawardena, Adams, and Williams (2013a) call for research into the experiences of those who have not completed MOOCs and for identifying the motivations of those who have participated in and/or completed MOOCs.

While MOOCs seem to be contributing to expanding access to education, the question remains as to whether this access has been extended to groups marginalized on the basis of gender, race, ethnicity, culture, geography, socio-economic status, and so on. Language proficiency is an obvious barrier to participation in MOOCs since most are conducted in English (Liyanagunawardena et al., 2013b). Furthermore, there is evidence that the majority of MOOC participants are from developed countries and are often young, male, well-educated, and employed (Christensen et al., 2013; Liyanagunawardena et al., 2013b; Nesterko et al., 2013). It thus seems fair to say that, at least for now, MOOCs tend to be providing more opportunities and resources to those who already have them. However, some contrasting findings that challenge this notion have started to emerge. For example, Garrido et al. (2016) have recently examined the use of MOOCs in developing countries (including Colombia, the Philippines, and South Africa) and found that (p. 5)

> [l]ow- and middle-income populations make up 80% of MOOC users, in contrast to wealthier populations reported elsewhere. Over 80% of MOOC users only have basic or intermediate level ICT skills, challenging the belief that MOOCs are predominantly taken by people with higher level skills. Forty-nine percent of MOOC users received certification in a MOOC class, and another 30% completed a course. This is far above the single-digit rates reported elsewhere. Women are more likely than men to complete a MOOC or obtain certification.

Another gap in the literature is related to the quality of MOOCs. Little evidence is currently available on how effective MOOCs are as a mode of learning, what participants have actually learned in a MOOC, and the nature of the learning that is taking place in a MOOC environment. Reich (2015) suggests the necessity of using experimental research designs that account for prior knowledge and which assess learners at different stages of course work.

Intelligent tutoring systems

Intelligent Tutoring Systems (ITS) are computer-based learning environments that use artificial intelligence to provide learners with personalized educational experiences (Woolf, 2010). ITS comprise features such as 'expert knowledge of the domain of interest', 'a model of the student's knowledge that is updated with every student transaction', 'a pedagogical model that determines what teaching approach to use under different circumstances', and 'a user interface with which the learner interacts' (Woolf, 2010). ITS cater to students' individual needs by providing hints and remediation, cognitive and metacognitive scaffolding, affective support, and alternative teaching approaches, such as games and dialogue formats to foster or sustain motivation.

In a recent meta-analysis of ITS studies, Ma, Adesope, Nesbit, and Liu (2014) found evidence that the use of ITS is more effective than both teacher-led, large-group instruction and non-ITS computer-assisted instruction and is as effective as individualized or small-group instruction with a human teacher. However, they call attention to methodological issues in the studies included in their analysis and caution against the use of such findings as a rationale for replacing current modes of instruction with ITS. They suggest that successful use of ITS requires careful consideration of learning designs and objectives. It also requires the consideration of factors such as accessibility and culture, which have only recently been receiving attention.

Apart from its pedagogical affordances, a key motivating factor for the use of ITS has been the potential for efficiency gains in situations where there is an insufficient number of adequately trained teachers. For instance, Woolf (2010) estimated that deploying networked versions of ITS reduced training costs by up to 70%.

Such evidence on the efficacy of ITS as a mode of learning has thus far not been comprehensively validated in developing country contexts. The large majority of ITS development, deployment, and related research has taken place in the developed world, specifically in countries that are Western, educated, industrialized, rich, and democratic (Blanchard, 2014; Nye, 2014). In Asia, most ITS-related research since the 1990s has been carried out in developed countries, such as Hong Kong, Japan, Singapore, South Korea, and Taiwan (Cha et al., 2006; Cheung, Hui, Zhang, & Yiu, 2003; Hwang, 2003; Liang & Xu, 2013), although some homegrown ITS in developing countries have more recently been documented (Kazi, Haddawy, & Suebnukarn, 2012; Ting & Phon-Amnuaisuk, 2012). Nye (2014) reports that current literature on ITS use in developing countries has not fully explored the interaction of curricular-pedagogical and technological contexts or the full range of cultural barriers to adoption. The small number of ITS research studies in developing countries that address adoption issues have largely focused on the use of mobile devices, cultural factors, and language support.

Digital game-based learning

Digital game-based learning (DGBL) facilitates learning through digital games. Advocates of DGBL, such as Lim (2008), assert that the 'fun' aspect of gameplay – created through the use of elements of challenge, fantasy, and curiosity, which engage and motivate players – can

be harnessed for engaging and effective learning and for improving learning quality overall. Whether digital games are designed primarily for entertainment or expressly for education and training purposes, DGBL is intended to facilitate improvements in a range of cognitive, skill-based, learning, motivational, and behavioral outcomes. However, skeptics are concerned that games may distract from other more 'important' learning activities (e.g., Harp & Mayer, 1998; Rowe, McQuiggan, Robison, & Lester, 2009, cited in Jennifer & Lester, 2014).

Four recent meta-analyses on DGBL report that games exert more effect in enhancing a number of cognitive, skill-based, learning, motivational, and behavioral outcomes compared to non-game formats (Clark, Tanner-Smith, & Killingsworth, 2014; Sitzmann, 2011; Vogel et al., 2006; Wouters, van Nimwegen, van Oostendorp, & van der Spek, 2013). These outcomes typically include improvements in motor skills, content understanding, problem-solving, collaboration and teamwork, communication, self-regulation, and positive changes in beliefs and attitudes. However, another meta-analysis (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012) asserts that the effectiveness claim is overgeneralized, raising concerns about the lack of rigorous and high-quality empirical evidence.

Research has also identified key issues in DGBL adoption, including the perceptions of games as learning tools, curriculum relevance, the accuracy of content and suitability for use in the classroom, the readiness of teachers, and the availability of teacher training time (Kirriemuir & McFarlane, 2004), as well as language and other socio-cultural factors (Vate-U-Lan, 2015).

One barrier to DGBL adoption that is particularly germane to developing countries is the cost of developing and deploying games, including the cost of the technology resources required to integrate these games into the classroom. This underscores the need to focus on game design and the specific affordances of different types of games. Some have argued that simpler game mechanics are effective in promoting certain types of learning outcomes (Charles et al., 2011; Clark et al., 2014; Lee & Hammer, 2011; Sheldon, 2011). Others emphasize the primacy of learning content over visual design as well as the potential for greater learning impact when games are combined with other instructional methods (Wouters et al., 2013).

By and large, research in DGBL in Asia is a relatively more mature field compared to ITS or MOOCs research. Nevertheless, the overall landscape is still dominated by developed countries, and more research on DGBL design, implementation, and outcomes in developing country contexts is warranted.

Learning analytics

Learning analytics (LA) refers to the collection, analysis, and reporting of data about learners and their contexts in order to improve student learning (Aljohani & Davis, 2012). Focused on improving learning quality and efficiency, the growing popularity of LA is driven by at least three factors: the emergence of big data; uptake in online learning, which systematically collects user transactional data; and the growing need for measurement to empirically demonstrate learning enhancements (Ferguson, 2012).

Analytics may be applied to the learning process in several ways, for instance, (1) tracking student performances, (2) disaggregating student performances by selected characteristics, (3) identifying outliers for early intervention, (4) predicting student performances, (5) improving student retention, (6) improving instructional models, (7) analyzing assessment techniques and instruments, and (8) evaluating curricula (IBM Software Group, 2001).

North America and Europe lead the research on LA. Papamitsiou and Economides's (2014) meta-analysis of learning analytics and educational data mining literature reported four major

foci of current research: (1) pedagogy-oriented issues, (2) contextualization of learning, (3) networked learning, and (4) educational resources management. By contrast, the literature on LA in Asia remains scant, although more Asia-focused research is expected to emerge as the use of learning management systems in Asian schools and education institutions increases. There have already been attempts in Asia to describe and analyze how data can be utilized to promote meaningful learner engagement, improve learning outcomes, and enhance teaching and learning strategies, particularly in the context of online learning (Jo, Kim, & Yoon, 2014; Zhou, Han, Yang, & Cheng, 2014; Zhu, Zhang, Wang, Chen, & Zeng, 2014).

Gašević (2017) suggests that for developing countries to adopt LA as a transformational tool, their implementation capabilities have to be developed. These include 'the development of data literacy among stakeholders; the development of policies for ethics, privacy protection, and algorithmic accountability; and the development of analytics-based tools with active stakeholder involvement' (Gašević, 2017, p. 11).

Sustaining and scaling up effective digital learning innovations

For digital learning innovations to contribute significantly towards achieving the SDG4, these innovations must be effective, sustained, and scaled up.

Effectiveness

Effective digital learning innovations are defined here as those that have a demonstrable positive impact on education systems or institutions in terms of enhancing equity, quality, and/or efficiency. Two concerns are noted in this regard. First, the effectiveness of a digital learning innovation is assessed relative to available alternatives, whether standard education practice or other digital learning innovations. Second, tension often arises between equity, quality, and efficiency goals: actions that lead to one may undermine one or both of the others. For example, the use of ITS or digital games in a classroom may lead to improved learning outcomes, but the cost of developing or adapting these innovations to the local context may be too prohibitive. Similarly, MOOCs may be a low-cost option for those who would otherwise be unable to access education services, but the impact on learning is variable. In assessing the effectiveness of a digital learning innovation, therefore, it is necessary to specify the conditions under which it contributes more to one or more of these goals relative to alternative modes or practices, where the negative impact on the other goal or goals is minimized, if not entirely eliminated.

Sustainability

Sustaining effective digital learning innovations is a challenge in any context (Attewell, 2001) but even more so in developing countries, where widespread digital access is yet to be realized. Among the barriers to sustainability in developing countries are outdated hardware and software, unaffordable Internet connectivity, lack of technical support, and lack of professional development and other capacity-building opportunities (Breuleux, Laferrière, & Lamon, 2002; Looi & Teh, 2015; Trucano, 2015).

Research strongly suggests that programs and initiatives related to digital learning can produce underachieved results because of little or no concern for sustainability from the outset (Gichoya, Hepworth, & Dawson, 2006). Given the infrastructural and resource constraints of education systems and institutions in developing Asian countries, sustainability factors need to

be considered at every stage of program planning and implementation. As Passey et al. (2016, pp. 121–122) observe,

> To succeed, ICT related educational programmes should be designed, adopted and implemented by government and third party organisations to accommodate a number of recognised issues. Importantly, technology continues to change rapidly and is often repurposed, and time is needed to implement and recognise agreed outcome benefits. Additionally, there are differences and complexities within the contexts in different countries (political, social, technological, linguistic, cultural, economic, local and religious). All three of these issues have significant implications for teaching and learning. If long-term integration is to be achieved, these issues must be considered appropriately.

Scalability

Scaling up an educational intervention may appear simple and straightforward at first glance: one takes what has worked in a few schools and applies it to many more schools. However, as the experience of many educational programs have shown, scaling up is in fact a complex, multidimensional process (Results for Development Institute & UNICEF, 2016). Uvin and Miller (1994) identifies four of these dimensions: *qualitative*, pertaining to increasing the number of beneficiaries in one location and/or widening the geographic spread; *functional*, referring to broadening the scope of activities; *political*, involving work to influence government and other stakeholders; and *organizational*, referring to the expansion of the implementing organization and its partners. Ultimately, scaling up involves 'adapt[ing] an innovation to effective usage in a wide variety of contexts, including settings where major conditions for success are absent or attenuated' (Clarke et al., 2006, p. 27). The primacy of context necessitates flexible governance for stakeholders to try, fail, learn, and relearn (Robinson, Winthrop, & McGivney, 2016). The readiness and capacity of stakeholders are likewise critical (Vrasidas, Glass, & Zembylas, 2009) – in particular, equipping them with the right set of skills through appropriate capacity-building activities to manage change effectively. In the long term, a change in behavior, norms, and beliefs, as well as a shift in ownership, are the desired outcomes (Burns, 2014).

Gaps in existing research

Research on digital learning in developing countries is still emergent. More attention needs to be paid to the process of localization/customization; the impact on educational equity, quality, and efficiency; and to sustainability and scalability. Some illustrative research questions for each area of concern or theme are presented in Table 35.1.

Conclusion and the way forward

This chapter has sought to provide some insight into the potential role of digital learning in helping to achieve the goals of equity, quality, and efficiency in education in developing Asian countries. In so doing, it has highlighted four emerging digital learning modes, namely MOOCs, ITS, DGBL, and LA. Implemented in an evidence-informed manner, digital learning can contribute significantly to advancing the SDG4 to ensure inclusive and equitable quality education and lifelong learning opportunities for all.

Table 35.1 Key themes and research questions

Theme	Illustrative research questions
Localization/ Customization	What curricular, pedagogical, technological, organizational, economic, and socio-cultural issues must be considered in designing, developing, and implementing effective digital learning innovations in diverse developing country contexts? How can these issues be addressed?
	Given that mobile use is a significant factor in developing countries, what are the implications of mobile use for the design and implementation of effective digital learning innovations across the range of developing country contexts? What issues are at play, and how can these issues be addressed effectively?
Equity	How, to what extent, and in what contexts do digital learning innovations broaden access to education in developing countries? For whom and under what conditions?
	Are there any differences in participation in digital learning innovations based on gender, socio-economic, cultural, or other factors? Are benefits and risks the same for each group? What factors contribute to any differences?
	What strategies can be employed to achieve greater inclusion?
Quality	How, to what extent, and in what contexts do digital learning innovations enhance learner engagement in developing countries?
	How, to what extent, and in what contexts do digital learning innovations improve learning outcomes in developing countries? What particular learning outcomes and under what conditions?
	Are there differential effects across learning domains, levels, settings, types of learners, level of technology integration, and so on? If so, what factors account for these differences?
	What are the parameters and requirements for teacher professional development and professional learning in relation to digital learning innovations? What strategies may be employed to meet these requirements?
Efficiency	Are digital learning innovations in developing countries more cost-effective than comparable traditional interventions? What are the trade-offs? Given these trade-offs, under what conditions are digital learning innovations desirable?
	How and to what extent do digital learning innovations improve the fit between education and societal needs and aspirations in developing countries?
Sustainability	What are the drivers and barriers to sustaining effective digital learning innovations in diverse developing country contexts?
	How can local and national ownership of effective digital learning innovations be fostered in developing countries?
	What are the human, infrastructural, technical, organizational, and financial requirements for achieving sustainability?
	What evidence-based strategies can be employed to increase the capability of stakeholders to sustain an effective digital learning innovation?
Scalability	What are the key issues in scaling up effective digital learning innovations in developing countries? How can these issues be addressed effectively?
	What are 'the essential aspects of [a] model that must be maintained as it scales' (Robinson et al., 2016, p. 69)?

The literature reviewed in this chapter underscores that technologies, such as MOOCs, ITS, DGBL, and LA, are a relatively new phenomenon in developing Asian countries. The corresponding research literature is therefore understandably scant but growing. We have argued that future research should focus on understanding how factors such as localization/customization,

equity, quality, efficiency, sustainability, and scalability interplay with digital learning in developing Asian countries. In particular, recognizing that digital learning holds significant potential, there is a need to explore how to effectively realize this potential across diverse and often constrained contexts. These include issues that reach beyond, but are critical in shaping, the application of technology and may include the mobilization of resources, alteration of the approach to learning assessment, and reconsideration of the role of the teacher, to name a few. The absence of a robust body of research on these issues points to relevant research questions to be investigated, the results of which educators and policy-makers can use to harness the power of digital learning to overcome the challenges of education in developing Asia.

Importantly, effectiveness, sustainability, and scalability are perhaps the most crucial considerations in bringing about the intended benefits of digital learning for all. Dealing with the challenges associated with effectiveness, sustainability, and scalability will require, among other things, strategic planning, result- and impact-oriented program design, and capacity-building at all levels, allowing for flexible governance, promoting partnerships for resource mobilization, and conducting ongoing cost-effectiveness studies as well as research, monitoring, and evaluation. These factors need to be embedded in every stage of digital learning program development and implementation. Only in this way can digital learning contribute to turning the vision of inclusive and equitable quality education for all into a reality.

Note

1 Note that those who work in the area of open educational resources typically do not view MOOCs as open unless the educational resources of the MOOC itself come with an open intellectual property license that allows others to, for example, freely copy, use, or re-use the material (see Smith & Seward, 2017).

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