Libraries and Learning Services

University of Auckland Research Repository, ResearchSpace

Suggested Reference

Copyright

Quality
in MOOCs:
Surveying the Terrain

Nina Hood and Allison Littlejohn

Quality in MOOCs:
Surveying the Terrain

Nina Hood

University of Auckland, New Zealand

Allison Littlejohn

The Open University, UK

Quality in MOOCs: Surveying the Terrain
Nina Hood and Allison Littlejohn

CONTENTS

ABSTRACT

MOOCs are re-operationalising traditional concepts in education. While they draw on elements of existing educational and learning models, they represent a new approach to instruction and learning. The challenges MOOCs present to traditional education models have important implications for approaching and assessing quality.

The purpose of this review is to identify quality measures and to highlight some of the tensions surrounding notions of quality, as well as the need for new ways of thinking about and approaching quality in MOOCs. It draws on the literature on both MOOCs and quality in education more generally in order to provide a framework for thinking about quality and the different variables and questions that must be considered when conceptualising quality in MOOCs. The review adopts a relativist approach, positioning quality as a measure for a specific purpose. The meaning and purpose ascribed to education shifts depending on the context and the actor, with governments, institutions, instructors and learners approaching education from different viewpoints and consequently viewing quality through different lenses.

The review draws upon Biggs's (1993) 3P model to explore notions and dimensions of quality in relation to MOOCs. Biggs conceptualised education as a complex set of interacting ecosystems, with each ecosystem divided into three types of variables — presage, process and product variables — which correspond to an input–environment–output model. The review identifies and examines a wide range of presage, process and product variables applicable to MOOCs, as well as exploring the relationships that have been found to exist between them. It brings together literature examining how quality should be interpreted and assessed in MOOCs at a more general and theoretical level, as well as empirical research studies that explore how these ideas about quality can be operationalised, including the measures and instruments that can be employed. What emerges from the literature are the complexities involved in interpreting and measuring quality in MOOCs and the importance of both context and perspective to discussions of quality.

1   INTRODUCTION

Any discussion of quality in education is challenging. Quality is not objective. It is a measure for a specific purpose. In education, purpose is not a neutral or constant construct. The meaning and purpose ascribed to education shifts depending on the context and the actor, with governments, institutions, instructors and learners approaching education from different viewpoints and consequently viewing quality through different lenses. This variation has resulted in quality measures being applied in education for a range of reasons: to support internal improvement efforts; for quality assurance purposes; and sometimes as a lever to govern in specific pre-defined directions.

In traditional formal education, there has tended to be some consensus between actors as to the overarching purpose of a particular course or programme. However, even in these situations, there often remains debate over precise definitions and measures of quality. Massive open online courses (MOOCs) disrupt (or at least have the potential to disrupt) many of the prevailing conventions and tenets of formal education, both offline and online. Their unique features are challenging the parameters of learning (and education), raising new questions about their purpose and the roles that they can play in lifelong learning. Similarly, MOOC quality can be viewed and measured in diverse ways. The quality measures employed and the nature of the data gathered in each instance act to privilege a specific facet of a MOOC, such as instructional design, media quality or learner achievement. To develop a robust understanding of quality in MOOCs, one that takes into account all of the activities and components that make up the experience of a learner, it is important to have measures of a range of dimensions of quality (Sumner, 2000).

The purpose of this review is to identify quality measures and to highlight some of the tensions surrounding notions of quality, as well as the need for new ways of thinking about and approaching quality in MOOCs. It draws on the literature on both MOOCs and quality in education more generally. The intention is to provide a framework for thinking about quality and the different variables and questions that must be considered when conceptualising quality in MOOCs.

The purpose of this review is to identify quality measures and to highlight some of the tensions surrounding notions of quality, as well as the need for new ways of thinking about and approaching quality in MOOCs.

The relativist approach that is adopted in this paper emphasises the importance of context. Consequently, the identification of variables and their organisation into a framework does not provide a concrete answer to the conundrum of how to assess quality. We are not yet at the stage in either the scholarship on MOOCs or the practice of learning with and through MOOCs to create an absolute set of measures that can be employed to measure quality (although some measures are emerging from the literature). It is hoped that the ideas raised here can act as a thought guide to support stakeholders in thinking critically about quality in MOOCs, and can highlight areas of research that offer new instruments and ways for approaching and measuring quality.

2   CONCEPTUALISING MOOCs

Any discussion of quality in education must be rooted in an understanding of the learning context to which the concept is being applied.

Any discussion of quality in education must be rooted in an understanding of the learning context to which the concept is being applied. The acronym MOOC — massive open online course — highlights the key dimensions of a MOOC. It is an online course that facilitates open access to learning at scale. However, the interpretation and employment of these dimensions is not consistent, resulting in considerable variation in purpose, design, learning opportunities and access amongst different MOOC providers and between individual MOOCs.

The term MOOC was first coined in 2008[1] and has subsequently been used by some to denote a new and potentially transformative form of education (Department for Business, Innovation and Skills, 2013). MOOCs have their origins in a range of education settings and practices. In many ways, MOOCs represent a fresh incarnation of distance learning, which originated in the 19th century as correspondence courses using the postal system, later utilised radio and television broadcasts, and more recently has incorporated online learning. The Internet not only provided a new medium for dissemination and transmission but also supported the development of new open education opportunities, such as open courseware (OCW) and open educational resources (OER). MOOCs have been positioned as hybrids of previous attempts at online distance education, combining early approaches to online distance learning with the scale and potential of OCW and OER (Gillani & Eynon, 2014).

In practice, the combinations of technology, pedagogical frameworks and instructional designs vary considerably between individual MOOCs. Some MOOCs have sought, with varying degrees of success, to reproduce offline models of teaching and learning, focusing on the organisation and presentation of course material whilst drawing on the Internet to open up these opportunities to a wider audience (Margaryan, Bianco, & Littlejohn, 2015). Others combine the opportunities presented by digital technologies with new pedagogical approaches and the flexibility of OER to design new learning experiences.

There have been numerous attempts to develop typologies of MOOCs (Department for Business, Innovation and Skills, 2013), and it increasingly is recognised that any attempt at categorisation must embrace multiplicity, acknowledging the diversity and often nuanced distinctions that can be made between MOOC designs, purposes, pedagogical approaches and learners. Similarly, there have been calls to abandon the MOOC acronym in favour of new titles that more accurately capture the particular design and purposes of specific courses (Bayne & Ross, 2014). These include: SPOC (small private online course; Hashmi, 2013), DOCC (distributed open collaborative course; Jaschik, 2013), POOC (participatory open

---

1   MOOC was first used to describe the "Connectivism and Connective Knowledge (CCK08)" course offered in 2008 by the University of Manitoba, in Canada, which attracted over 2,200 participants globally.

online course; Daniel, 2012) and BOOC (big — or boutique — open online course; Hickey, 2013; Tattersall, 2013).

The term MOOC on its own provides limited insight into the educational and learning experience being offered. The specific nature and composition of individual MOOCs are profoundly shaped and ultimately the product of their designers and instructors, the platform and platform provider, and the participants, all of whom bring their own frames of reference and contextual frameworks. Therefore, any discussion or attempt to quantify or qualify notions of quality in MOOCs requires the exploration of the complexities and diversity in designs, pedagogies, purposes, teacher experiences and roles, as well as participant motivations, expectations and behaviours present in MOOCs (Mackness, Mak, & Williams, 2010; Milligan, Littlejohn, & Margaryan, 2013; Ross, Sinclair, Knox, & Macleod, 2014).

The specific nature and composition of individual MOOCs are profoundly shaped and ultimately the product of their designers and instructors, the platform and platform provider, and the participants, all of whom bring their own frames of reference and contextual frameworks.

The complexities and variations in design and purpose start to become apparent when exploring how the four dimensions of a MOOC — massive, open, online and course — have been variously interpreted and implemented.

2.1   Massive

Massive refers to the potential scale of MOOCs. It most commonly is employed in reference to the large number of learners who can participate in a MOOC and in this sense is linked closely to notions of "open" and the potential for anyone to access the learning opportunities available via MOOCs.

The extent to which MOOCs live up to this potential has been questioned. High dropout rates, with current figures suggesting that less than ten per cent of learners complete a course (Jordan, 2015), have led people to suggest that whilst MOOCs can accommodate massive numbers of learners, they are not yet achieving this consistently. Furthermore, the dominance of well-educated men from developed countries participating in MOOCs (Zhenghao et al., 2015) suggests that whilst they have the scope to reach diverse audiences, and fulfil the initial hype surrounding their capacity to broaden access and democratise educational opportunities, this is yet to be fully realised.

The meaning and implications of "massive" in MOOCs have been extended beyond their participants and potential reach to incorporate the design elements involved to solve the challenge of educating as many people as possible (Downes, 2013; Grover, Franz, Schneider, & Pea, 2013). Ferguson and Sharples (2014, p. 98) have suggested that to date, "learning through mass public media is limited in its effectiveness, and successful large-scale online education is expensive to produce and deliver." Large-scale access to learning MOOCs

has implications not only for attracting and supporting large numbers of learners but also for designing the learning systems and developing the necessary pedagogy to support all of these learners. This involves consideration of how to disseminate content effectively and support meaningful interactions between learners (Downes, 2013), as well as how to devise new forms of education that enable high-quality teaching and learning opportunities to occur at scale. Tyler (1939) contended that content delivery cannot exist in isolation; the value of content is related only to the use and interpretation of the content in specific contexts. Tyler's view highlights the challenge involved in MOOC design, given the multiple, diverse contexts of individual learners.

The importance of contextualising teaching and learning opportunities has resulted in numerous MOOCs being developed that are designed for (although generally not exclusive to) specific audiences and particular contexts. These include high school courses, professional learning courses, and new providers catering specifically for the corporate space, including Udemy,[2] SkillSoft,[3] Lynda,[4] Grovo[5] and Big Think.[6] Degree courses, such as the Computer Science Masters offered as a collaboration between Georgia Tech and Udacity,[7] the iMBA created by Coursera[8] and the University of Illinois, and Udacity's Nanodegrees, have also been developed for learners who specifically want to engage in a more formal, structured course of study.

> **The massive scope and reach of MOOCs also expand access to high-quality learning opportunities to a wide range of learners, although arguably, this possibility has yet to be fully realised.**

Despite the instructional design and pedagogical challenges associated with learning at a massive scale, Ferguson and Sharples (2014) suggest that MOOCs potentially allow learners to access support from a wide range of other learners and facilitate the development of culturally diverse perspectives. For educators, the process of creating a MOOC can encourage access to new resources and provide opportunities for innovation within the teaching practice of the provider. The massive scope and reach of MOOCs also expand access to high-quality learning opportunities to a wide range of learners, although arguably, this possibility has yet to be fully realised.

What is clear generally is that the massive number of learners in a MOOC have a wider range of motivations for learning than is normally observed in a conventional course. Not all learners intend to complete the course or gain a certificate, bringing into question "drop-out" measures (Littlejohn & Milligan, 2015). Learners are able to "drop in" to a MOOC, largely due to the open nature of courses where registration is open for the duration of the course.

---

2   https://www.udemy.com
3   http://www.skillsoft.com
4   https://www.lynda.com
5   https://www.grovo.com
6   http://bigthink.com
7   https://www.udacity.com
8   https://www.coursera.org

2.2 Open

Open education is not a new phenomenon. It first was associated with open universities worldwide and more recently with the broader open movement in education, which amongst other dimensions incorporates OER and OCW. "Open" has multiple meanings in relation to MOOCs. It may refer to access; anyone, no matter his or her background, prior experience or current context, may enrol in a MOOC. Open can also refer to cost; that is, a MOOC is available free of charge. A third meaning relates to the open nature of knowledge acquisition in a MOOC, including the employment of OER or OCW available under a Creative Commons licence. A fourth meaning is around knowledge production and the opportunity for the remixing and reuse of resources developed during a MOOC by the instructors and by the learners themselves to create new knowledge (Milligan, Littlejohn, & Margaryan, 2013).

It has been argued that with the rising cost of higher education, the increasing demand for access to higher education, and the growing need for people to engage in learning throughout their lives in order to update their knowledge and skills, open education provides a means for reducing economic, geographic and social barriers to participation. In this context, Wiley and Hilton (2009) have positioned openness as a "prerequisite to changes institutions of higher education need to make in order to remain relevant to the society in which they exist."

> **Wiley and Hilton (2009) have positioned openness as a "prerequisite to changes institutions of higher education need to make in order to remain relevant to the society in which they exist."**

Whilst MOOCs were founded on notions of openness, these are being challenged. The business models of platform providers as well as the institutions that offer MOOCs have led to experiments with different pricing models. These include paying to gain certification, to sit a proctored exam, to receive course credit, or to work towards a degree. The current open access model, which allows anyone to enrol in a MOOC, also is being challenged by the growing recognition that not everyone is adequately prepared, with the necessary autonomy, dispositions and skills, to engage fully in a MOOC. The informal, largely self-directed nature of learning in MOOCs and the lack of support or interpersonal connections during a course mean that despite being open to anyone, learning opportunities are in reality restricted to those with the necessary knowledge, skills and dispositions to engage independently.

2.3 Online

The online aspect of MOOCs increasingly is being blurred, as MOOCs are being used in conjunction with or to supplement in-person school and university classes (Bates, 2014; Bruff, Fisher, McEwen, & Smith, 2014; Caulfield, Collier, & Halawa, 2013; Firmin et al., 2014; Holotescu, Grosseck, Cretu, & Naaji, 2014), expanding their scope to include blended learning contexts. In a review of the evidence surrounding the integration of

MOOCs into offline learning contexts, Israel (2015) determined that whilst the blended approach yields comparable achievement outcomes to traditional classroom settings, the use of MOOCs tends to be associated with lower levels of learner satisfaction. Downes (2013) suggested that for an online course to qualify as a MOOC, no required element of the course should have to take place in a specific physical location. However, this requirement does not preclude additional offline interactions taking place.

Whilst it seems reasonable to suggest that for a course to be labelled a MOOC there must be the potential for it to operate as a fully online learning experience, it is important to recognise that no online course is bounded to the online context. Learning is distributed across and informed by the multiple contexts of a learner's life. How and why a learner engages with a MOOC are determined by both their current situation as well as their personal ontogeny. The learning context of a MOOC also is situated within and across the institutional contexts of the specific course creator and the platform provider. Recognising and addressing the multiple and at times competing contexts in which each MOOC is situated are critical to discussions of quality.

2.4   Course

How "course" is conceptualised varies across different MOOCs (Table 1). Downes (2013) has suggested three criteria that must be met for a MOOC to be categorised as a course: (i) it is bounded by a start and end date; (ii) it is united by a common theme or discourse; and (iii) it is a progression of ordered events. Whilst MOOCs typically are bounded, this may manifest in different ways. MOOCs initially started as structured courses, designed to parallel in-person, formal learning, such as university classes, with start and end dates. However, an increasing number of MOOCs are not constrained by specific start or end dates (Shah, 2015), facilitating a more flexible, self-paced model, which enables learners to complete a course at their own pace. The length of courses also varies, with some constructed as a series of shorter modules that may be taken independently or added together to form a longer learning experience.

The structure and degree of conformity in patterns of engagement vary substantially amongst MOOCs. Conole (2013) suggested that participation can range from completely informal, with learners having the autonomy and flexibility to determine and chart their own learning journey, to engagement in a formal course, which operates in a similar manner to offline formal education. Reich (2013) has questioned whether a MOOC is a textbook (a transmitter of static content) or a course, because of the conflicts that exist around confined timing and structured versus self-directed learning, the tension between skills-based or content-based objectives, and whether certification is included (or, indeed, achieved by learners). Instead of focusing on issues of structured versus unstructured and informal versus formal learning, Siemens (2012) argued that the real tension in MOOCs is between the transmission model and the construction model of knowledge and learning. Siemens has suggested that rather than being viewed as courses, MOOCs should be conceptualised as a platform on which individual learners construct and ultimately define their own learning.

Table 1. Common Typologies of MOOCs

cMOOCs vs. xMOOCs
1   Connectivist MOOCs, or *cMOOCs,* are based on principles of constructivist pedagogy. Materials are generated by and through interactions and collaborations between MOOC participants. The course is designed to function as a network, which is able to take in and process new information or resources and adapt to these inputs to produce remixable and repurposable materials and knowledge.
2   Instructivist MOOCs, or *xMOOCs,* focus on more behavioural models of learning and pedagogy. Information is primarily transmitted from provider to learners, often through short video lectures, rather than being co-constructed. Learners participate largely autonomously and independently, with limited opportunities (no requirement) to interact.

LANE'S (2012) THREE-PART TYPOLOGY
1   *Network* MOOCs align with cMOOCs.
2   *Content* MOOCs align with xMOOCs.
3   *Task* MOOCs are focused on problem-based learning, which draws on real-world contexts and emphasises the application of learning in practice. Skills are demonstrated to learners in a range of presentation formats, combining both instructivist and constructivist principles.

CLARK'S (2013) EIGHT-PART MOOC TAXONOMY
1   *Transfer MOOCs* – existing classroom lectures are transferred to a MOOC.
2   *Made MOOCs* – videos, interactive materials and activities are made exclusively for a MOOC.
3   *Synch MOOCs* – have a fixed start and end date.
4   *Asynch MOOCs* – do not have fixed start and end dates, enabling flexibility in engagement and submission.
5   *Adaptive MOOCs* – provide personalised learning experiences, based on dynamic assessment and data gathering during the course.
6   *Group MOOCs* – focus on collaboration in small groups.
7   *Connectivist MOOCs* – information is generated and transformed through interpersonal connections across a network of peers.
8   *Mini MOOCs* – are shorter courses that are less time intensive and attract fewer learners.

Importantly, these eight types are not mutually exclusive.

3   QUALITY IN MOOCs: TENSIONS AND CHALLENGES

Given the complexities and variation in what MOOCs are and the purposes that they serve, identifying the dimensions of quality and their corresponding measures is challenging. Quality measures are always relative. There is no absolute threshold standard that can be set or a definitive list of specific or fixed criteria that each MOOC can be measured against. Any discussion of quality therefore must actively take into consideration the diversity amongst MOOCs as well as the various, and often competing, frames of reference of their stakeholders.

The opportunities for co-construction in MOOCs, with content, instructional materials and learning opportunities being contributed by both instructors and learners, raise questions about the boundaries of quality measures.

MOOCs are re-operationalising traditional concepts in education. Whilst they draw on elements of existing educational and learning models, they represent a new approach to instruction and learning. Enrolments are open and flexible, resulting in learners with diverse motivations and goals, and highly variable patterns of engagement. The curriculum of MOOCs is not always static and incorporates (both by design and through differing modes of learner engagement) a range of learning opportunities and pathways, which individual learners are able to self-select and independently navigate. This results in achievement no longer relating to a pre-established standard but rather being determined by individual learners in relation to their self-identified goals (DeBoer, Ho, Stump, & Breslow, 2014). Further, the opportunities for co-construction in MOOCs, with content, instructional materials and learning opportunities being contributed by both instructors and learners, raise questions about the boundaries of quality measures, even in circumstances where conventional metrics such as "media quality" are employed.

MOOCs also must be situated within their broader educational, economic and social contexts. Participation in higher education and ongoing professional development and learning are increasingly essential for success in the labour market. In the move away from training people for jobs for life to enabling people to upskill and learn continually, there is a need for diversity in opportunities and forms of learning. Both "conventional courses" and "unconventional forms of learning" (including online, informal and curiosity-driven learning) are required to meet growing educational needs. However, this transformation necessitates a change in mindset and culture in order to extend new learning opportunities beyond conventional designs (Littlejohn, Falconer, & McGill, 2014).

This review will draw upon Biggs's (1993) 3P model to explore notions and dimensions of quality in relation to MOOCs. This model has already been used to structure and organise different quality measures useful for higher education (Gibbs, 2010). The model suggested by Biggs conceptualises education as a complex set of interacting ecosystems. To understand

how a particular ecosystem (e.g., a MOOC) operates or to gauge its impact, it is necessary to break it down into its constituent parts and examine how these parts relate to each other and how they combine to form a whole. It further is necessary to understand the ecosystem and the variables of which it is composed in relation to other ecologies. Biggs divides each learning ecosystem into three types of variables — presage, process and product variables — which correspond to an input–environment–output model.

Presage variables are the resources and factors that go into the teaching and learning process, including the learners, instructors, institution and, in the case of MOOCs, the platform and platform provider. Process variables refer to the processes and actions associated with the presage variables, including instructional design, pedagogical approaches, and learning resources and materials. Product variables are the outputs or outcomes of the educational processes. The following sections will explore the presage, process and product variables associated with MOOCs.

Scholarship around quality in MOOCs can be divided crudely into two broad categories: (i) literature examining how quality should be interpreted and assessed in MOOCs at a more general and theoretical level; and (ii) empirical research studies that explore how these ideas about quality can be operationalised, including the measures and instruments that can be employed. In the literature from both categories there is an awareness (although not universally) of the need for new approaches to quality and the need to reconceptualise many of the dimensions of quality associated with more traditional educational opportunities. This has spurred researchers to explore new areas and to trial novel measures and instruments for assessing quality. Whilst these studies provide valuable insight about the different variables or dimensions of quality, it is apparent that the relationship between the variables as well as their relationship to quality is complex. Consequently, no single, overarching answer regarding how quality should be approached or measured in MOOCs is reached in this report. Rather, the review identifies and examines a wide range of presage, process and product variables applicable to MOOCs, and the relationships that have been found to exist between them.

3.1   Presage Variables: Platform; provider and instructor; learner

Traditional measures of presage variables include the funding and allocation of funding institutions put into teaching, student-to-staff ratios both across an institution as a whole as well as within individual courses, the quality of teaching staff (most often measured by the proportion of courses taught by tenured faculty as opposed to teaching assistants or non-academic staff), and the quality of students entering an institution, as measured by their prior academic achievement and the acceptance rate.

MOOCs disrupt many of these traditional measures. They are non-selective, with open admission, and are frequently designed to have a single instructor teaching thousands of learners. This has resulted in calls for quality measures that recognise the diversity of learners and the openness of a course (Butcher, Hoosen, Uvalić-Trumbić, & Daniel, 2013;

iNACOL, 2011; Quality Matters, 2013; Rosewell & Jansen, 2014). These new measures, however, have important implications for process and product variables.

3.1.1 Platform

The nature of a platform (including the structure and operation of the organisation that administers it) plays an important role in determining the access, reach and nature of the MOOC on offer. It further influences the instructional design, the available technology, and possible cost structures. Platforms are experimenting with new course structures, such as incorporating greater intentionality into course design by creating MOOCs with more practical outcomes for learners (Shah, 2015). Platform providers are also experimenting with different cost structures, including offering pay-for credentialing and course credit opportunities. Some providers have developed their own credentials—for example, Nanodegrees[9] from Udacity, Specialisations[10] from Coursera, and XSeries[11] from edX. These largely take the form of professional certificates of achievement, stamped by the institution providing the programme. Providers have also partnered with universities either to offer credit for individual courses or to provide whole degree structures.

3.1.2 Provider and Instructor

Theoretically, anyone can create a MOOC. The first university MOOCs were created and run by individual researchers in Canada (Downes, 2008, 2009). The United States government, the World Bank, the American Museum of Natural History, the Museum of Modern Art (New York), Google and AT&T are some of the many organisations that have run MOOCs. However, to date, MOOCs have been created predominately by instructional designers in universities — mainly prominent institutions worldwide. This has led some commentators to suggest that MOOCs are merely an exercise in brand promotion (Adamopoulos, 2014; Conole, 2013). Others imply that MOOCs promote and reinforce distinctions between well-known research universities and large corporations that are the producers of MOOCs (and controllers of knowledge), and less affluent universities, which do not necessarily have the financial resources to produce MOOCs and consequently are the consumers of MOOCs (Rhoads, Berdan, & Toven-Lindsey, 2013). Tensions and power imbalances between, on the one hand, MOOC creators, the courses they develop and the learning they support, and learners on the other are highlighted by the fact that most universities do not offer credit for their MOOCs (Adamopoulos, 2013).

The role of the instructor in a MOOC has important implications for the learning that occurs.

The role of the instructor in a MOOC has important implications for the learning that occurs. However, the roles adopted by instructors and the impact that they have varies substantially between MOOCs. To date, the three most common types of instructors in MOOCs are: (i) the distant "rock star"

9 https://www.udacity.com/nanodegree
10 https://www.coursera.org/featured/top_specializations_locale_en_os_web
11 https://www.edx.org/xseries

or academic celebrity lecturer; (ii) the co-participant or facilitator within a network; and (iii) the automated processes that act as a proxy for a human tutor or assessor (Bayne & Ross, 2014; Rodriguez, 2012). A further role has emerged recently, that of the pay-for personal mentor, who provides 1:1 feedback, email and forum support and live weekly office hours (Morrison, 2014). Radically new ways to connect with instructors are emerging: learners connect to a central hub using a mobile app which then connects them with a tutor or other forms of help from around the world; a tracking system enables fees to be charged and transferred between the student and the tutor; online assessments verify the competence and skills of the learner and their identity; and a blockchain[12] system records each transaction so that the student has a verified set of qualifications associated with him or her (Contact North, 2015).

Similarly to traditional, offline courses, the instructor in a MOOC determines or mediates the pedagogical approaches that are employed, the level of teaching skill and familiarity with content, and the opportunities for instructor–learner interaction and engagement during the course period. Designing and running a MOOC is a labour-intensive activity. Kolowich (2013) determined a MOOC typically takes over 100 hours of pre-course set-up time and then an additional ten hours per week during the running of the course. However, many educators are not recognised for the work they put into designing and running a MOOC, in the way their "traditional" duties are credited. Ross et al. (2014) have argued for the importance of acknowledging the complexity of teacher positions and experiences in MOOCs and how these influence learner engagement. Data suggest that the instructor has a significant impact on learner retention in MOOCs (Adamopoulos, 2013). Further research suggests that instructors' participation in discussion forum activity and their active support of learners during the running of a MOOC positively influence learning outcomes (Coetzee, Lim, Fox, Hartman, & Hearst, 2011; Deslauriers, Schelew, & Wieman, 2011).

Data on interaction and feedback, and — crucially — whether learners use feedback could provide important measures of instructor quality. Measures of interaction and feedback take on added significance in MOOCs, as each learner potentially is a teacher for other learners, and in certain MOOCs, the instructor adopts the role of facilitator and co-participant. Better understanding the relationship between the instructor and certain process variables along with their impacts on product variables has important quality implications in MOOCs.

3.1.3 Learner

It is estimated that 35 million people signed up to take at least one MOOC in 2015 (Shah, 2015). Whilst these courses theoretically are open to anyone with an Internet connection, data suggest that MOOCs currently are not attracting as diverse a body of learners as originally hoped. An analysis of 32 MOOCs offered by the University of Pennsylvania on the Coursera platform (Christensen et al., 2013) found that 83% of participants had a post-secondary degree

---

12 A blockchain system is a distributed database that maintains a growing list of transactions using cryptography to avoid tampering; see "How Blockchain Will Disrupt the Higher Education Transcript," at https://campustechnology.com/articles/2016/05/16/how-blockchain-will-disrupt-the-higher-education-transcript.aspx.

and 79.4% had a bachelor's degree or higher. Forty per cent were under the age of 30, whilst less than ten per cent were over 60. There were significantly more males (56.9%) than females, and 62.4% of learners were employed full-time or self-employed, with only 13.4% of learners unemployed or retired. Similar patterns emerged on the edX platform (Ho et al., 2014), with data indicating that 29% of learners were female, 66% held a bachelor's degree or higher, and 27% lived in the United States. However, the authors noted there was considerable diversity amongst the learners of certain courses.

Motivation determines how a person engages with a learning opportunity both cognitively and behaviourally and therefore is a mediating factor in relation to other quality measures.

Whilst learner demographics may not be as diverse as original MOOC enthusiasts had hoped, there is considerable variety in learners' motivations for enrolling in a MOOC. Common factors include: interest in the topic, access to free learning opportunities, the desire to refresh knowledge, the opportunity to draw on world-class university knowledge, and the wish to gain accreditation (Davis, Dickens, Leon, del Mar Sanchez Vera, & White, 2014; Wintrup, Wakefield, & Davis, 2015). Christensen et al. (2013) found that nearly half of MOOC students reported their reason for enrolling in a course as "curiosity, just for fun," whilst 43.9% cited the opportunity to "gain skills to do my job better." Motivation determines how a person engages with a learning opportunity both cognitively and behaviourally and therefore is a mediating factor in relation to other quality measures.

Studies have identified relationships between learner characteristics and patterns of engagement in MOOCs. Four profiles of learner engagement have been developed: (i) auditing — learners who did not do the quizzes or assignments but engaged with other resources, such as the video lectures; (ii) completing — learners who completed all of the activities; (iii) disengaging — learners who participated at the beginning of a MOOC but whose engagement dropped off or ceased over time; and (iv) sampling — learners who engaged in resources once or twice, often in the middle of the course, but were not consistent in their engagement (Kizilcec, Piech, & Schneider, 2013). Average course certification (or completion) rates are 62% amongst registrants who explored the course, nine per cent amongst registrants who viewed the course and six per cent amongst all registrants in the course (Ho et al., 2014).

Whilst for many commentators, low completion rates have been viewed as problematic, it is important to remember that passive engagement and lurking should be considered valid learning activities, and unlike in traditional education, they do not indicate a lack of an outcome (Department for Business, Innovation and Skills, 2013) or an absence of learning. A majority of learners in MOOCs are not adhering to traditional expectations or learning behaviours. Consequently, they do not necessarily measure success as engaging with all of the content or completing the activities and achieving a certification of completion (Littlejohn, Hood, Milligan, & Mustain, 2016). Successful learning in MOOCs increasingly

is learner driven and learner determined. As a result, traditional quality measures related to outcome variables (such as completion rates or grades) may be of limited relevance to MOOCs (Littlejohn & Milligan, 2015).

Confidence, prior experience and motivation have been found to mediate engagement (Milligan et al., 2013). It further has been suggested that learners' geographical location affects accessibility to MOOCs as well as interest in topics (Liyanagunawardena, Adams, & Williams, 2013), with demographic information usable as an intermediary characteristic to explain behaviour in a MOOC (Skrypnyk, de Vries, & Hennis, 2014). Further research has identified a relationship between learners' behaviour and engagement and their current contexts, including occupation (de Waard et al., 2011; Hood, Littlejohn, & Milligan, 2015; Wang & Baker, 2015), as well as a relationship between learners' learning objectives and their learning outcomes (Kop, Fournier, & Mak, 2011). A learners' prior education experience also has been found to influence their retention in a MOOC (Emanuel, 2013; Koller, Ng, Do, & Chen, 2013; Rayyan, Seaton, Belcher, Pritchard, & Chuang, 2013) and their readiness to learn (Bond, 2015; Davis et al., 2014; Kop et al., 2011), with more experienced learners typically finding it easier to navigate the unstructured nature of learning in a MOOC (Lin, Lin, & Hung, 2015).

The significance of learners' backgrounds, characteristics and motivations for their engagement and learning outcomes reinforces the importance of situating learning in a MOOC within the broader contexts of a learner's life. Whilst MOOCs are frequently characterised as decontextualised learning experiences supported by fragmented technology tools (Ebben & Murphy, 2014), context is critical for learners and the learning process. When discussing and assessing quality in MOOCs it is necessary to situate the MOOC, the learning opportunities it provides and individual learners within the multiple ecosystems in which they interact. One of the disrupting forces in a MOOC is that it provokes a move in thinking about quality from the perspective of the instructor, institution and platform provider to the learner. Therefore, establishing reliable measures of confidence, experience and motivation, which extend beyond self-report, could provide a more accurate view of quality than conventional learner metrics.

3.2   Process Variables: Pedagogy and Instructional Design

The flexibility of participation and the self-directed nature of engagement, which enable learners to self-select the learning opportunities and pathways they follow when participating in a MOOC (DeBoer et al., 2014), necessitate the re-operationalisation of many of the process variables typically involved in higher education. Questions emerge regarding the balance between structure (intended to provide direction) and self-regulation, between breadth and depth of content, and whether to emphasise instruction or self-directed learning. Further questions exist around the employment of broadcast or dialogue models of delivery, whether MOOCs should offer edutainment or deep learning opportunities, and whether and how to promote homophily or diversity in learners' engagement and participation.

3.2.1 Elements of Instructional Design in MOOCs

A number of studies have explored how elements of instructional design and the employment of different tools and resources influence engagement and support learning in MOOCs. Sharples et al. (2014) have suggested caution is required in navigating this area, due to a lack of consensus on which learner activities are most appropriate to measure or how these can be used to improve teaching and quality in MOOCs. Many studies rely on the outcome-oriented measures of retention and completion as proxies for learning when assessing process variables. However, these are not necessarily accurate measures of learning in MOOCs, where participation is often self-directed, with learners following individual, asynchronous pathways for which there is no correct or prescribed route (DeBoer et al., 2014). The following sections explore a range of instructional design variables, discussing their relevance to MOOCs and identifying measures and instruments that have been employed to gauge their role and impact in MOOCs.

3.2.2 Differentiation and Learner-centred Design

Inherent in the design of MOOCs should be an understanding of the diversity of the learner population and the need to provide learning activities that cater to and support different learning styles and needs (Alario-Hoyos, Perez-Sanagustin, Cormier, & Delgado-Kloos, 2014; Guardia, Maina, & Sangra, 2013; Hew, 2014; Margaryan et al., 2015). The design should empower learners (Amo, 2013; Guardia et al., 2013), offering opportunities for personalised learning (Istrate & Kestens, 2015) as well as drawing on learners' individual contexts and previous experiences (Scagnoli, 2012). The diversity of learners' goals and motivations for taking a MOOC must be addressed within its instructional design, allowing for learner autonomy (Mackness, Waite, Roberts, & Lovegrove, 2013) and flexible learning patterns. However, this flexibility must be situated within an overarching, coherent design that incorporates adequate support structures. Daradoumis, Bassi, Xhafa and Caballe (2013) suggested that whilst MOOCs allow for individual learning journeys, there is a problematic lack of designed customisation and personalisation in MOOCs to respond to learner characteristics. This was supported by Margaryan et al. (2015), who found that less than one-third of the 76 MOOCs they examined had different activity options, and in those that did, the level of differentiation was limited.

There are emerging quality measures related to learner behaviours that can be measured through a combination of background data, clickstream data and discourse analysis.

There are strong links between the diversity of learners (presage variable) MOOCs can attract and the need to incorporate differentiated pathways and learner-centred designs. To date, there have been few MOOC-specific studies exploring the particular connections between this process variable and product variables related to learner outcomes. However, there are emerging quality measures related to learner behaviours that can be measured through a combination of background data, clickstream data and discourse analysis (Arbaugh, 2014; Macfadyen & Dawson, 2010; Richardson, 2012). Nonetheless,

these measures so far have not been sufficiently reliable, nor have they been connected satisfactorily to learner outcomes.

3.2.3   Support and Scaffold

Whilst the instructional design of a MOOC should facilitate flexible approaches and opportunities for learners to adapt the course to suit their particular context and needs, it also is important to ensure that adequate support structures are integrated into the design. Learners' perseverance in a MOOC has been connected to their level of autonomy and the presence of learning support and scaffolds (Skrypnyk et al., 2015). Learning supports can be developed through the incorporation of accessible materials and instructors who actively contribute to and help learners (Hew, 2014), as well as through opportunities for peer assistance (Amo, 2013; Guardia et al., 2013). However, the small number of facilitators or instructors in MOOCs compared to learner numbers, and their consequent ability to adequately support learners, has raised concern (Dolan, 2014; Kop et al., 2011). Learners have reported feeling isolated or neglected, with little true engagement with others on the course — instructor or peers — minimising learners' belief in the importance of their own contribution to the learning process (Dolan, 2014).

Studies have found that the degree of structure in a course, as well as how individual learners operate within the given structure, influence engagement and activity (Jordan, 2015; Perna et al., 2014). The time structure of a MOOC also determines learner activity. Shorter courses (Adamopoulos, 2014; Jordan, 2015), courses that have a calendar-based schedule with a final exam or project (Adamopoulos, 2014), and courses that do not allow students to enter at different times (Jordan, 2015) tend to retain a greater proportion of students. However, a further study has determined relatively consistent behavioural and activity patterns between learners who took a MOOC synchronously, following a strict timetable of engagement, and those who participated in an archived version of the same MOOC, which allowed them to engage more flexibly over an extended time period (Campbell, Gibbs, Najafi, & Severinski, 2014).

Learning and data analytics are being used to guide the learner and instructor through learning experiences in open learning initiatives. For example, in one study (Rientes et al., 2016), tutors received weekly predictive analytics about each of their students. Tutors were able to use this data to intervene or to adjust their approach throughout the course. Another study explored the causal effect of procrastination on achievement in MOOCs and how directive nudges can affect behaviour (Martinez, 2014). These examples offer possible routes for developing new indicators and methods that, in conjunction with other approaches, can provide meaningful measures for the quality in MOOCs.

3.2.4   Clear Vision for MOOC, Including Consistent Pedagogical Approach

Establishing an overall concept or vision for the MOOC (Conole, 2013), which includes a learning plan, defined structure (that may be more or less flexible) and clear orientation and expectations (Alario-Hoyos et al. 2014; Guardia et al., 2013; Warburton & Mor, 2015),

has been identified as an important component of instructional design in MOOCs. The vision for a MOOC further should be clear, consistent and coherent, with a well-defined pedagogical approach (Conole, 2013; Istrate & Kestens, 2015; Warburton & Mor, 2015) that is embedded within and draws upon learning theories and knowledge of best practice. MOOCs are not a pedagogical approach in and of themselves, nor does establishing a course as a MOOC provide an adequate vision for the learning that will take place. Similarly to offline (and other online) courses, it is necessary to establish a coherent vision for a MOOC, as well as guiding pedagogical principles and learning objectives to direct the learning process. A recent Gates Foundation programme (Adair, 2013) reviewed 11 MOOCs against the Quality Matters rubric and found that one of the most commonly missed standards was "learning objectives clearly stated."

3.2.5   Participatory Design and Activity-based Learning

Designing a MOOC based on the concepts of participatory design and activity-based learning features heavily in the literature (Hew, 2014; Margaryan et al., 2015; Warburton & Mor, 2015). Employing these design concepts facilitates the construction of a MOOC that is relevant to learners (Istrate & Kestens, 2015) and supports visible and active learning, as well as the application of theory to practice (Conole, 2008, 2013). Integrated into this dimension of instructional design is a competency-based approach to learning (Guardia et al., 2013), which contrasts to the instructivist (xMOOC) approach that focuses on the direct consumption of information.

Evidence suggests that participatory design and activity-based learning are not routinely integrated into MOOC design. In 68 out of 76 courses examined by Margaryan et al. (2015), learning activities did not require learners to relate the course material to their prior knowledge and skills, whilst 67 of the MOOCs were not problem-centred. Only eight of the 76 courses included learning activities involving authentic problems analogous to "real-world" situations. Indicators that require qualitative judgments to be made about whether a MOOC incorporates elements of participatory design and activity-based learning have been developed. Further research into the relationship between these variables and other presage and product variables could enrich the ability to assess quality in MOOCs.

3.2.6   Interaction and Collaboration

Interaction and collaboration encompass both instructor–learner interactions and learner-to-learner collaborations. Peer interactions are positioned as supporting learning and knowledge-building activities (Amo, 2013; Conole, 2013; Hew, 2014; Margaryan et al., 2015), community formation (Warburton & Mor, 2015) and opportunities for help-seeking and peer assistance (Amo, 2013; Guardia et al., 2013; Hew, 2014). A relationship has been identified between learners' participation in discussion forums and course completion (Gillani & Eynon, 2014; Kizilcec et al., 2013; Sinha, Jermann, & Dillenbourg, 2014). The exact reasons for this are uncertain. Analysis of discussion forum posts indicates a wide variation in the content and topics that are discussed (Chandrasekaran, Ragupathi, Kan,

& Tan, 2015; Gillani, Yasserie, Eynon, & Hjorth, 2014). However, a correlation has been detected between the intensity of activity and course milestones (Gillani et al., 2014).

Encouraging interaction between learners also encourages input from a diversity of sources (Gillani & Eynon, 2014; Scagnoli, 2012) and greater contextualisation of learning. Using data and learning analytics, Gillani and Eynon (2014) determined that high-performing students engage more frequently in MOOC discussion forums; however, their interactions are not restricted to other high-performing students, suggesting that discussion forums have the potential to promote diversity within a course.

Discussion forums also provide an important information source for instructors about their students and how they are engaging with the content (Rosé, Goldman, Zoltners Sherer, & Resnick, 2015). There is evidence to suggest that the depth of discussion in MOOCs is less substantial than in other online learning instructors participate in (Margaryan et al., 2015; Rosé et al., 2015). Margaryan et al. (2015) found that whilst in some MOOCs designed as co-constructed learning environments there were instances of instructor and learner interactions, these tended to be general and non-specific, lacking in-depth or targeted feedback that would have drawn on the instructor's expertise.

Data and learning analytics have the potential to offer insight into learner and instructor participation in collaborative and interactive behaviour in MOOCs, providing information that could be meaningful at both the whole cohort and individual student levels. New technologies and techniques are being developed that facilitate the automated analysis of discussion in MOOCs. These include technology for analysing discussions for learning (Howley, Mayfield, & Rosé, 2013), the formation of discussion groups (Yang, Wen, Kumar, Xing, & Rosé, 2014), and indicators of motivation, cognitive engagement and attitudes towards the course (Wen, Yang, & Rosé, 2014a, 2014b). Developing measures capable of capturing interactions quantitatively as well as qualitatively will facilitate a richer understanding of how interactions and collaboration support student learning and engagement, as well as how they contribute to the fulfilment of individual learners' goals.

Developing measures capable of capturing interactions quantitatively as well as qualitatively will facilitate a richer understanding of how interactions and collaboration support student learning and engagement.

3.2.7   Strategic Use of Feedback and Assessment

Opportunities for feedback and assessment that support understanding and development in learners are important elements of effective instructional design in MOOCs (Alario-Hoyos, 2014; Amo, 2013; Conole, 2013; Margaryan et al., 2015). Receiving targeted, relevant, informative feedback in a timely manner is important for supporting students' ongoing learning and topic mastery (Hattie, 2009). There is evidence that data from formative testing are strongly predictive of student outcomes (Tempelaar, Rientes, & Giesbers, 2015).

However, in their analysis of 76 MOOCs, Margaryan et al. (2015) found few opportunities for high-quality instructor feedback.

It generally is accepted that multiple measures of learning and assessment are needed in MOOCs (Daradoumis et al., 2013). The various perspectives of the different actors involved in MOOCs as to their purpose and intended outcomes result in very different attitudes towards assessment and feedback opportunities. When MOOCs are conceptualised (by learners or designers) as informal learning activities, the need for formal, summative assessment opportunities becomes potentially less important than formative assessment and feedback throughout the MOOC. However, when MOOCs are conceptualised as more formal learning opportunities, including those offering certification, feedback and assessment take on a different role.

The literature has tended to focus more on the issues associated with and the mechanisms for facilitating formal assessment opportunities in MOOCs. Particular attention has been given to how assessment in MOOCs can be aligned with more traditional certification and accreditation processes in education. Research has investigated how formative and summative feedback can be generated (Whitelock, Gilbert, & Wills, 2013), how MOOCs could operate as foundational learning experiences before traditional degree courses (Wartell, 2012), and how and whether university credit might be offered by more MOOCs (Bellum 2013; Bruff et al., 2013). Further research has explored technologies that could be employed to enable automated or peer-assessed essay-based assignments (Balfour, 2013; Reilly, Stafford, Williams, & Corliss, 2014) and to counteract cheating, through techniques to ensure fair testing conditions (Meyer & Zhu, 2013), including technologies that confirm personal identity (Sandeen, 2013). The reliability of different peer assessment, which is used in some MOOCs, has been investigated. Admiraal, Huisman and Pilli (2015) determined only a low to moderate correlation between peer assessments of the same assignment and a weak correlation between self and peer assessment. Studies further have identified a negative correlation between completion rates and the use of peer grading for assessment (Adamopoulos, 2014; Jordan, 2015).

3.2.8 High-quality Resources and Activity Design

The use and creation of high-quality, authentic resources and content (Amo; 2013; Conole, 2013; Margaryan et al., 2015) and the opportunities for quality knowledge creation throughout the course of the MOOC (Guardia et al., 2013) are also associated with effective instructional design. Different types of resources have different receptions and learning affordances (Mamgain, Sharma, & Goyal, 2014), and these must be incorporated into instructional design decisions. Dillenbourg, Fox, Kirchner, Mitchell and Wirsing (2014) have warned that a key quality risk in MOOCs is to focus on the engagement of learners and the professionalism of preparation and execution, at the expense of learning effectiveness and the fulfilment of learning objectives. They warn of the tension between "edutainment" and supporting deep learning, suggesting that providing "overpolished" and entertaining materials without first considering the pedagogical approaches within which

they are used can limit their effectiveness and decrease the overall quality of the learning experience.

Learners' perceptions of the richness of course content have been found to be positively correlated with perceptions of knowledge comprehension and the quality of the learning exchanges that occur (Lin et al., 2015), as well as successful completion of a course (Adamopoulous, 2014). Learners further are found to value consistency in content (Grunewald, Meinel, Totschnig, & Willems, 2013) and the inclusion of resources that are connected to practical, real-life examples (Grunewald et al., 2013; Littlejohn et al., 2016).

Research has examined factors influencing learners' perceptions of video quality in MOOCs. Synchronicity has been found to correlate with students' perceptions regarding quality (Li, Verma, Skevi, Zufferey, & Dillenbourg, 2014), as well as shorter videos that incorporate in-video quizzes or instructor slides (Guo, Kim, & Rubin, 2014; Mamgain et al., 2014); the inclusion of subtitles and the ability to vary the video speed (Mamgain et al., 2014) have been found to increase learners' perceptions of video content. Ensuring that MOOC content does not just replicate in-person lectures and that content is designed to align with the pedagogical approach is also important (Dillenbourg et al., 2014).

The research suggests the need for quality measures that evaluate both content and resource design as well as learner engagement with content and resources. A number of quality criteria are already being used by universities for accreditation and to maintain internal standards that could be extended, potentially in a modified form, to MOOCs (Dillenbourg et al., 2014). Examples of such frameworks that have been expanded to address MOOCs include the Quality Matters guide,[13] iNACOL[14] and OpenUpEd.[15] These could be used in conjunction with new technology-enabled measures of learner engagement. One such example is the Precise Effectiveness Strategy, which purports to calculate the effectiveness of learners' interactions with educational resources and activities (Munoz-Merino, Ruiperez-Valiente, Alario-Hoyos, Perez-Sanagustin, & Delgado Kloos, 2015).

The research suggests the need for quality measures that evaluate both content and resource design as well as learner engagement with content and resources.

3.2.9   Sound Technology Use

Sound technology use is important to the design and delivery of high-quality learning experiences and opportunities (Amo, 2013; Conole, 2013; Guardia et al., 2013; Istrate & Kesten, 2015). Technology is conceptualised as an integral component of MOOC design, which should enhance rather than merely facilitate learning (Guardia et al., 2015). Whilst a range of technological tools have been developed and utilised in MOOCs, most conform to the unidirectional transmission of knowledge and have failed to capture the deep learning opportunities technology can enable (Ebben & Murphy, 2014; Rhoads et al.,

---

13 https://www.qualitymatters.org
14 http://www.inacol.org
15 http://www.openuped.eu/images/docs/OpenupEd_quality_label_-_Version1_0.pdf

2013). However, technology alone will not transform learning; innovative pedagogy is also required (Dillenbourg et al., 2014; Rhoads et al., 2013).

There are calls for MOOCs to incorporate more multimedia content and resources, including visualisations, animations and synchronous communication (Grunewald et al., 2013). The presence of real-time discussion has been connected with more positive perceptions of learning outcomes (Lin et al., 2015). Data from 6.9 million video sessions in four MOOCs found that to maximise student engagement, instructors must plan work specifically for an online video format rather than just replicating presentation styles that work in in-person settings (Guo et al., 2014).

There is considerable opportunity to utilise learning analytics to better personalise and tailor MOOCs to learners (Daradoumis et al., 2013; Kanwar, 2013; Lackner, Ebner, & Khalil, 2015; Sinha et al., 2014; Tabba & Medouri, 2013). Chandrasekaran et al. (2015) have called for automated methods to aid instructors in responding to student feedback and questions, whilst Kay, Reimann, Diebold and Kummerfeld (2013) suggested that learning analytics can be used to better understand knowledge creation and learning processes in MOOCs. Developing indicators that can be used in conjunction with learning analytics could provide powerful measures of pedagogically effective technology use in MOOCs; these will be explored in greater detail in the following sections, in relation to learner outcomes.

3.3   Product Variables: Learners and Learning

In traditional models of higher education, the most common measure used to indicate the quality of the product is the proportion of students gaining a degree and the level at which the degree is gained (Gibbs, 2010). The extent to which graduating students gain employment in a field relevant to their degree, and their starting salary level, are other common dimensions of quality (Gibbs, 2010). The MOOC literature frequently has employed retention, completion and certification rates as measures of quality. However, there is growing recognition of the need to move away from traditional product variables when assessing quality in MOOCs. Grover et al. (2013, p. 1) have suggested that the question "What makes a good MOOC?" needs to be reframed as "How can we make a MOOC work for as many of its diverse participants as possible?" This requires reconceptualising participation and achievement according to the diverse motivations, goal orientations and actions of participants (DeBoer et al., 2104). This push towards interpreting quality outcome measures in relation to individualised learning and individual learner outcomes represents a significant break from traditional measures of product variables.

The reorientation of traditional mindsets relating to quality and outcome measures in education reflects the changing nature of the product in MOOCs and within education more generally. The product in a MOOC is not standardised across all learners. Learners are able to set some of their own terms of participation in MOOCs and therefore have a very different relationship to course requirements, learning processes and often the institution offering the MOOC compared with what occurs in traditional forms of higher education.

3.3.1   Completion Rates

Completion rates and degree classifications are commonly employed metrics for assessing quality in education. As previously discussed, the use of these measures in the context of MOOCs is highly problematic. Whilst much of the research literature has employed completion rates as a proxy for learning, other research suggests that completion is not always the goal of individual learners (Littlejohn et al., 2016) and therefore not an appropriate measure of the quality of learning on its own.

Particular learner behaviours have been found to correlate positively with completion levels: engagement in discussion forums (Gillani et al., 2014), completion of weekly quizzes (Admiraal et al., 2015), and routine engagement over the course of a MOOC (Loya, Gopal, Shukla, Jermann, & Tormey, 2015; Sinha et al., 2014). As such, they can be interpreted as facilitators of the learning process. However, research has shown that completion is not synonymous with satisfaction, the achievement of goals, or learners' perceptions of successful learning (Koller et al., 2013; Littlejohn et al., 2016; Wang & Baker, 2015). Further evidence indicates that learners who lurk, engage passively or do not complete the full course have just as high an overall experience of a MOOC as those learners who complete it (Kizilcec et al., 2013).

The new context of learning that MOOCs represent requires new measures of success and quality to capture the diversity in participant behaviours and intentions (Bayne and Ross, 2014). This is a complex undertaking that entails developing a "nuanced, strategic, dynamic and contextual" understanding of individual learners and individual MOOCs (Mak, Williams, & Mackness, 2010, p. 280).

> **The new context of learning that MOOCs represent requires new measures of success and quality to capture the diversity in participant behaviours and intentions.**

3.3.2   Beyond Completion Rates

There is a clear need to develop new product variables that reflect the diverse and contextualised patterns of participation and the range of outcomes in MOOCs. These must include the individual motivations and goals of learners, both as they are conceptualised at the start of a course as well as how they develop over time. This will enable the development of differentiated product variables and the tracking of individual learners' engagement with MOOC resources, assessment — both formative and summative — and feedback, interaction with others, and patterns of communication. This profile of individual learners should also include background information on learners, including demographic data, prior learning experiences and behavioural data.

Research into learning analytics provides potential tools to facilitate the collection of this evidence as well as its employment to better understand the quality of outcomes. Research shows that combining demographic details, academic and social integration, and social and behavioural factors, together with behaviour within the course, can be used to predict

different types of performance (Agudo-Peregrina, Iglesias-Pradas, Conde-González, & Hernández-García, 2014; Credé & Niehorster, 2012; Macfadyen & Dawson, 2010; Marks, Sibley, & Arbaugh, 2005; Tempelaar et al., 2015). There is still much work to do in order to develop a deeper understanding of how different combinations of variables relate to different outcomes.

Other product variables related to individual learners that extend beyond within-MOOC behaviour and performance outcomes include variables related to post-MOOC behaviour and results. Potential measures include career outcomes, such as whether people have gained jobs or promotions that they can trace back to their MOOC experience (Zhenghao et al., 2015), network outcomes (whether people made connections with people they otherwise would not have encountered), and educational outcomes, such as whether people have embarked on a course of study as a result of taking a MOOC.

Dillenbourg et al. (2014) suggested developing a profile of individual learners, which can be used to inform their personal MOOC experience and to develop an understanding of the affordances that need to be created for learners that will drive the conditioning variables to be measured. The result is that measuring the quality of the product will be based on a rich set of variables that are employed in different combinations in response to different contextual factors.

3.3.3   Innovation in Teaching and Learning

Alongside variables related to learners and learning, other product variables include the opportunities for innovation within teaching practice that MOOCs provide. This would seek to situate MOOCs within the broader education landscape. Quality variables relate to how MOOCs develop new pedagogical models that leverage the affordances of technology to support learners and their diverse needs, to promote richer learning experiences, and to address challenges facing education at all levels. This perspective promotes MOOCs moving beyond replication, towards innovation.

4   THE WAY FORWARD

The complexities involved in first interpreting and then trying to measure quality in MOOCs are apparent. Many of the dimensions of quality discussed above depend largely on the MOOC's context and the perspective of the particular actor. The diversity of learners in a MOOC, the range of purposes for which MOOCs are designed, and the various motivations individual learners have for engaging with a MOOC make identifying a single approach for measuring quality impossible. Furthermore, the difficulties in operationalising many of the dimensions of quality — either quantitatively or qualitatively — make assessments of quality challenging.

Daniel (2012) suggested that MOOCs could be evaluated by learners and educators, with the aim to produce league tables that rank courses (there are several examples of this already happening). He also suggested that poorly performing courses either would disappear due to lack of demand or would undertake efforts to improve quality. Uvalić-Trumbić (2013) suggested assessing a given MOOC against the question "What is it offering to the student?" However, given the diversity amongst MOOC participants, developing an answer to this question is not straightforward.

Another route forward is to equate quality with participation measures (Dillenbourg et al., 2014). The primary focus would be on assessments of the learning outcomes of individual participants, thereby placing the learner at the centre of measures of quality. This is in keeping with the growing focus in the research on developing multiple measures of learner behaviour, motivations and engagement, through the employment of various learning and data analytic techniques. Dillenbourg et al. (2014) have suggested that through multiple assessments of individual learners, participation measures could also inform the evaluation of cohorts of learners, instructional design decisions and the learning outcomes that result from them, and instructors, whose quality is dependent on the outcomes of the course.

This focus on the learner and the relationship between product and process variables seems to be central to the quality of MOOCs. If the learning outcomes, as measured through a range of variables and indicators, are perceived to represent a high-quality learning experience, then by implication the process variables — the various dimensions of pedagogy and instructional design — are appropriate in this context. However, if the learners' experiences and resulting learning outcomes are not positive, then the process variables may be deemed less suitable to that particular context, even if they conform to a pre-developed list of guidelines. The aim, therefore, is to ensure that the gap between initial expectations and the final perceptions of the delivered learning experience is as small as possible—that is, the process variables lead to the desired product variables and outcome measures.

This focus on the learner and the relationship between product and process variables seems to be central to the quality of MOOCs.

Rather than coming to a single conclusion about quality in MOOCs, this review has attempted to explore some of the tensions and challenges associated with quality and to identify a range of variables that can be used to measure quality in MOOCs. It has emerged clearly in the literature that traditional measures and indicators of quality are not always the most appropriate for MOOCs. Similarly, given the diversity amongst MOOC offerings, it is unlikely that there is one clear route forward for assessing quality. Biggs's 3P model provides a framework for identifying variables and measures associated with quality and for exploring the relationships between them. The aim here was to explain the possible uses of each variable and, where possible, to identify potential measures and instruments that can be used to gauge them.

There is a clear trend in much of the literature towards the need to start any exploration of quality in MOOCs with the learner, using various measures of learner perceptions, behaviours, actions and experiences as the foundation. Whilst the stated intention of this review was to act primarily as a thought piece, to stimulate new ways of thinking about and approaching quality in MOOCs, the authors would like to conclude with a piece of advice: *When assessing quality in MOOCs, it is of paramount importance that there be a clear understanding about what is being measured and the reasons for the measurement, and an appreciation for the limits of what individual measures or single variables are able to tell us about quality.*

REFERENCES

Adair, D. (2013, September 25). *QM for MOOCs: Results of QM reviews of Gates Foundation-funded MOOCs.* Paper presented at the 5th Annual QM Conference, Nashville, TN. Retrieved from https://www.qualitymatters.org/moocs-%0Bresults-reviews-gates-foundation-funded-moocs

Adamopoulos, A. (2013). *What makes a great MOOC? An interdisciplinary analysis of student retention in online courses.* Paper presented at the Thirty-Fourth International Conference on Information Systems, Milan, Italy. Retrieved from http://pages.stern.nyu.edu/~padamopo/What%20makes%20a%20great%20MOOC.pdf

Admiraal, W., Huisman, B., & Pilli, O. (2015). Assessment in massive open online courses. *Journal of e-Learning, 13*(4), 207–216.

Agudo-Peregrina, Á., Iglesias-Pradas, S., Conde-González, M., & Hernández-García, Á. (2014). Can we predict success from log data in VLEs? Classification of interactions for learning analytics and their relation with performance in VLE-supported F2F and online learning. *Computers in Human Behavior, 31*, 542–550.

Alario-Hoyos, C., Perez-Sanagustin, M., Cormier, D., & Delgado-Kloos, C. (2014). Proposal for a conceptual framework for educators to describe and design MOOCs. *Journal of Universal Computer Science, 20*(1), 6–23.

Amo, D. (2013, November). *MOOCs: Experimental approaches for quality in pedagogical and design fundamentals.* Paper presented at TEEM '13, Salamanca, Spain.

Arbaugh, J. B. (2014). System, scholar, or students? Which most influences online MBA course effectiveness? *Journal of Computer Assisted Learning, 30*(4), 349–362. doi:10.1111/jcal.12048

Balfour, S. (2013). Assessing writing in MOOCs: Automated essay scoring and Calibrated Peer Review™. *Research and Practice in Assessment, 8*, 40–48. Retrieved from http://www.rpajournal.com/dev/wp-content/uploads/2013/05/SF4.pdf

Bates, T. (2014, October 19). The strengths and weaknesses of MOOCs: Part I [Web log comment]. Retrieved from http://www.tonybates.ca/2014/10/19/the-strengths-and-weaknesses-of-moocs-part-i/

Bayne, S., & Ross, J. (2014). MOOC pedagogy. In P. Kim (Ed.), *Massive open online courses: The MOOC revolution* (pp. 23–45). New York, NY: Routledge.

Bellum, J. (2013, August 5). The adult learner and MOOCs. *EDUCAUSE Review.* Retrieved from http://www.educause.edu/ero/article/adult-learner-and-moocs

Biggs, J. (1993). From theory to practice: A cognitive systems approach. *Higher Education Research & Development, 12*(1), 73–85.

Bond, P. (2015). Information literacy in MOOCs. *Current Issues in Emerging eLearning, 2*(1), Article 6. Retrieved from http://scholarworks.umb.edu/cgi/viewcontent.cgi?article=1013&context=ciee

Bruff, D. O., Fisher, D. H., McEwen, K. E., & Smith, B. E. (2013). Wrapping a MOOC: Student perceptions of an experiment in blended learning. *Journal of Online Learning and Teaching, 9*(2), 187–199.

Butcher, N., Hoosen, S., Uvalić-Trumbić, S., & Daniel, J. (2013). *Guide to quality in post-traditional online higher education.* Retrieved from http://www.eadtu.eu/home/policy-areas/quality-assurance/publications/227-guide-to-quality-in-post-traditional-online-higher-education

Campbell, J., Gibbs, A., Najafi, H., & Severinski, C. (2014). A comparison of learner intent and behaviour in live and archived MOOCs. *International Review of Research in Open and Distributed Learning, 15* (5), 234–262.

Caulfield, M., Collier, A., & Halawa, S. (2013, October 7). Rethinking online community in MOOCs used for blended learning. *EDUCAUSE Review.* Retrieved from http://www.educause.edu/ero/article/rethinking-online-community-moocs-used-blended-learning

Chandrasekaran, M., Ragupathi, K., Kan, M., & Tan, B. (2015, December). *Towards feasible instructor intervention in MOOC discussion forums.* Paper presented at the Thirty-Sixth International Conference on Information Systems, Fort Worth, TX.

Christensen, G., Steinmetz, A., Alcorn, B., Bennett, A., Woods, D., & Emanuel, E. J. (2013). *The MOOC phenomenon: Who takes massive open online courses and why?* Retrieved from http://ssrn.com/abstract=2350964

Clark, D. (2013, April 16). *MOOCs: Taxonomy of 8 types of MOOC.* Retrieved from http://donaldclarkplanb.blogspot.co.nz/2013/04/moocs-taxonomy-of-8-types-of-mooc.html

Coetzee, D., Lim, S., Fox, A., Hartmann, B., and Hearst, M. A. (2015). Structuring interactions for large-scale synchronous peer learning. In *Proceedings of the 18th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW), Vancouver, Canada* (pp. 1139–1152). New York, NY: ACM.

Conole, G. (2008). *New schemas for mapping pedagogies and technologies.* Retrieved from http://www.ariadne.ac.uk/issue56/conole

Conole, G. (2013). MOOCs as disruptive technologies: Strategies for enhancing the learner experience and quality of MOOCs. *RED – Revista de Educación a Distancia, 39.* Retrieved from http://www.um.es/ead/red/39/conole.pdf

Contact North. (2015, May 16). *Uber-U is already here.* Retrieved from http://teachonline.ca/tools-trends/exploring-future-education/uber-u-already-here

Credé, M., & Niehorster, S. (2012). Adjustment to college as measured by the Student Adaptation to College Questionnaire: A quantitative review of its structure and relationships with correlates and consequences. *Educational Psychology Review, 24*(1), 133–165.

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. *Journal of Interactive Media in Education*, *2012*(3). doi:10.5334/2012-18

Daradoumis, T., Bassi, R., Xhafa, F., & Caballe, S. (2013). A review on massive eLearning (MOOC) design, delivery and assessment. In *Proceedings – 2013 8th International Conference on P2P, Parallel, Grid, Cloud and Internet Computing, 3PGCIC 2013* (pp. 208–213). Piscataway, NJ: IEEE. doi:10.1109/3PGCIC.2013.37

Davis, H., Dickens, K., Leon, M., del Mar Sanchez Vera, M., & White, S. (2014, April). *MOOCs for universities and learners: An analysis of motivating factors.* Paper presented at the 6th International Conference on Computer Supported Education, Barcelona Spain.

DeBoer, J., Ho, A., Stump, G. S., & Breslow, L. (2014). Changing "course": Reconceptualizing educational variables for massive open online courses. *Educational Researcher, 43*(2), 74–84. doi:10.3102/0013189X14523038

Department for Business, Innovation and Skills. (2013). *The maturing of the MOOC.* London, UK: Author.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrolment physics class. *Science, 332*(6031), 862–864.

de Waard, I., Abajian, S., Gallagher, M, Hogue, R., Keskin, N., Koutropoulos, A., & Rodriguez, O. (2011). Using mLearning and MOOCs to understand chaos, emergence, and complexity in education. *International Review of Research in Open and Distance Learning, 12*(7), 94–115.

Dillenbourg, P., Fox, A., Kirchner, C., Mitchell, J., & Wirsing, M. (2014). *Massive open online courses: Current state and perspectives.* Manifesto from Dagstuhl Perspectives Workshop. doi:10.4230/DagMan.4.1.1

Dolan, V. (2014). Massive online obsessive compulsion: What are they saying out there about the latest phenomenon in higher education? *International Review of Research in Open and Distributed Learning, 15*(2), 268–281.

Downes, S. (2008). Places to go: Connectivism and connective knowledge. *Innovate: Journal of Online Education, 5*(1), Article 6. Retrieved from http://nsuworks.nova.edu/innovate/vol5/iss1/6

Downes, S. (2009, February 24). *Connectivist dynamics in communities* [Web log post]. Retrieved from http://halfanhour.blogspot.co.uk/2009/02/connectivist-dynamics-in-communities.html

Downes, S. (2013, April 24). *The quality of massive open online courses.* Retrieved from http://mooc.efquel.org/files/2013/05/week2-The-quality-of-massive-open-online-courses-StephenDownes.pdf

Ebben, M., & Murphy, J. (2014). Unpacking MOOC scholarly discourse: A review of nascent MOOC scholarship. *Learning Media and Technology, 39*, 328–345.

Emanuel, E. (2013, November 21). Online education: MOOCs taken by educated few. *Nature, 503*(342). doi:10.1038/503342a

Ferguson, R., and Sharples, M. (2014). Innovative pedagogy at massive scale: Teaching and learning in MOOCs. In C. Rensing, S. de Freitas, T. Ley, & P. J. Munoz-Merino (Eds.), *Open learning and teaching in educational communities: 9th European Conference on Technology Enhanced Learning, EC-TEL 2014, Graz, Austria, September 16–19, 2014, Proceedings* (pp. 178–111). Cham, Switzerland: Springer.

Firmin, R., Schiorring, E., Whitmer, J., Willett, T., Collins, E. D., & Sujitparapitaya, S. (2014). Case study: Using MOOCs for conventional college coursework. *Distance Education, 35*(2), 178–201. doi:10.1080/01587919.2014.917707

Gibbs, G. (2010). *Dimensions of quality.* York, UK: The Higher Education Academy.

Gillani, N., & Eynon, R. (2014). Communication patterns in massively open online courses. *Internet and Higher Education, 23*, 18–26.

Gillani, N., Yasserie, T., Eynon, R., & Hjorth, I. (2014). Structural limitations of learning in a crowd: Communication vulnerability and information diffusion in MOOCs. *Scientific Insights, 4*, 6447.

Grover, S., Franz, P., Schneider, E., & Pea, R. (2013). *The MOOC as distributed intelligence: Dimension of a framework an evaluation of MOOCs.* Paper presented at the 10th Annual International Conference on Computer Supported Collaborative Learning, Madison, WI. Retrieved from http://life-slc.org/docs/LSLC_rp_A194_Grover-etal_CSCL2013_MOOCs-and-DI_Volume%202_CSCL2013.pdf

Grunewald, F., Meinel, C., Totschnig, M., & Willems, C. (2013). Designing MOOCs for the support of multiple learning styles. In *Conference Proceedings from EC-TEL 2013, LNCS* (pp. 371–382). Berlin, Germany: Springer-Verlag

Guardia, L., Maina, M., & Sangra, A. (2013). MOOC design principles: A pedagogical approach from the learner's perspective. *eLearning Papers, 33*, 1–5.
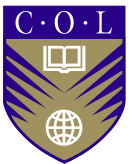
Guo, P., Kim, J., & Rubin, R. (2014). How video production affects student engagement: An empirical study of MOOC videos. In *Proceedings of the First ACM conference on Learning @ Scale Conference* (pp. 41–50). New York, NY: ACM.

Hashmi, A. (2013, September 16). HarvardX set to launch second SPOC. *Harvard Crimson.* Retrieved from http://harvardx.harvard.edu/links/harvardx-set-launch-second-spoc-harvard-crimson-amna-h-hashmi-september-16-2013

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* London, UK: Routledge.

Hew. K. (2014). Promoting engagement in online courses: What strategies can we learn from three highly rated MOOCS? *British Journal of Educational Technology, 47*(2), 320–342. doi:10.1111/bjet.12235

Hickey, D. (2013). *On MOOCs, BOOCs, and DOCCs: Innovation in open courses.* Retrieved from http://remediatingassessment.blogspot.co.nz/2013/09/on-moocs-boocs-and-docc-innovation-in.html

Ho, A. D., Reich, J., Nesterko, S. O., Seaton, D. T., Mullaney, T., Waldo, J., & Chuang, I. (2014). HarvardX and MITx: The first year of open online courses, fall 2012 – summer 2013. *HarvardX and MITx Working Papers, No. 1.* doi:10.2139/ssrn.2381263

Holotescu, C., Grosseck, G., Cretu, V., & Naaji, A. (2014). Integrating MOOCs in blended courses. In *Proceedings of the 10th International Scientific Conference eLearning and Software for Education* (pp. 243–250). Retrieved from http://proceedings.elseconference.eu/index.php?r=site/index&year=2014&index=papers&vol=13&paper=415a2fbc41c54155ab4abaae14f0be4c

Hood, N., Littlejohn, A., & Milligan, C. (2015). Context counts: How learners' contexts influence learning in a MOOC. *Computers & Education, 91*, 83–91.

Howley, I., Mayfield, E., & Rosé, C. P. (2013). Linguistic analysis methods for studying small groups. In C. Hmelo-Silver, A. O'Donnell, C. Chan, & C. Chin (Eds.), *The international handbook of collaborative learning* (pp. 184–202). New York, NY: Routledge.

iNACOL. (2011, October). *National standards for quality online courses: Version 2.* Vienna, VA: INACOL. Retrieved from http://www.inacol.org/wp-content/uploads/2015/02/national-standards-for-quality-online-courses-v2.pdf

Israel, M. (2015). Effectiveness of integrating MOOCs in traditional classrooms for undergraduate students. *International Review of Research in Open and Distributed Learning, 16*(5), 102–118.

Istrate, O., & Kestens, A. (2015, April). *Developing and monitoring a MOOC: The IFRC experience.* Paper presented at the 11th International Scientific Conference eLearning and Software for Education, Bucharest, Romania. Retrieved from http://www.academia.edu/14707457/DEVELOPING_AND_MONITORING_A_MOOC_THE_IFRC_EXPERIENCE

Jaschik, S. (2013, August 19). Feminists challenge Moocs with Docc. *Times Higher Education.* Retrieved from http://www.timeshighereducation.co.uk/news/feminists-challenge-moocs-with-docc/2006596.article

Jordan, K. (2015). Massive open online course completion rates revisited: Assessment, length and attrition. *International Review of Research in Open and Distributed Learning, 16*(3), 341–358.

Kanwar, A. (2013, October 16). *Quality vs. quantity: Can technology help?* Opening keynote presentation at the 25th ICDE World Conference, Tianjin, China.

Kay, J., Reimann, P., Diebold, E., & Kummerfeld, B. (2013). MOOCs: So many learners, so much potential…. *IEEE Intelligent Systems, 28*(3), 70–77.

Kizilcec, R., Piech, C., & Schneider, E. (2013). *Deconstructing disengagement: Analyzing learner subpopulations in massive open online courses.* Paper presented at LAK '13, Leuven, Belgium.

Koller, D., Ng, A., Do, C., & Chen, Z. (2013). Retention and intention in massive open online courses: In depth. *EDUCAUSE Review Online.* Retrieved from http://er.educause.edu/articles/2013/6/retention-and-intention-in-massive-open-online-courses-in-depth

Kolowich, S. (2013, March 18). The professors behind the MOOC hype. *The Chronicle of Higher Education.* Retrieved from http://chronicle.com/article/The-Professors-Behind-the-MOOC/137905/

Kop, R., Fournier, H., Mak, J. (2011). A pedagogy of abundance or a pedagogy to support human beings? Participant support on massive open online courses. *International Review of Research in Open and Distributed Learning, 12,* 74–93.

Lackner, E., Ebner, M., & Khalil, M. (2015). MOOCs as granular systems: Design patterns to foster participant activity. *eLearning Papers, 42,* 28–37.

Lane, L. (2012, August 15). Three kinds of MOOCs. *Lisa's (Online) Teaching & History Blog.* Retrieved from http://lisahistory.net/wordpress/2012/08/three-kinds-of-moocs/

Li, N., Verma, H., Skevi, A., Zufferey, G., & Dillenbourg, P. (2014). MOOC learning in spontaneous study groups: Does synchronously watching videos make a difference? In U. Cress & C. D. Kloos (Eds.), *Proceedings of the European MOOCs Stakeholders Summit, 2014* (pp. 88–94). Lausanne, Switzerland: École Polytechnique Fédérale de Lausanne & eLearning Papers. Retrieved from https://infoscience.epfl.ch/record/196608/files/publisherversion.pdf

Lin, Y-L., Lin, H-W., & Hung, T-T. (2015). Value hierarchy for massive open online courses. *Computers in Human Behaviour, 53,* 408–418.

Littlejohn, A., Falconer, I., & McGill, L. (2014). Open, lifewide learning: A vision. In A. Littlejohn & C. Pegler (Eds.), *Reusing open resources: Learning in open networks for work, life and education* (2nd rev. ed., pp. 115–124). London, UK: Routledge.

Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *Internet and Higher Education, 29,* 40–48.

Littlejohn, A., & Milligan, C. (2015). Designing MOOCs for professional learners: Tools and patterns to encourage self-regulated learning. *eLearning Papers, 42* (special issue on design patterns for open online teaching and learning), 38–45. Retrieved from http://www.openeducationeuropa.eu/en/node/170924

Liyanagunawardena, T., Adams, A., & Williams, S. (2013). MOOCs: A systematic study of the published literature 2008–2012. *International Review of Research in Open and Distributed Learning, 14*(3), 202–227.

Loya, A., Gopal, A., Shukla, I., Jermann, P., & Tormey, R. (2015). Conscientious behaviour, flexibility and learning in massive open on-line courses. *Procedia – Social and Behavioral Sciences, 191,* 519–525.

Macfadyen, L. P., & Dawson, S. (2010). Mining LMS data to develop an "early warning system" for educators: A proof of concept. *Computers & Education, 54*(2), 588–599.

Mackness, J., Mak, S. F. J., & Williams, R. (2010). The ideals and reality of participating in a MOOC. In L. Dirckinck-Holmfeld, V. Hodgson, C. Jones, M. de Laat, D. McConnell, & T. Ryberg (Eds.), *Proceedings of the Seventh International Conference on Networked Learning* (pp. 266–275). Lancaster, UK: University of Lancaster.

Mackness, J., Waite, M., Roberts, G., & Lovegrove, E. (2013). Learning in a small, task-oriented, connectivist MOOC: Pedagogical issues and implications for higher education. *International Review of Research in Open and Distributed Learning, 14*(4), 140–159.

Mak, S., Williams, R., & Mackness, J. (2010). Blogs and forums as communication and learning tools in a MOOC. In L. Dirckinck-Holmfeld, V. Hodgson V, C. Jones, M. de Laat, D. McConnell, & T. Ryberg (Eds.), *Proceedings of the 7th International Conference on Networked Learning 2010* (pp. 275–284). Lancaster, UK: Lancaster University. Retrieved from https://www.lancaster.ac.uk/fss/organisations/netlc/past/nlc2010/abstracts/PDFs/Mak.pdf

Mamgain, N., Sharma, A., & Goyal, P. (2014). *Learner's perspective on video-viewing features offered by MOOC providers: Coursera and edX*. Paper presented at the 2014 IEEE International Conference on MOOC, Innovation and Technology in Education (MITE). doi:10.1109/MITE.2014.7020298

Margaryan, A., Bianco, M., & Littlejohn, A. (2015). Instructional quality of massive open online courses (MOOCs). *Computers & Education, 80*, 77–83.

Marks, R. B., Sibley, S. D., & Arbaugh, J. B. (2005). A structural equation model of predictors for effective online learning. *Journal of Management Education, 29*(4), 531–563.

Martinez, I. (2014). The effects of nudges on students' effort and performance: Lessons from a MOOC (working paper). *EdPolicyWorks*. Retrieved from http://curry.virginia.edu/uploads/resourceLibrary/19_Martinez_Lessons_from_a_MOOC.pdf

Meyer, J. P., & Zhu, S. (2013) Fair and equitable measurement of student learning in MOOCs: An introduction to item response theory, scale linking, and score equating. *Research and Practice in Assessment, 8*, 26–39.

Milligan, C., Littlejohn, A., &, Margaryan, A. (2013). Patterns of engagement in connectivist MOOCs. *MERLOT, 9*(2), 149–159.

Morrison, D. (2014, January 18). Need-to-know-news: MOOC mentors for hire, Coursera's MOC$s, edX shares MOOC data and more. *Online Learning Insights*. Retrieved from https://onlinelearninginsights.wordpress.com/2014/01/28/need-to-know-news-mooc-mentors-for-hire-courseras-mocs-edx-shares-mooc-data-and-more/

Munoz-Merino, P., Ruiperez-Valiente, J., Alario-Hoyos, C., Perez-Sanagustin, M., & Delgado Kloos,, C. (2015). Precise Effectiveness Strategy for analyzing the effectiveness of students with educational resources and activities in MOOCs. *Computers in Human Behaviour, 47*, 108–118.

Perna, L., Ruby, A., Boruch, R., Wang, N., Scull, J., Ahmad, S., & Evans, C. (2014). Moving through MOOCs: Understanding the progression of users in massive open online courses. *Education Researcher, 43*(9), 421–432.

Quality Matters. (2016). *Continuing and professional education — rubric*. Retrieved from https://www.qualitymatters.org/about-continuing-and-professional-education-rubric-0

Raths, D. (2016, May 16). How blockchain will disrupt the higher education transcript. *Campus Technology*. Retrieved from https://campustechnology.com/articles/2016/05/16/how-blockchain-will-disrupt-the-higher-education-transcript.aspx

Rayyan, S., Seaton, D., Belcher, J., Pritchard, D., & Chuang, I. (2013). Participation and performance in 8.02x Electricity and Magnetism: The first physics MOOC from MITx. *arXiv preprint arXiv:1310.3173*. Retrieved from http://arxiv.org/abs/1310.3173

Reich, J. (2013, October 11). MOOC completion and retention in the context of student intent. *EDUCAUSE Review*. Retrieved from http://er.educause.edu/articles/2014/12/mooc-completion-and-retention-in-the-context-of-student-intent

Reilly, E., Stafford, R., Williams, K., & Corliss, S. (2014). Evaluating the validity and applicability of automated essay scoring in two massive open online courses. *International Review of Research in Open and Distributed Learning, 15*(5), 84–98.

Rhoads, R. A., Berdan, J., & Toven-Lindsey, B. (2013). The open courseware movement in higher education: Unmasking power and raising questions about the movement's democratic potential. *Educational Theory, 63*(1), 87–110.

Richardson, J. (2012). The attainment of white and ethnic minority students in distance education. *Assessment & Evaluation in Higher Education, 37*(4), 393–408.

Rientes, B., Boroowa, A., Cross, S., Kubiak, C., Mayles, K., & Murphy, S. (2016). Analytics4Action evaluation framework: A review of evidence-based learning analytics interventions at the Open University UK. *Journal of Interactive Media in Education.* doi:10.5334/jime.394

Rodriguez, C. (2012). MOOCs and the AI-Stanford like courses: Two successful and distinct course formats for massive open online courses. *European Journal of Open, Distance and E-Learning.* Retrieved from http://files.eric.ed.gov/fulltext/EJ982976.pdf

Rosé, C., Goldman, P., Zoltners Sherer, J., & Resnick, L. (2015). Supportive technologies for group discussion in MOOCs. *Current Issues in Emerging eLearning, 2*(1), Article 5.

Rosewell, J., & Jansen, D. (2014). The OpenupEd quality label: Benchmarks for MOOCs. *INNOQUAL: The International Journal for Innovation and Quality in Learning, 2*(3), 88–100.

Ross, J., Sinclair, C., Knox, J., & Macleod, H. (2014). Teacher experiences and academic identity: The missing components of MOOC pedagogy. *Journal of Online Learning and Teaching, 10*(1), 57.

Sandeen, C. (2013). Assessment's place in the new MOOC world. *Research and Practice in Assessment, 8*, 5–12. Retrieved from http://www.rpajournal.com/dev/wp-content/uploads/2013/05/SF1.pdf

Scagnoli, N. (2012). *Thoughts on instructional design for MOOCs.* Retrieved from https://www.ideals.illinois.edu/bitstream/handle/2142/44835/Instructional%20Design%20of%20a%20MOOC.pdf

Shah, D. (2015, December 28). MOOCs in 2015: Breaking down the numbers. *EdSurge.* Retrieved from https://www.edsurge.com/news/2015-12-28-moocs-in-2015-breaking-down-the-numbers

Sharples, M., Adams, A., Ferguson, R., Gaved, M., McAndrew, P., Rienties, B., Weller, M., & Whitelock, D. (2014). *Innovating pedagogy 2014: Open University innovation report 3.* Milton Keynes, UK: The Open University. Retrieved from http://www.openuniversity.edu/sites/www.openuniversity.edu/files/The_Open_University_Innovating_Pedagogy_2014_0.pdf

Siemens, G. (2012). MOOCs are really a platform. *ELearnSpace.* Retrieved from http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform/

Sinha, T., Li, N., Jermann, P., & Dillenbourg, P. (2014). Capturing "attrition intensifying" structural traits from didactic interaction sequences of MOOC learners. In *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing. Workshop on Modeling Large Scale Social Interaction in Massively Open Online Courses* (pp. 42–49). Retrieved from https://www.aclweb.org/anthology/W/W14/W14-41.pdf

Skrypnyk, O., de Vries, P., & Hennis, T. (2015). *Reconsidering retention in MOOCs: The relevance of formal assessment and pedagogy.* Paper presented at the EMOOCS Conference 2015, Third European MOOCs Stakeholders Summit, Mons, Belgium.

Sumner, J. (2000). Serving the system: A critical history of distance education. *Open Learning, 15*(3), 267–285.

Tabba Y., & Medouri, A. (2013). LASyM: A learning analytics system for MOOCs. *International Journal of Advanced Computer Science and Applications, 4*(5), 113–119.

Tattersall, A. (2013) Gold rush or just fool's gold — a quick look at the literature. *ScHARR MOOC Diaries.* Retrieved from http://scharrmoocdiaries.blogspot.co.uk/2013/07/scharr-mooc-diaries-part-xvii-gold-rush.html

Tempelaar, D. T., Rienties, B., & Giesbers, B. (2015). In search for the most informative data for feedback generation: Learning analytics in a data-rich context. *Computers in Human Behavior, 47,* 157–167.

Tyler, K. (1939). Recent developments in radio education. *The English Journal, 28*(3), 193–199.

Uvalić-Trumbić, S. (2013). MOOCs: Mistaking brand for quality? *University World News.* Retrieved from http://www.universityworldnews.com/article.php?story=20130206180425691

Wang Y., & Baker, R. (2015). Content or platform: Why do students complete MOOCs? *MERLOT, 11*(1), 17–30.

Warburton, S., & Mor, Y. (2015). Double loop design: Configuring narratives, patterns and scenarios in the design of technology enhanced learning. In M. Maina et al. (Eds.), *The art and science of learning design* (pp. 93–104). Rotterdam, The Netherlands: Sense Publishers.

Wartell, M. (2012). A new paradigm for remediation: MOOCs in secondary schools. *EDUCAUSE Review.* Retrieved from http://er.educause.edu/articles/2012/11/a-new-paradigm-for-remediation-moocs-in-secondary-schools

Wen, M., Yang, D., & Rosé, C. P. (2014a). Linguistic reflections of student engagement in massive open online courses. In *Proceedings of the International Conference on Weblogs and Social Media.* Retrieved from http://www.cs.cmu.edu/~mwen/papers/icwsm2014-camera-ready.pdf

Wen, M., Yang, D., & Rosé, C. P. (2014b). Sentiment analysis in MOOC discussion forums: What does it tell us? In *Proceedings of Educational Data Mining.* Retrieved from http://www.cs.cmu.edu/~mwen/papers/edm2014-camera-ready.pdf

Whitelock, D., Gilbert, L., & Wills, G. (2013). *Feedback generators: Providing feedback in MOOCs.* Paper presented at the CAA 2013 International Conference, University of Southampton, UK. Retrieved from http://caaconference.co.uk/wp-content/uploads/Whitelock_caa2013_submission.pdf

Wiley, D., & Hilton, J. (2009). Openness, dynamic specialization, and the disaggregated future of higher education. *International Review of Research in Open and Distributed Learning, 10*(5). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/768

Wintrup, J., Wakefield, K., & Davis, H. (2015). Engaged learning in MOOCs: A study using the UK Engagement Survey. York, UK: The Higher Education Academy. Retrieved from https://www.heacademy.ac.uk/sites/default/files/resources/engaged-learning-in-moocs.pdf

Yang, D., Wen, M., Kumar, A., Xing, E., & Rosé, C. (2014). Towards an integration of text and graph clustering methods as a lens for studying social interaction in MOOCs. *International Review of Research in Open and Distributed Learning, 15*(5). Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1853/3083

Zhenghao, C., Alcorn, B., Christensen, G., Eriksson, N., Koller, D., & Emanuel, E. (2015, September 22). Who's benefiting from MOOCs, and why. *Harvard Business Review.* Retrieved from https://hbr.org/2015/09/whos-benefiting-from-moocs-and-why