Online learning engagement: Critical factors and research evidence from literature

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Abstract

In this study, we highlight how previous work on online learning engagement, especially its antecedents and outcomes, has changed over the past decade. Our analysis of literature consisted of three parts: topics; theories and methodology. In addition, we describe current developments in the study of online learning engagement and discuss the role of emerging technologies in better understanding online learning engagement. We have found that even though most factors that have proved to be effective in traditional settings also apply to online learning environments, current research tends to repeat itself if seen through the lens of topics and results. Following the current trends that we have summarised, we propose new directions for research on engagement in online learning.

Keywords: engagement, online learning, literature review

Introduction

Students' engagement in learning is increasingly viewed as an indicator of successful classroom instruction and valued as an outcome of school-improvement activities. However, politicians and researchers are worried about lack of engagement in specific subjects, such as science, technology, engineering and mathematics (STEM) subjects. For example, the European Commission's Horizon 2020 Work Programme (European Commission. 2016) emphasises that science education should better engage young people in science learning. Similarly, in Australia, a study revealed a continuing decline in interest and engagement in mathematics and science subjects among high school students. Between 1992 and 2012, year 12 students increased by 16%, while general interest in science and mathematics-related subjects decreased around 5%-10% (Kennedy et al., 2014). Moreover, the labour demand in most STEM fields is expected to increase dramatically, between 8% and 12%, in the foreseeable future (PwC, 2015). Educators and stakeholders are passionate about enhancing students' engagement and interest in STEM subjects. This is relevant to online learning, as it is happening almost everywhere in many fields. Meanwhile, it is also important to analyse previous studies on student engagement, which will provide useful information on real-world practice.

In general, students are more engaged when they are interested in their work, persisting in it despite challenges and obstacles, and taking visible delight in accomplishing work goals. Student engagement also refers to a student's willingness, need, desire and compulsion to participate and succeed in the learning process (Bomia et al., 1997). A robust amount of research has been done on engagement, especially the antecedents and outcomes of research on engagement in learning in traditional classrooms. Such antecedents include: motivational factors such as autonomy, interest and self-efficacy (Skinner et al., 2009); learning-community participation (Pike et al., 2011); school-level factors such as flipped classrooms (Gilboy et al., 2015); technological factors such as gamification (Cronk, 2012); teacher support (Klem & Connell, 2004); peer interaction, class structure, task characteristics and personal needs (Fredricks et al., 2004). Such outcomes of engagement include: achievement and dropping out (Steele & Fullagar, 2009; Fredricks et al., 2004); satisfaction (Wefald & Downey, 2009); problem-solving skills (Eseryel et al., 2014); persistence (Kuh et al., 2008).

The objective of this paper is to summarise previous studies on online learning engagement and how they have changed over time. In a more detailed way, we analyse the topics discussed, theories applied, conclusions proposed and how future studies can be conducted in online learning environments. No systematic review of online learning engagement currently exists; thus, these questions have not been systematically examined before, except in one review book, published by Mayer (2014). In *Student Engagement in Online Learning: What Works and Why,* Mayer discussed the importance of online learning and engagement among students, the techniques researchers used, efforts to improve engagement, etc. However, it was more of a guide than a practice-based monograph, and no articles dealt with one specific question: What evidence exists regarding online learning engagement? With this question in mind, we conducted our literature review, with the objective of contributing to further work in designing online courses and investigating whether general engagement factors could be applied to specific subjects, such as science learning.

Definition of engagement in the literature

We began our work by summarising how previous studies have defined the concept of *engagement,* as the literature has been inconsistent. Since our main goal is to track the research trends of online learning engagement, we go through the selected 40 papers (for literature filtering process see Methodology part) carefully in order to find out how previous studies defined *engagement.* Our inclusion criteria are: a, article has one clear definition of *engagement;* b, clear source of reference to *engagement;* c, the focus study is in line with the definition of *engagement.* The result is shown at Table 1.

Table 1. Articles that define student engagement

Article source (N=16)	Cited the definition of	Context of engagement
Hew (2016)	Fredericks et al. (2004)	Behavior; emotion; cognition
Paulus et al. (2016)	Kearsley & Shneiderman (1999)	Cognition
Pellas (2014)	Fredericks et al. (2004)	Behavior; emotion; cognition
Stott (2016)	Kuh (2003)	Time, energy devoted to task
Kahn et al. (2016)	Krause & Coates (2008)	Effort, commitment to learning
Sun & Rueda (2012)	Fredericks et al. (2004)	Behavior; emotion; cognition
Richardson & Newby (2006)	Guthrie (1996)	Cognition
Czerkawski & Lyman (2016)	Trowler (2010)	Time, effort, source and commitment to learning
Yang (2011)	Cole & Chan (1994)	Involvement, active participation of learning/language learning
Yoo & Huang (2013)	Kuh (2003)	Time, energy devoted to task
Spence & Usher (2007)	Spence & Usher (2007)	General Computer/courseware
Lu et al. (2017)	Christenson et al. (2012)	Concept framework close to self-regulated learning
Bradford & Wyatt (2010)	Dziuban et al. (2007)	Willingness, effort to study
Robinson & Hullinger (2008)	Kuh (2003)	Time, energy devoted to task
Ma et al. (2015)	Kuh (2003)	Time, energy devoted to task
Coates (2006)	NSSE (2003)	collaborative learning and formative communication

*For a full list of journal titles, see Appendix A

According to our literature review, 16 papers (40%) defined the term *engagement* explicitly (see Table 1), while others did not provide a specific definition. We found that two definitions were regularly cited. One was proposed by Fredericks, Blumenfeld and Paris in 2004 and the other by Kuh in 2001-2003. Our discussion will mainly focus on those two definitions.

Fredericks and colleague interpreted engagement via a well-known three-dimensional conception: behavioural engagement, emotional engagement and cognitive engagement (Fredericks et al., 2004). To simplify the definition, *engagement* generally refers to how students act, feel and think. In the academic world, these engagement dimensions (behavioural, emotional and cognitive) point separately to on-task behaviour (Peterson et al., 1984), interests or attitudes (Epstein & McPartland, 1976), and motivation and self-regulated learning (Boekarts et al., 2000; Christenson et al., 2012).

Nearly one out of three articles referred to the Kuh definition (2003), which defined *engagement* as 'the time and energy students devote to educationally sound activities inside and outside of the classroom, and the policies and practices that institutions use to induce students to take part in these activities'. Kuh's definition corresponds closely to the National Survey on Student Engagement's (NSSE, 2003) conception of engagement in some ways. According to the NSSE, student engagement is built on five benchmarks, namely: level of academic challenge; active and collaborative learning; student-faculty interaction; enriching educational experience; and supportive campus environment.

Czerkawski and Lyman (2016) favour Trowler's (2010) definition of *engagement*. They believe that student engagement not only deals with interactions among time, effort and resources among students, but also is influenced by institutional efforts in enriching students' learning experiences and performance. Schneider et al. (2016) operationalise engagement as a state of involvement in learning in which students have higher-than-average skill levels and experience, as well as interests related to the task. Moreover, they experience the task as challenging. Corresponding with Hidi and Renninger (2006), they interpret interest as psychological orientation toward a particular goal or task, skills as mastery of specific tasks (Eccles & Wigfield, 2002) and challenges as determination to persist in facing situations.

Notably, even though multiple definitions of *engagement* exist, they mainly refer and apply to traditional educational environments, and in the literature review, no agreed-upon definition of 'online learning engagement' was ever established.

Walji, Deacon, Small and Czerniewicz (2016) defined *engagement* in the massive open online learning course (MOOC) context as the 'willingness and extent to which people are active in a MOOC, as displayed through their interaction with the content and people in the course'. In 2006, Coates proposed the Student Engagement Questionnaire (SEQ) for evaluating engagement in campus-based studies. He collected a sample across Australian universities. The questionnaire included seven scales and measured students' use of online systems (Coates, 2006). The following year, he developed a four-cluster engagement pattern for both online and traditional settings (Coates, 2007).

When engaged, learners are willing to invest more time and energy, as well as their own cognitive resources, into the task. All the aforementioned points can elicit positive influence on the 'state of engagement'. However, we assert that engagement should include both the situation and its result. Thus, we should examine engagement in a more consistent way. In addition, compared with traditional classroom learning, it seems that online learning needs fewer resources (in which everything is easy to grasp) and more concentration, time and commitment. In this case, a proper definition of *online learning engagement* has yet to be proposed.

By analysing current research on engagement, we propose our definition of *students' online learning engagement* (SOLE): students' devotion of time, energy, value/interest, attitude, learning strategy or even creative thinking in e-learning environments and the motivational and action processes elicited. We argue that students who are engaged have the potential for positive behaviour and a sense of commitment, but this does not necessarily promote positive learning outcomes (e.g., not necessarily

higher achievement, but improved well-being). Thus, we interpreted engagement as both a situation and a process that are measurable, but not necessarily results-oriented.

Community of inquiry

Community of Inquiry (CoI) is a theory developed to explain how learning happened online (Garrison & Anderson, 2003). It asserts that learning happens in the interaction of three different presences, namely: teaching presence, cognitive presence and social presence. Garrison, Anderson and Archer (2000) described teaching presence as 'design, facilitation and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes'. This definition indicated teachers' role in designing, facilitating and guiding students in the learning environment, which helps promote high-level cognitive and social engagement.

Social presence in online learning has been defined as how people socially and emotionally perceived and devoted themselves in a learning situation. A proper level of social presence is connected with learning satisfaction, sense of community, and learning performance. Cognitive presence refers to the competence of interpreting, constructing and confirming meaning through sustained reflection and discourse (Garrison, Anderson & Archer, 2001). Putting it differently, it represents how learner "make sense" of the meaning in different context. Since the introduction in 1999, CoI is increasingly applied as a classical framework in online learning study, especially more and more popular among engagement study (e.g., Scogin & Stuessy, 2015; Paulus et al., 2006).

Self-directed learning

The concept of *self-directed learning* (SDL) was developed during a time when scholars and practitioners tried to understand how adults learn. The very first description of SDL appeared in the work of Tough (1967), who studied a self-planned learning project with 66 Canadians based on the work of Houle (1961). Later, Knowles (1975) contributed to SDL literature in a book that explained basic SDL concepts and how to implement them through learning contracts. Despite continuous efforts to reframe the definition of SDL in a critical way, the one proposed by Knowles generally has been accepted and quoted: "In its broadest meaning, self-directed learning describes a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (Knowles, 1975, p. 18). In online learning environments, SDL goes beyond purely adult education, especially since the emergence of MOOC learning, in which self-paced learning seems to be prevalent. In this review, we define *self-directed learning* as an important skill for lifelong learning. It takes place when a learner diagnoses learning needs, sets learning goals, chooses learning materials and evaluates learning results individually. A proper level of autonomy, skills and attitudes is needed in SDL.

Structure of the study

The first part regards the filtering process of our literature table; In the second part, we discuss our results of review, from the perspective of themes, theories and methodologies, we are able to summarise the trends of online engagement study; The last part acts as the conclusion, in which we not only collect ideas and thoughts based on extant literature, but also pay attention to innovative technics for better understand student engagement; Based on the "whole picture", we also give suggestions for future study.

Table 2. Keywords: examples of application

Keywords	Student	Engag*	Online
Sub-keywords	Learner undergraduates graduates secondary school	Engage engaging involvement Engaged	Web Internet MOOC e-learning digital learning distance education

Methodology

Finding extant literature

We searched for relevant studies through the Education Resources Information Centre (ERIC). Altogether, 83 papers were found using the keywords STUDENT, ENGAG* and ONLINE (see Table 2 for full key words list). ERIC was chosen because it contains well-known journals on education from various publishing organisations and is usually considered to be a relevant database for identifying educational literature (Hertzberg & Rudner, 1999). As online learning usually lies at the intersection of education and technology, we also searched additional databases that fit our scope for relevant literature, including EBSCO, PsycInfo and Science Direct.

Inclusion criteria

We decided to use only high-quality journals within the field of educational technology and educational research. Examples of targeted journals include *Computer & Education, British Journal of Educational Technology* and *Distance Education*. Table 3 displays the source of articles briefly. The ERIC database included 12 such papers. Similarly, we found seven more papers from Science Direct and EBSCO. In the next stage, a careful inspection of the extant-literature list excluded several articles with all the descriptors in their titles, but that focused on different topics. In the meantime, some well-known (or highly cited) papers not published in top-level journals also were considered in the table (i.e., Coates, 2007; Czerkawski & Lyman III, 2016). This was followed by a manual search using key words 'online' and 'engagement', or 'MOOC' and 'engagement', these were added to our final list of 40 articles from top-quality journals, as mentioned above.

To sum up, the inclusion criteria applied were: 1. empirical; 2. written in English; 3. published between January 2000 and April 2017; 4. published in high-quality, peer-viewed journals that focus on learning and technology; and 5. discussed online students' learning engagement. The list of the 40 papers selected can be found in Appendix A.

Table 4 lists literature information such as sample size, author, and topic discussed. Overall, we utilised 40 articles from 22 journals. The full names of the journals are listed in Appendix C, while the rest of the legend can be found in Appendix A and Appendix B at the end of this article. In the table below, when needed, each column is presented in the form of an abbreviation.

Table 3. Summary of article sources

Source of literature/database	Number
ERIC	14
Science Direct	5
EBSCO	11
Wiley Online library	10
Total (N)	40

Table 4. Literature source table

Authors (year)	Sample Gender (size)	Educational level/context	Phenomenon	Theory in use	Research method
Wang (2007)	NM*(N=212)	PG/US&KR&CN	Experience	PDI	Mixed methods
Shea & Bidjerano (2009)	NM (N=2159)	UG&PG/US	Model	CoI	Quantitative
Freitas et al. (2015)	NM (N=862)	ML/AU	MOOC	N/A	Mixed methods
Hew (2016)	NM (N=965)	ML/US	MOOC	SDT	Qualitative
Barak et al. (2016)	NM (N=325)	ML/IL	MOOC	SDT	Mixed methods
Kelly et al. (2010)	F(N=300) M(N=161)	UG/UK	Design	SRL	Mixed method
Paulus et al. (2006)	F(N=12) M(N=9)	UG/US	Design Environment	CoI	Qualitative
Pellas (2014)	F(N=124) M(N=181)	UG&PG/GR	Inter-relations Game	N/A	Quantitative
Phan et al. (2016)	NM (N=573)	ML/US	MOOC	SRL	Quantitative
Stott (2016)	NM (N=465)	UG/AUS	Design	N/A	Quantitative
Sullivan et al. (2011)	F(N=49) M(N=12)	UG/US	Design Environment	N/A	Mixed method
Chen et al. (2010)	F(N=11,649) M(N=6,122)	UG/US	Relations	NSSE	Quantitative
Kahn et al. (2016)	F(N=9) M(N=13)	PG/UK	Model	AMA	Qualitative
McBrien et al. (2009)	N/A (N=90)	UG&PG/GR	Design	TDT	Qualitative
O'Shea et al. (2015)	N/A (N=57)	UG&PG/AUS	Experience	PEF	Mixed method
Ward et al. (2016)	F(N=151) M(N=31)	UG/UK	Design	N/A	Quantitative
Eseryel et al. (2014)	F(N=50) M(N=38)	HS/US	Relations	SDT, SET	Quantitative
Sun & Rueda (2012)	F(N=67) M(N=135)	UG/US	Relations	FEF	Quantitative
Pellas & Kazanidis (2015)	F(N=40) M(N=85)	UG&PG/GR	Design	FEF	Quantitative
Bradford & Wyatt (2010)	NM (N=90)	UG/US	Relations	N/A	Quantitative
Robinson & Hullinger (2008)	F(N=115) M(N=86)	UG/US	Benchmarks	NSSE	Quantitative
Ma et al. (2015)	NM (N=900) courses	NM/CN	Instructor presence	N/A	Quantitative
Cho & Cho (2014)	F(N=122) M(N=36)	UG/US	Instructor scaffolding	N/A	Quantitative
Coates (2007)	NM (N= 1,051)	UG/AUS	Model	NSSE	Quantitative
Scogin & Stuessy (2015)	NM (N= 10)	MS/US	Instructor presence	SDT	Qualitative
Richardson & Newby (2006)	F(N=63) M(N=58)	PG/US	Relations	N/A	Quantitative
Czerkawski & Lyman (2016)	NM	N/A	Model	NSSE	N/A
Dorner (2012)	NM (N= 28)	TS/HU	Instructor presence	NSSE	Qualitative
Yang (2011)	F(N=49) M(N=69)	UG/TW	Design	SL	Mixed method
Ellis (2016)	F(N=50) M(N=25)	UG/AU	Relations	Phenomenography	Qualitative

Table 4. Literature source table (cont.)

Authors (year)	Sample Gender (size)	Educational level/context	Phenomenon	Theory in use	Research method
Mello (2016)	N/A (N= 67)	PG/UK	Design	SDL	Quantitative
Spence & Usher (2007)	F(N=127) M(N=37)	UG/US	Relations	SCT	Quantitative
Lu et al. (2017)	F(N=36) M(N=86)	ML/TW	MOOC	N/A	Quantitative
Walji et al. (2016)	NM	ML/ZA	Design	N/A	Qualitative
Chang & Wei (2016)	F(N=2583) M(N=2437)	ML/TW	MOOC	N/A	Mixed method
Dixson (2012)	NM (N=57)	UG/US	Learning experience	N/A	Quantitative
Ward et al. (2016)	F(N=151) M(N=35)	UG/UK	Design	N/A	Mixed method
O'Shea et al. (2015)	F(N=32) M(N=6)	UG/AU	Course design Learning experience	PEF	Qualitative
Yoo & Huang (2013)	F(N=136) M(N=47)	AL/US	Relationships	SDT Engagement theory	Quantitative
Chen et al. (2010)	F(N=13000) M(N=7000)	UG/US	Relationships	NSSE	Quantitative

*NM=not mentioned; ML= MOOC learner.
More legend for coding can be found in Appendices 1, 2 and 3

Results of the review

Themes, theories and frameworks, methodologies and findings made up the four main parts of the review. These four aspects will be discussed one by one in the following section. In addition, we try to summarise the findings of each sub-group.

Themes discussed in literature

Our objective is to summarise the general research topics related to online learning engagement in the past decade. To do so, we read the papers carefully and marked each with one or two keywords, based on the context. Examples of markers include 'relationships', 'course design', 'instructor presence' and 'MOOC' (as shown in the literature source table above). Next, all the markers were abstracted and formed into four sub-groups of themes: course design/redesign and learning environment, instructor/faculty presence and learning experience, models and interrelationships between factors, and MOOCs and emerging technologies (as theme-extraction process illustrated in Figure 1). The intent in cataloguing them into these sub-groups is to cover important aspects of the learning process, e.g., course preparation and the instructor's role in scaffolding. We discuss the sub-groups individually as follows: Learning design and learning environment; learning support ad learning experience; models of online learning engagement; and MOOC leaning and technology enhanced features.

Course design and online learning environment

Amid all the reviewed extant literature, 34% (N=14) of the articles discussed course planning and learning environments to some degree. Collaborative environments, game-based design, instructor presence and how these facilitate engagement were frequently investigated (N=12). We discuss this in further detail below.

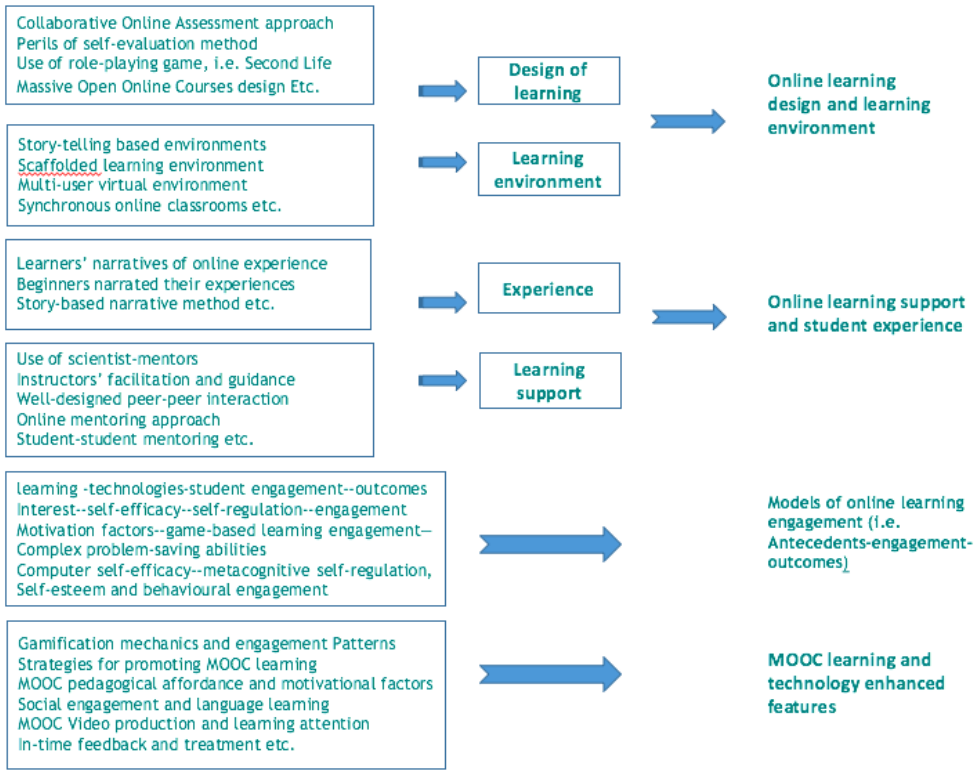

Figure 1. Theme-extraction process

Kelly et al. (2010) designed a Collaborative Online Assessment approach that offered a scaffolded environment for first-year students to engage in peer assignment learning. In their year-long experiment, higher-quality cognitive engagement with the course and higher marks were observed. The researchers believe the frequency of posting messages and answering others' messages reflects critical thinking and deep processing of knowledge; thus, the online assessment approach promotes cognitive engagement. Engagement (especially cognitive engagement) was measured based on quantitative data, such as messages posted and mid/final multi-choice tests, and qualitative data, such as a questionnaire related to course feedback. This is one of the common practices in studies on engagement.

Not every study supported the effectiveness of the self-assessment or peer-assessment approaches. For example, Stott (2016) examined the potential perils of using self-evaluation methods by students in online learning. As he put it: 'there are risks inherent in online teaching for both the students and the instructor if core online courses follow on from or are scheduled in the same semester as face-to-face courses'.

Researchers' interests also point to how different designs of virtual learning environments impact engagement, e.g., story-telling-based environments (Paulus el al., 2006), multi-user virtual environments (MUVEs) (Sullivan et al., 2011) and synchronous online classrooms (McBrien et al., 2009). Researchers also have a passion for gamification in education, especially on how the famous role-playing game Second Life (SL) has facilitated online learning. Some applied SL to investigate how this gamification mechanism promoted work-related issues among psychology students (Ward et al., 2016) and compared the value of SL in both blended and online courses (Pellas & Kazanidis, 2015), while others such as Chang and Wei (2016) explored the gamification mechanics of the hotly debated MOOCs in terms of how they engaged learners.

Mello (2016) explored students' engagement with self-directed learning (SDL) by offering them well-designed content and materials online. Differences were observed among PhD and master's students, with the former more open-minded toward SDL than the latter. In addition, studies found that

students who engaged more with online sources reported higher marks, and blended-course formats contributed to a better environment for SDL. While many studies focus on a traditional 'triangle-relation research model'—traditionally identified as motivation, engagement and outcome—this study is a rare find, as it emphasises a very important, yet usually neglected factor in the learning ecology: the material.

Online learning support and student learning experience

Quite a few articles discuss the instructor's presence in online courses and the importance of peer support, e.g., whether instructors should work as scientist-mentors (Dorner, 2012) or support scaffold learning (Ma et al., 2015; Cho & Cho, 2014). Considering that the presence of instructors in online learning sometimes affects students' learning experience, we classified these as one group and discuss them in the second part. In the theory of Community of Inquiry (CoI) (Garrison & Anderson, 2003; Garrison & Arbaugh, 2007), Garrison et al. (2000) described teaching presence as 'design, facilitation and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes'. This definition indicated teachers' role in designing, facilitating and guiding students in the learning environment, which helps promote high-level cognitive and social engagement.

A recent empirical study by Ma et al. (2015) investigated how teaching presence affects students' online learning engagement using in-depth data mining. Instead of using students as a sample, it utilised 900 courses in which a learning management system was used: Tsinghua Education Online (THEOL) in China, which offers high-quality courses from top universities both in China and abroad. Teachers' preparation of courses influenced students' viewing activities, while instructors' facilitation and guidance in the course actively affected students' completion of courses (Ma et al., 2015). Four articles were concerned with instructors' role in scaffolding and how it leads to better engagement. For example, Cho and Cho's (2014) work on the relation between instructor scaffolding and student interaction and academic engagement revealed some interesting findings: While instructors' scaffolding fostered interaction directly, which, in turn, affected students' emotional and behavioural engagement, it was not associated with perceived performance-avoidance goal structures. Literatures also discussed the importance of online mentoring (Ensher et al., 2003), or e-mentoring (Goodyear et al., 2001; Young et al., 2005). For example, Dorner (2012) questioned how online mentoring affects students' cognitive engagement. Based on social network analysis and content analysis, his study revealed that while connections existed between mentor presence and cognitive engagement, interactive mentoring does not necessarily mean better and deeper cognitive engagement. As noted by Boyle el al. (2010), student-to-student mentoring, another important method of fostering online engagement, tends to be overlooked by researchers. In a collaborative effort between researchers from Britain, Korea and New Zealand, student retention was found to increase up to 20% in a student-to-student mentoring and peer support community (Boyle et al., 2010).

Qualitative research based on learners' narratives of online experiences also shed light on their online engagement. Conrad's (2002) interest lay in how online learning beginners narrated their experiences, focusing on qualities such as anxiety, fear and pressure, and how this was related to engagement. The instructor's role at the beginning of the course was proved to be functional, e.g., first-time learners liked the instructor's welcome message and appreciated his or her efforts in establishing a nice community. Compared with quantitative methods, the qualitative, story-based narrative method enables in-depth analysis of students' personal experiences, and individual differences may be revealed through this process.

Based on this part, our suggestion for future research is to use both qualitative and quantitative data. For instance, future studies can investigate students' situational feelings during courses through pop-up questions, and, in addition, ask similar questions in post-study interviews. In this case, enough information will be collected and, hence, will be compared, offering more precise information on student engagement.

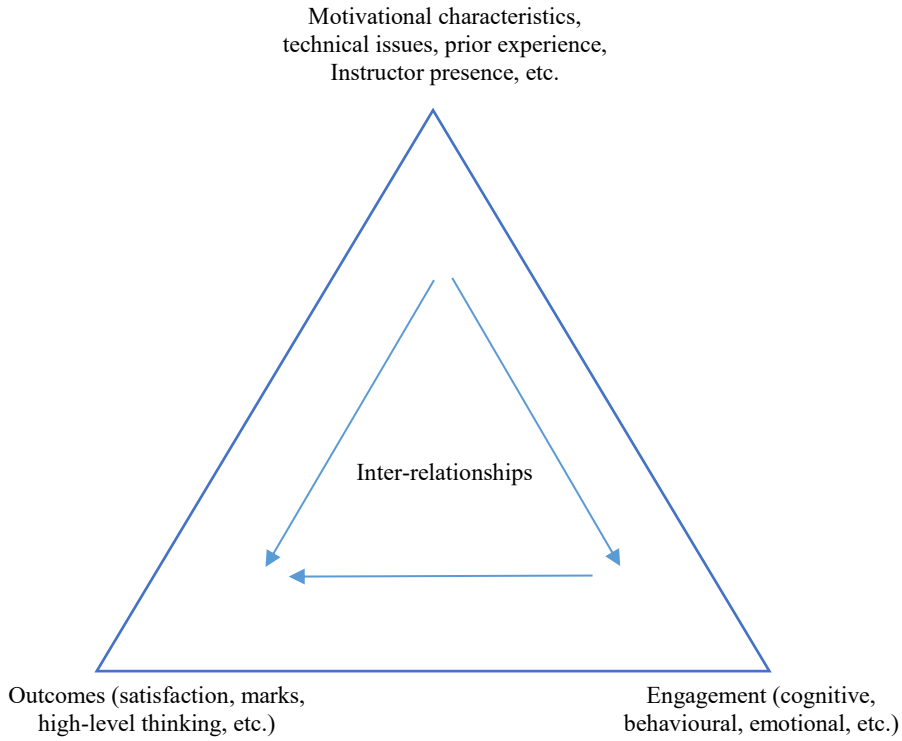

Figure 2. 'The triangle model': common practice in research on online engagement

Models of online learning-engagement antecedents, engagement and related outcomes

According to our theme-extraction process, extant studies on models and relationships among different factors seem to be a popular 'hotspot' among educators and researchers -- more specifically, on antecedents of engagement and achievement. Considering the typical paradigms that most studies have followed, we have drawn up a typical research model of interrelationships of engagement. Since most articles applied a similar approach, we propose it the 'triangle research model on engagement,' as it is demonstrated in Figure 2, current research on online learning engagement tend to investigate the interrelations between preconditions of engagement, engagement and the relevant outcomes.

Richardson and Newby (2006) defined cognitive engagement as students' integration and utilisation of motivations and learning strategies in their courses, which includes aspects such as student persistence, thought organisation and knowledge processing. They explored the relationship between online learners' programme focus, gender and age, and how these were connected with various levels of cognitive engagement. As students gain more and more online learning experience, their strategies tend to diverge and are more likely to be self-regulatory (Richardson & Newby, 2006). A later study demonstrated the impact of learning-task-related technologies on student engagement and even on learning outcomes, but found no significant correlation between institutional or personal characteristics and engagement (Chen et al., 2010). One of the important lessons of these studies is to consider to take students' prior experience (either academic experience or technical readiness) when planning and designing an online learning program. Prior experience and knowledge can provide both course designers and instructors with information on what and how to teach properly in an online environment. In addition, there are interesting findings on the relationships between factors such as interest, self-efficacy and self-regulation, and the three levels of engagement (behavioural, emotional and cognitive) (Sun & Rueda, 2012). For example, situational interest and self-regulation were significantly connected with all three forms of engagement, while computer self-efficacy failed to predict any kind of engagement in online learning.

Some researchers were interested in students' engagement in massive, multiplayer online games (MMOGs), e.g., Eseryel et al (2014) investigated the possible effects of motivational factors on online game-based learning engagement and the impact of that engagement on complex problem-saving abilities. Motivation-related factors such as interest, competence and self-efficacy were found to impact engagement, while aspects such as autonomy and relatedness failed to predict it. *Relatedness* refers to the sense of being cared about and connected to others. Another finding proved the hypothesis that prior problem representation and engagement are strong predictors of post-problem representation skills (Eseryel et al., 2014). Moreover, a similar experiment by Pellas (2014) found a negative correlation between computer self-efficacy, metacognitive self-regulation, self-esteem and behavioural engagement, but a positive correlation between cognitive and emotional engagement. Motivation and other psychological factors are popular topics, but they are not always predictors of engagement.

MOOCs and emerging technologies

Since 2012, the term *massive open online courses* (MOOCs) has become increasingly familiar to the public. Many top universities across the world have started offering quality MOOCs to learners free of charge. The *New York Times* even named 2012 'the year of MOOC' (Pappano, 2012). According to the literature-in-review, most MOOC-engagement studies were initiated in 2015, with themes such as strategies for promoting learning (Hew, 2016; Lu et al., 2017), engaging gamification mechanics and engagement patterns (Chang & Wei, 2016; Phan et al., 2016), and pedagogical affordance and motivational factors (Walji et al., 2016; Barak et al., 2016). Unfortunately, due to space limitation, we only discuss some examples in this section.

Hew (2016) aimed to determine the engaging features of MOOCs by studying three highly rated MOOCs. He asked students what they liked about MOOCs, and they cited: easily accessible instructors; problem-based learning (PBL) features; quality peer interaction and active learning style; and application of useful course resources. These factors further supported the argument proposed by O' Shea et al., (2015), who believed that accessible and supportive instructors were a crucial factor in boosting engagement. Another strategy that has been demonstrated to promote online learning engagement is learning analytics. In a newly published paper, Lu et al. (2017) applied learning analytics as an intervention to students' MOOC learning. Instructors monitored students' activity using a learning-management system (LMS) and provided instant treatment. For instance, they monitored learning difficulties that emerged among students during certain phases of the course, which enabled instructors and TAs to provide instant solutions to specific groups of students based on their feedback. This method resulted in positive and improved learning performance and greater engagement in the intervention group, compared with the non-treatment group. This in-time learning analytics and feedback experiment sheds light on current practices on how to improve MOOC learning efficiency.

Another study by Barak et al. (2016) focused on social engagement and online language learning. This study supported the importance of social interaction, while languages and cultural differences have no connection with motivational factors. It successfully identified five types of MOOC completers, namely problem-solvers, networkers, benefactors, innovation-seekers and complementary learners (Barak et al., 2016). Researchers' passion for identifying patterns extended to games, as some MOOCs are designed with gamification characteristics, e.g., Chang and Wei (2016) explored how gamification mechanics engaged learners by using a mixed method. Virtual goods, redeemable points, team-leader boards, Where's Wally games, and trophies and badges were valued by learners as the most engaging mechanisms, providing course designers with more information on how to design their course content to better engage learners.

While most studies followed common paradigms, such as the relationships between various dimensions, motivational factors, instructors' presence, etc., the pedagogical aspects of online learning rarely are covered. In a recently published MOOC study, Walj et al. (2016) discussed the role of pedagogical affordance and supporting tools in a MOOC, and how they amplify engagement. As

both researchers and learning designers, they consider three pedagogical aspects -- teacher presence, social learning and peer learning -- to be the most crucial factors to keep in mind when designing a MOOC. Their study supports previous work in the field (Kelly et al., 2010; Boyle et al., 2010; Ma et al., 2015; Barak et al., 2016).

We constantly encountered papers discussing the use of technologies in enriching the online learning experience. In this digital era, it seems that learning technology is becoming increasingly more attractive to researchers than the courses themselves. Through analysis, we noticed that even learning-design-related studies are drifting away from the content itself, i.e., people care more about motivations, innovative techniques or presentational forms instead of emphasising the quality of the courses. In fact, we believe that course design and content, and even how the course is introduced and the methods of presentation used, can play an important role in course engagement. Therefore, we call for more in-depth research on online course material, namely, how the course material is introduced and what kinds of presentations are used. Topics such as the relationship between pedagogical features and online learning engagement deserve closer investigation.

Theories in practice and framework

In this section, theories that are popular among researchers will be examined and the interrelationships among various theories also will be discussed. Before the discussion of theories, we first collected all the theories used in the extant literature, then catalogued them into groups based on domains of knowledge. In general, four main categories of theories were singled out, as shown in Table 5.

Generally, motivational theories, 'distance'-related theories, complex integrated frameworks and learning theories are used as frameworks in on-line engagement research. Our aim is not only to discuss theories-in-use generally, but also to explore the differences among similar theories and how they affect research design. Due to space limitations, we won't discuss all of those aforementioned theories.

According to the literature review, self-determination theory (SDT) was frequently mentioned as the theoretical framework for understanding how the learner can be engaged once his or her basic psychological needs are met (e.g., Hew, 2016; Barak et al., 2016; Eseryel et al., 2014; Scogin & Stuessy, 2015). SDT asserts that all students, regardless of gender, age, background, etc., there are three preconditions that support or engage them to do the task or not: the need for competence, the need for relatedness and the need for autonomy (Deci & Ryan, 1985). Researchers used community of inquiry (CoI) theory mainly because they assume engagement happens when there is a 'presence' of teaching, cognition and social interaction (e.g., Shea & Bidjerano, 2009; Paulus et al., 2006). Researchers of online learning consistently have been interested in examining the importance of motivational factors on engagement: Some drew a framework of engagement utilising SDT with either three aspects of engagement or CoI (Hew, 2016; Scogin & Stuessy, 2015), while others applied SDT and self-efficacy to general motivational-measurement questionnaires (Barak et al., 2016; Eseryel et al., 2014). Regardless of paradigms and frameworks, we notice a rising tendency to address students' motivations and psychological needs in online education.

Table 5. Summary of theories applied in extant literature

Catalogue	Theories (example)
Learning Theories	Constructivism; Collaboration; SDL; SRL; Phenomenography
Motivational Theories	SDT; Self-efficacy; Autonomy; Relatedness
'Distance' Theories	Power Distance index; Transactional Distance Theory
Complex Frameworks	Pittaway's engagement framework; Fredricks' three-dimension engagement framework; CoI

Since the introduction of CoI, it has been heavily cited and accepted as one of the classical theories that explains and assesses online learning. CoI posits that learning is a complex process, the result of interaction between three 'presences', namely teaching presence, social presence and cognitive presence (Garrison & Arbaugh, 2007). Shea and Bidjerano (2009) examined several recent theories on educational technology in which they validated an instrument design based on CoI and how elements such as teaching presence, social presence and cognitive presence interact within this framework. Through the lens of CoI, they also examined 'epistemic' engagement, proposed by Larreamendy-Joerns and Leinhardt (2006). This epistemic engagement 'discuss[es] the potential for online learning to reflect processes of participatory practice, with designs that gradually assist learners to develop the language and skills of a disciplinary discourse'.

The three-dimension engagement framework, proposed by Fredricks et al. (2004), is probably by far the most popular such framework. Behavioural engagement is related to previous studies on students' on-task behaviour, emotional engagement is connected with attitude, and cognitive engagement is related to motivation and self-directed learning (SDL). SDL and self-regulated learning (SRL) are sometimes used interchangeably. Loyens et al. (2008) discussed how they overlap and differ: Both SDL and SRL 'involve active engagement and goal-directed behaviour', and both entail 'goal setting and task analysis, implementation of the plan that was constructed, and self-evaluation of the learning process'. In addition, both activate metacognitive skills. However, SDL can be broader than SRL (Loyens et al., 2008). For example, in online learning, SDL may be involved more in deciding what to learn, while SRL is more about self-control (behaviour) and learning pace. Pittaway's engagement framework (2012) provided another possibility for analysing engagement. Intended to explore how students engage in learning, this framework is composed of five elements: personal engagement; academic engagement; intellectual engagement; social engagement; and professional engagement.

In sum, the most commonly cited and applied theories or framework are Fredricks' three-dimension engagement framework; CoI Community of Inquiry (CoI) and Self-directed learning. Those theories either acted as the guideline in research design or as data analysis framework. It is also worth mentioning that flow theory has gained popularity among education study, for instance, in science Inquiry (i.e. Schneider et al., 2016). Moreover, even though various theories and relevant frameworks exist in the literature, it seems that research findings are broadly similar, either from the perspectives of instructor presence and environment design, or based on learners' motivations and outcomes. Suggestions also tend to repeat themselves, e.g., solve any technical problems that students might encounter, support students emotionally, redesign course content, consider students' diversity and promote more interaction. The question remaining for us is: How can we engage students and 'create' new knowledge using innovative studies, new theories or new ways of measuring which engagement really matters? With these questions in mind, we will discuss these possibilities in the final part of this paper.

Methodologies used in engagement research

Distribution of student/sample groups

Most of the papers consider students' engagement at various stages, with a few exceptions being learners from MOOCs. We defined this group as 'general MOOC learners'. Table 6 displays the educational background of samples. Although participants vary widely among studies, from middle school students (e.g., Scogin & Stuessy, 2015) to postgraduates (Wang, 2007; Kahn et al., 2016; Richardson & Newby, 2006; Mello, 2016), most papers focused on undergraduate students (N=18). Moreover, participants from colleges came from diverse fields. Several studies (N=4) considered postgraduates, either because of the context or objective of courses. Interestingly, five studies used samples from both undergraduates and postgraduates (e.g., McBrien et al., 2009; Pellas, 2014).

Table 6. Sample used in studies: education level

Sample type	Number of articles
Middle/high school students	3
Undergraduates	18
postgraduates	4
Undergraduates/postgraduates	5
MOOC learners	7
Other	3

Table 7. Research contributions by country

Geological distribution	Number of articles	Age %
United States	15	37.5
United Kingdom	4	10
Australia	4	10
Greece	3	7.5
Others	7	17.5
N/A	7	17.5

One study recruited both graduates and postgraduates to compare both groups on aspects such as computer self-efficacy and metacognitive self-regulation, and how these qualities influenced student engagement in online, game-based learning (Pellas, 2014). Graduates were labelled novices, while post-graduates were treated as experts in the factors mentioned above. The sample of MOOC-related studies (N=7) was diverse, as MOOCs are open to the public. However, one study (Ma et al., 2015) sampled courses instead of learners to investigate how the presence of an instructor affects students' learning activities. The rest of the articles identified covered participants from middle or high school (N=3), and adult and pre-service teachers as students (N=2), a group not normally seen among researchers.

Research context

Table 7 illustrates country distributions of the study. Even though most studies were conducted in the U.S. (N=15), UK (N=4) and Australia (N=4), we did see a broad range of contributions from almost all over the world -- Greece in particular, which stood out from European countries with three studies in student online engagement. Among them, Pellas et al. from Aegean University in Greece were the main contributors in studies related to gamification. The other contributors included researchers from mainland China and Taiwan (N=2), Canada, South Africa, Hungary, Austria and Israel (N=5). Even though English-speaking countries contributed the most publications on online learning engagement (57.5%), we believe that several high-quality studies were published in other languages, but due to our exception criteria, they could not be used.

Number and gender in relation to sample

Next, we summarise the sample size and gender distribution among our cases based on methods. For all the quantitative investigations, sample number varied dramatically, from as low as 67 (Mello, 2016) to as high as 17,771 (Chen et al., 2010). In quantitative studies, researchers' suggestions also varied. For example, with factor analysis, Hair et al. (2010) recommend a sample of at least 100, while Tabachnick and Fidell (2007, p. 613) believe that a sample higher than 300 is 'comfortable'. For those applying structural equation modelling (SEM), a ratio of 10 responses per free parameter is required to obtain trustworthy estimates, according to Bentler and Chou (1987). Flynn and Pearcy (2001) also proposed a rule of thumb of 10 per item in scale development. Due to the 'massive' number of

participants, studies on MOOCs tend to have large samples. For example, Chang and Wei (2016) investigated 2,583 females and 2,437 males to explore the gamification mechanics in MOOCs and how they engaged students in playful learning. There was one exception: Lu et al. (2017) used learning analytics to detect engagement situations to find solutions for better performance. With a focused interest in typical techniques and groups, the sample only represents 122 cases, still enough for quantitative research.

Six cases have sample sizes less than 30. They used either qualitative or mixed methods (e.g., Paulus et al., 2006; Conrad, 2002). For qualitative studies, Glaser and Strauss (1967) proposed the concept of saturation, which refers to the relatively stable condition of results even after adding more participants to the study. Even though researchers' suggestions varied, for most qualitative investigations, 30-50 seems perfect (Morse, 1994). One exception is phenomenological studies, as Morse (1994) suggested at least six samples, while Creswell (1998) believe five to 25 should be enough. Qualitative sample size may be determined best by time allotted, resources available and study objectives. In our survey, eight studies had sample sizes between 30 and 80, while most studies (N=24) investigated more than 100 cases or participants. Among these, studies on MOOCs tended to have more than 500 participants (e.g., Phan et al., 2016; Chang & Wei, 2016).

Methodologies applied in research

In our literature, as Table 8 indicates, more than half (55%) of the overall studies applied quantitative approach, while the rest adopted mixed methods and qualitative methods, representing nine (22%) and eight (20%) of the selected studies. One study did not clearly report the method applied (Czerkawski & Lyman, 2016). Obviously, quantitative approaches have dominated online engagement-research methods.

For articles adopting quantitative methods, the most common practices in data collection were the survey questionnaire or a combination of online learning log data and a questionnaire. Even though the former approach always dominated (N=17), the latter was favoured both among MOOC-related studies (e.g., Phan et al., 2016) and game-based online learning (Eseryel et al., 2014). Log data have the potential to provide detailed data on students' course activity and performance, and also are regarded as an important source for learning analytics (e.g., Ma et al., 2015). For qualitative approaches, mainstream methods such as interviews (N=7) frequently were adopted, while sometimes, this was supported by online learning-log data. Mixed methods enabled more freedom in choosing multiple survey methods—these could be either log data plus a questionnaire (N=5) or a questionnaire plus an interview (N=3), or even the integration of interview, questionnaire and log data (e.g., Walji et al., 2016). Studies using mixed methods tended to apply quantitative data to first-step investigation, then utilise a qualitative approach (e.g., content analysis or video analysis) for deep reasoning and understanding. Due to the flexibility of online learning and the complexity of learners online, there is no doubt that mixed approaches will receive more and more attention in the context of online learning research.

Table 8. Methods used in literature

Methodology	Total (N)	Ways of collecting data	Count (N)
Quantitative	22	Questionnaire	17
		Questionnaire + log data	5
Qualitative	9	Interview	7
		Log data + interview	2
Mixed methods	8	Log data + questionnaire	4
		Interview + questionnaire	3
		Other	1
Unknown	1	N/A	1

To sum up, we found that in all the articles selected, female samples tend to outnumber male samples, regardless of research context/subjects. Moreover, studies on MOOCs tended to have much larger sample sizes than the rest. Undergraduate students (N=18) were the most popular sample among online learning-engagement studies, which is consistent with the current situation of almost every university offering online courses to undergraduates. In addition, most of the research took place in the U.S., UK and Australia (23 articles overall), while the rest were scattered around Europe and Southeast Asia. In addition, more than half the studies adopted a quantitative approach instead of qualitative methods. However, the trend seems to be that mixed methods are becoming more and more popular.

Conclusions

This study reviewed 40 academic articles in online learning engagement from perspectives such as phenomena, theories, methods, we found that research interest focused mainly on course design and the learning environment, instructor presence and learning experience, models and interrelationships between preconditions, engagement and outcomes, and MOOCs and MOOC-related technologies. We also learned that how researchers' definitions of engagement guided their choices of methodology and theory. In addition, with mixed-methods research drawing increasing attention recently, quantitative methods are still the mainstream methodology. As predicted, the development of MOOCs boosted the advancement of research using innovative learning technologies, e.g., applying learning analytics and web scraping to educational big data. Even though various theories and relevant frameworks exist in the literature, it seems that research findings are repeating themselves, either from the perspectives of instructor presence and environment design, or based on learners' motivations and performance, etc. The truth is, many theories, or experiments that have been applied or conducted in traditional classrooms, need to be adjusted to fit the online learning environment. Also, there is not enough interdisciplinary-cooperation efforts in the articles we collected. Online learning-engagement research should extend its focus and cooperate more with other disciplines, e.g., computer science, brain science, psychology and sociology. Based on the findings, we suggest new methods and directions for future online learning-engagement study.

Generally, researchers of online learning engagement are concerned more about factors of engagement rather than how and what this engagement will elicit. However, we believe, from the perspective of holistic development, that it is important to know the 'chain reaction' from engagement. This chain reaction can go beyond learning achievement, likely building confidence and stronger self-concept, more willingness to participate in online learning in the future, etc.

Research trends

Recently, using learning analytics in online learning has been one of the favoured methods for understanding engagement, especially among MOOC researchers, educators and data scientists alike. Learning analytics, in a general sense, means the use of learner-produced data and analysis models to explore the patterns and social connections of people's learning activities, to predict and advise on learning (Siemens, 2010). Driven by big data and online learning, learning analytics has been a recent trend in online learning engagement study. In our literature, for example, Lu et al. (2017) applied learning analytics as an intervention to support learning in MOOCs.

Eye-tracking techniques offer new possibilities for scrutinising online learning engagement as well. Previously, studies utilising eye tracking focused mainly on online search activities (Lorigo et al., 2008; Granka et al., 2004) and reading and linguistics complexity (e.g., Gordon et al., 2006), then research interest spread to fields such as computer games (e.g., Alkan & Cagiltay, 2007), online consumer experience (Wook Chae & Chang Lee, 2013), multimedia learning (e.g., Van Gog & Scheiter, 2010) and online cognitive load (Wang et al., 2014), among other aspects. Recently, we have seen the potential for measuring online learning engagement using eye-tracking devices. So-called heat maps, i.e.,

visualisations of scan paths, can predict how students will engage with online materials and interact with platforms. We believe eye-tracking techniques will yield additional perspectives and information on understanding students' website-browsing habits, video-watching patterns and attention focus. However, it would be better to combine eye-tracking techniques with other methods, e.g., interviews and questionnaires. As Lorigo et al. (2008) have suggested: "One of the challenges in better interpreting ocular indices is effectively integrating eye tracking with other methods, especially methods traditionally deployed".

Future research

Building on the aforementioned analysis of common practices and new trends in online-learning research, we hereby suggest that future research into online learning engagement: 1. Take the impact of new learning technologies seriously, e.g., learn about analytics and holographic pictures, and research how to utilise them to make the online learning environment more user-friendly and engaging; 2. think about engagement of online learning consistently, i.e., look at antecedents, engagement and outcomes of engagement in a dynamic way; 3. launch more in-depth investigations into students' cognitive and behavioural engagement online using learning analytic or eye-tracking devices; and 4. qualitative methods are good, but not enough. For example, researchers also can collect qualitative data: apply interviews at the end of course and open or semi-open questions in the course, learning logs also serves as important data for engagement research. Better to combine both quantitative and qualitative methods. 5. Study into the result of *engagement* (both positive and passive aspects) from the perspective of holistic development. 6. Link engagement theory or framework with the implementation of online leaning. For instance, when basing engagement study on SDT, should explain how students' feeling of autonomy and relatedness have been supported. For example, through allowing free choices and enabling students to collaboration or chat discussion. In addition, understand how the students' feeling of competence is supported through versatile formative assessment methods.

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Appendix A. Educational level/context coding

Abbreviation	Full names of learners
ML	General MOOC leaners
MS	Middle school students
HS	High school students
UG	Undergraduate students
PG	Postgraduate students
AL	Adult learners
TS	Teachers as students
US	United States of American
UK	United Kingdom
CN	China
GR	Greece
TW	Taiwan
ZA	South African
AU	Australia
HU	Hungary
CA	Canada
IL	Israel
KR	South Korea

Appendix B. Theory-in-use coding

Theory Abbreviation	Full names of theory
PDI	Power distance index
SRL	Self-regulation learning
SDT	Self-determination theory
CoI	Community of inquiry
SET	Self-efficacy theory
PEF	Pittaway's (2012) engagement framework
SCT	Bandura's (1986, 1997) social cognitive theory
SDL	Self-directed learning
SL	Situated learning
NSSE	National Survey of Student Engagement
FEF	Fredicks et al. (2004) engagement framewprk
TDT	Transactional distance theory
AMA	Archer's model of agency

Appendix C. Journal abbreviation coding

Journal Abbreviation	Full names of Journals
BJET	British Journal of Educational Science
ETR&D	Educational Technology Research and Development
Comput Human Behav	Computers in Human Behaviour
AJDE	American Journal of Distance Education
JECR	Journal of Educational Computing Research
ILE	Interactive Learning Environments
IHE	Internet and Higher Education
Assess Eval High Educ	Assessment & Evaluation in Higher Education
JCAL	Journal of Computer Assisted Learning
IRRODL	International Review of Research in Open and Distance Learning
J Educ Techno Soc	Journal of Educational Technology & Society
Educ Inf Technol	Education and Information Technologies
J Educ Bus	Journal of Education for Business
Sci Educ	Science education
RLT	Research in Learning Technology
AJTE	Australian Journal of Teacher Education
JCHE	The Journal of Continuing Higher Education
JoSoTL	Journal of the Scholarship of Teaching and Learning
Comput Educ	Computer & Education
CALL	Computer Assisted Language Learning
J Comput High Educ	Journal of Computing in Higher Education
Distance Educ	Distance Education

*NM indicates not mentioned. N/A indicates not applicable.

To cite this article: Yang, D., Lavonen, M. J., & Niemi, H. (2018). Online learning engagement: Factors and results-evidence from literature. *Themes in eLearning*, 11(1), 1-22.

URL: http://earthlab.uoi.gr/tel