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How do learning technologies impact on undergraduates' emotional and cognitive engagement with their learning?

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Abstract:

A common theme in the literature on learning technologies is the way in which they can facilitate engagement both within and outside of the classroom. However, a lack of a scholarly consensus on what constitutes engagement renders problematic the issue of how one makes meaningful sense of the data presented in studies. This paper presents an integrative review that explores student engagement with learning technologies, with that identifies major themes and trends within the field. When viewed against the evidence-based claims of individual studies, common ubiquitous narratives concerning learning technologies are rendered problematised. The paper concludes with suggestions for future research in this area in the light of its findings.

Keywords: student engagement; emotional engagement; cognitive engagement; digital education; learning technologies;

Introduction

The increased use of learning technologies to support student education – not least in response to the delivery of teaching during the Covid-19 pandemic – has brought with it the potential to rethink, sometimes radically, traditional pedagogy (see e.g. Sharpe and Beetham 2013). Such implementation is neither ideologically neutral (Hayes, 2017; Selwyn 2014; Veletsianos and Moe, 2017) nor, given the continual emergence of new technologies and their inevitable early adoption amongst educators, necessarily employed in a consistent manner within and across modules, programmes, and institutions. The diversity of teaching and learning situations in which learning technology might be used (see, for instance, Bowen 2012), coupled with the heterogeneous nature of the tools themselves, can also have a bearing on how we understand the impact of technology within education.

One major benefit identified with learning technologies is the way in which they can facilitate engagement both within and outside of the classroom (Bauer and Haynie, 2017; Brame 2013; Brown 2013; Gilboy et al 2015). Engagement as a concept has become

increasingly prominent in both the research literature (Reschly and Christenson 2012; Kuh 2009) and for professional bodies (Thomas 2012); the mooted benefits of independent study over class contact time (Havergal 2016) bring with it the potential – both positive and negative – for engagement to become a metric for evaluation of programmes (see, e.g. UK Office for Students, 2018). As a result, multiple new surveys have sprung up (such as the UK Engagement Survey: see AdvanceHE 2018) in order to measure student engagement.

Nevertheless, the concept of engagement has yet to reach a stable definition (Christenson et al 2012). Whilst the literature appears to be coalescing around the notion of engagement as a multi-dimensional metaconstruct (Fredericks et al 2004), there remains a question of how many dimensions exist, and how one might categorise them (Reschly and Christenson 2012). For instance, is *academic engagement* (time on task, completion of exercises) a sub-category of, or meaningfully distinct from, *behavioural engagement* (attendance, extracurricular activity) (Appleton et al 2008)? Is there a benefit to teasing out the nuances that distinguish *affective engagement* (a sense of belonging, identification; Appleton et al 2006) and *emotional engagement* (enthusiasm, interest, enjoyment etc.; Skinner et al 2008, 2009)? Although *cognitive engagement* (strategies for learning, self-regulation) appears in most typologies of engagement, should it include *agentic engagement* (the sense of students actively taking a lead in the learning situation, rather than being passive recipients; Reeve 2012)? Also, is motivation distinct from engagement, or can it be subsumed within it (see Martin 2007)?

The lack of a scholarly consensus on what constitutes engagement renders problematic the issue of how one makes meaningful sense of the plethora of data garnered by surveys and interventions. Complicating matters further is the absence first of clarity over whether such dimensions of engagement exist on a single continuum (e.g from emotionally

disengaged to emotionally fully engaged) or separate continua, and second, how one measures such engagement. Certain markers, for instance, attendance in class as an index of behavioural engagement, can be readily quantified, but for other types of engagement (notably cognitive and emotional) researchers have to rely primarily on students reporting accurately what they think and feel about studies (Reschly and Christenson 2012). Finally, studies that focus on any measures of engagement ought to acknowledge the crucial role played by context (home, place of study, peers etc.) in affecting levels of engagement (Christenson et al 2012).

It is against this background that studies of student engagement with learning technologies must be situated. The ready availability of learning analytics (podcasts viewed, log-ins to virtual learning environments, etc.) mean that it is very easy to document certain types of behavioural (that is, participatory) aspects of engagement, without necessarily being able to nuance such findings with respect to contextual factors. Less common, but gradually gaining in critical mass, are studies that explore the ways in which digital tools might enhance or inhibit emotional and cognitive engagement (e.g. Selwyn 2016), with the latter fostering a vital critical and reflective counterbalance against ideologically driven arguments for the use of learning technologies in education.

However, the issues that exist in the general literature about student engagement impact on the growing body of work directed at engagement with learning technologies. Put simply, this literature offers a fragmentary and at times contradictory view of the area due to (1) a lack of clarity over the types of engagement that are being discussed; (2) a blurring of distinctions between the related but distinct concepts of engagement, learning, and motivation; (3) a lack of clarity over appropriate measurement tools for the types of engagement being operationalised; and (4) the sheer diversity of learning technologies and

educational purposes to which they are being put making it difficult to compare approaches. In short, for the pedagogue keen to understand better how students engage with learning technologies, there is work to be done in helping them make sense of the field and how they might navigate it critically and reflectively.

To this end, this paper presents an integrative review (Kornhaber et al 2016) that explores student engagement with learning technologies, with a view to identifying major themes and trends within the field. In line with the majority of existing work on engagement, we treat the concept as a tripartite multidimensional construct, consisting of behavioural, emotional, and cognitive dimensions. Our focus is on the latter two, for the difficulty in obtaining data around these areas (in comparison to the wealth of information available through learning analytics) risks occluding them in the field. Moreover, there is evidence to suggest that 'affective and cognitive changes … precede the observable, behavioural changes' (Reschly and Christenson 2012, p. 9), indicating that preliminary surveys of the field should focus on these areas first. For this reason, our focus is on the affective (sense of belonging, identification) rather than pleasurable (enjoyment, enthusiasm) aspects of emotional engagement. Our research questions are thus as follows:

(1) How have studies of emotional (affective) and cognitive engagement with learning technologies for student education been represented in the literature?
(2) What are the contexts (including learning environments) in which such engagement is taking place?
(3) What data gathering measures have been used to help understand this engagement?
(4) What lessons might be learnt from this literature to help us better understand the impact of learning technologies on student engagement?

Materials and Methods

The integrative review process was chosen in order to 'build knowledge and synthesise data from a range of perspectives and research methodologies' (Kornhaber et al 2016, p. 1211; Whittemore and Knafl 2005). It was preferred to more systematic review methodologies due to its capacity for examining a phenomenon from diverse angles, rather than focusing on a single research problem (Whittemore and Knafl 2005); doing so offers the opportunity to generate new thinking about a topic. Following Kornhaber et al (2016), this review was guided by the framework advanced by Whittemore and Knafl (2005), which is based on five stages: problem identification, literature search, data evaluation, data analysis and presentation.

Literature Search

The electronic databases Scopus, PubMed, Web of Knowledge and Educational Resources Information Center (ERIC) were searched systematically to find studies for inclusion. The search used was 'engagement AND digital AND undergraduate'.

Inclusion Criteria

For inclusion criteria, a manuscript had to be available and meet the following conditions: a) be available in English; b) be original, peer-reviewed primary research; c) consider the context of tertiary/higher education; d) include discussions of undergraduate students; e) refer to student engagement. These criteria excluded texts such as reviews and conference papers; monographs were also excluded where they could not demonstrate peer review.

Data Evaluation

The initial database search identified 256 papers (see Figure 1 for an overview of the review process); after duplicates were removed, 213 papers remained. The titles and abstracts of each of these papers were allocated to two of the current authors for independent appraisal in the light of the inclusion criteria. Although papers were assigned at random, the overall distribution of the allocation ensured that authors reviewed the same number of papers with each of the other co-authors. At the end of this stage, there were 71 papers over which the pairs of authors disagreed whether the title and abstract met the inclusion criteria; this prompted a further round in which these papers were assigned a third reader (again at random, but to ensure an even distribution of assignments across the sample as a whole). In the end, 161 of the 213 papers were excluded at this stage of the process.

<INSERT FIGURE 1 NEAR HERE>

The remaining 52 papers were then assigned randomly to two of the authors (again ensuring an even distribution of authorial pairs) for further review. During this stage of the process, authors read through their allocated papers to determine whether the paper did indeed meet the inclusion criteria, and, in particular, whether the nature of engagement described (implicitly or explicitly) was emotional and/or cognitive. During this stage, authors disagreed over the inclusion of 12 of the papers, and a third author was again assigned to arbitrate. At this level of scrutiny, a further 30 papers were felt not to meet the inclusion criteria, leaving 22 papers for the integrative review.

Data Extraction and Synthesis

In order to investigate the data in these remaining papers, thematic analysis, a flexible research tool providing a rich and detailed account of data (Braun and Clarke, 2006), was employed. Thematic analysis also allows researchers to interpret various aspects of the

research topic (Boyatzis, 1998). Four of the 22 papers were selected at random to be analysed by all of the authors as a quasi-pilot. The authors discussed their preliminary codings of the data, not with the intention of pre-determining eventual themes, but rather to calibrate and coordinate approaches to ensure consistency across the sample. Once the authors were satisfied that a shared approach was in place, the remaining papers were divided up so that all papers were coded by two authors, with an equal distribution of pairs of authors across the sample.

In addition to the coding as part of the thematic analysis, the learning contexts for the use of technology described in each paper as well as the methodologies employed in understanding student engagement were recorded (research questions 2 and 3). For this, all authors completed a checklist for each paper (based on a model from Armellini 2018; see Table 1) to capture modes of teaching delivery and (in the penultimate row of Table 1) collection methods for engagement data. Once all the papers had been coded and checklists compiled, the authors discussed their codings and diagnosed emerging themes from the data.

<INSERT TABLE 1 NEAR HERE>

Results

The 22 articles analysed in this review were published between 2007 and 2019, with over half published in the last 4 years (see Table 2). The institutional contexts (research question 2) revealed by the articles are thus: the studies in question were conducted in 12 different countries, mostly from North America (41%), Europe (27%), Australasia (18%), but also Chile, Hong Kong, Taiwan and Palestine. Seven of the 22 papers relate to case studies in STEM subjects. A further five papers focus on the social sciences, and three come from Education studies. The remaining seven papers explore topics across multiple disciplinary

areas, sometimes across multiple universities. There were no case studies drawn exclusively from the Arts and Humanities.

The degree to which student engagement was treated rigorously as a theoretical construct (research question 1) varied considerably according to the nature of the individual study, though given the criteria for inclusion in the integrative review it was not surprising to find (as part of research question 3) a qualitative component in data collection in 73% of the studies (11 involved mixed methods; 5 purely qualitative methods; see columns 3 and 4 of Table 2). Collectively, the studies explored the application of a diverse application of learning technologies (research question 4), albeit in a predominantly blended capacity (compare Figure 2 with Table 1) and measured different dimensions of engagement – a heterogeneity in keeping with the diversity found in the original sample of 256 papers.

<INSERT TABLE 2 NEAR HERE>
<INSERT FIGURE 2 NEAR HERE>

Key Themes

The data codings were grouped into four major themes: 'ubiquitous narratives' (introductory, and often sweeping, claims about the role of learning technology in education), 'inclusivity and accessibility', 'community building', and 'pedagogies'. Closer analysis of how these themes were represented in the data led to the first two being combined, as the data here were more concerned with institutional contexts (research question 2) rather than specific engagement-related activities. 'Community building' encompassed a range of sub-themes concerning modes of interaction and building emotional (affective) engagement; the sub-themes of 'learning strategies' focussed primarily on issues relating to cognitive engagement. These latter two themes, therefore, directly address research questions 1 and 4.

Institutional Contexts

The ubiquity of technology, and how this plays into notions of digital natives (Prensky 2001), was a frequent rhetorical gambit, and the geographical spread of the papers in question emphasise how this is a global phenomenon (e.g. Gallegos and Nakashima 2018; Harris 2017; Jones and Healing 2010; Mercier and Rata 2017; Shraim 2014; Swinnerton et al 2017; Witecki and Nonnecke 2015; Yang and Chang 2012). From this starting point, learning technologies were presented as beneficial and potentially transformational (Montgomery et al 2015; Vaughan and Clourier 2017), with some authors making links to employability (Harris 2017; Mercier and Rata 2017; Ribeiro 2016; Shraim 2014).

One of the most pervasive benefits identified with learning technologies concerns inclusivity and accessibility. These include the capacity of such technologies to enable diverse groups to interact with material (Mercier and Rata 2017; Swinnerton et al 2017); the complementation (or even replacement) of physical learning environments with virtual spaces (Harris 2017; McGuinness and Fulton 2019; Swinnerton et al 2017; Vaughan and Cloutier 2017); and the possibility of allowing learning to take place at a time convenient for the students (Harris 2017; Montgomery et al 2015; Shraim 2014; Swinnerton et al 2017; Vaughan and Cloutier 2018; Yang and Chang 2012).

Community Building

The use of learning technologies to facilitate interaction between peers and teachers was presented as beneficial, helping to shape both learning communities and discursive practices (Coleman 2018; Harris 2017; Hicks et al 2017; Mercier and Rata 2017; Swinnerton et al 2017; Yang and Chang 2012). In this context, technology is viewed not simply as a unimodal means to develop understanding among individual learners, but rather as a site in which social interaction can lead potentially towards greater (affective) engagement (Harris 2017;

Gallegos and Nakashima 2018; Jones and Healing 2010; Stephens et al 2007; Swinnerton et al 2017; Yang and Chang 2012). Extending the benefits internationally, learning technologies were also offered as enablers for students to make important contributions towards solving global problems in virtual spaces (Jaña et al 2015; McGuinness and Fulton 2019). Global partnerships, through real and virtual learning spaces, were also suggested to increase intercultural understanding (Jaña et al 2015).

Pedagogies

Inevitably, the incorporation of technology into teaching and learning brings with it opportunities for the pedagogue, as well as challenges. However, comparatively few of the papers addressed directly the corresponding need to rethink pedagogy (notable exceptions include Barry 2013; Gallegos and Nakashima, 2018; Johnston et al 2018; Mercier and Rata 2017; Shraim 2014; Swinnerton et al 2017). Indeed, many of the papers under review presented examples of learning technologies simply duplicating elements of existing practice (a concern noted by Vaughan and Cloutier 2017: 1177) without necessarily providing any obviously tangible benefits.

Discussion

For all of the generally positive views of learning technologies outlined above, it was notable that sustained critique of underlying assumptions, and even the findings, was frequently absent in arguments. This is not a new observation: Selwyn (2016: 1007) suggests that the ubiquity of learning technologies (so often treated as a launching point for the articles under review here), and the degree to which they have swiftly become ‘part of the furniture’, has inhibited critical examination. Nor can such an inhibition be attributed to a failure of data

collection (research question 3) – as noted above, the majority of studies gather qualitative data suitable for nuanced, critical understanding of student engagement with learning technologies. This returns us to research questions 1 and 2 (representations of engagement and the contexts in which it occur). To this end, the data leave it unclear whether this lack of criticality is a symptom of an academic environment in which infrastructural expenditure on learning technology requires its uptake, or whether the bulk of the articles here simply reflect the more general dominance of 'issues of improving teaching and learning' within this area (Ibid.). One of the advantages, however, of the integrative literature review approach is that it offers the opportunity of identifying internal contradictions within the literature as a whole – which is to say, the seeds of an informed critical stance towards the literature on learning technologies can be identified and explored, and from there, a move towards a more nuanced understanding of the lessons that can be learned from this literature (research question 4).

Context I: Digital Natives

The data do suggest that most (though not necessarily all) students are familiar with technology and digital resources. However, to describe all students as digital natives (Prensky 2001) is problematic, for it glosses over contradictions and tensions within this grouping. Whilst most students possess suitable devices for accessing learning technologies, it is clear that not all of them choose to use them for educational purposes (Witecki and Nonnecke, 2015). The unequal distribution of competencies with digital platforms also tends to be underplayed in the literature: there exists a great deal of variance within student bodies (Ryan 2013), and familiarity with one platform does not necessarily lead to cognitive skills (i.e. cognitive engagement) that can be readily transferred by all students to another environment (see Gallegos and Nakashima 2018: 172; Harris 2017; and Lu and Churchill 2014: 413). As one might expect, unfamiliarity with the technology (especially when teaching staff assume prior competence on the

basis of notions of digital natives) can have a negative impact on student engagement (Ryan 2013; Selwyn 2016). The ways in which students perceive particular environments as more-or-less suitable for pedagogic versus social usage (and the perceived encroachment of one into the other) is also a factor in terms of engagement (Sharim 2014).

For all that issues around inclusivity drive arguments in favour of learning technologies, the data suggest that diversity across cohorts is still not fully understood. In this respect, it is salutary to note that different genders appear to adopt different cognitive strategies when engaging with learning technologies (Stephens et al 2007: 235; Swinnerton et al 2010: 61, 64; Witecki and Nonnecke 2015: 77). Nor is there clarity across the data in understanding how students employ learning technologies in unstructured contexts (e.g. laptops in lectures: see Witecki and Nonnecke 2015); see also 'Impact on Engagement: Pedagogical Design', below. The benefits to students being able to access materials at any time is frequently noted, as is the preference of students to prefer devices and platforms that minimise time lag in accessing data or social interactions (Harris 2017; Jones and Healing 2010; Witecki and Nonnecke 2015). The consequences of this on the wellbeing of students – the erosion of boundaries between time allocated to work and leisure – is not on the whole represented in the literature. The same is true for the detrimental effect on health of working from screens for elongated periods of time (Selwyn 2016: 1012–1013).

Context II: Technologically mediated interactions

The fostering of authentic social collaborations (and with it the potential to enhance affective engagement) through the use of learning technologies was weakly represented in the data. Whilst increased use of social media can facilitate dialogue between peers and teachers (Harris 2017; Yang and Chang 2012), questions remained over the superficiality of such

technologically mediated interactions and the implications this has for the emergence of communities of practice. Whilst online learning technologies led to positive attitudes (emotional engagement), and peer interaction was deemed valuable for enhancing engagement, students tend not to value peer comments (Hicks et al 2017), leading often to a reluctance to contribute to online discussions (Shriam 2014; Stephens et al 2007). This lack of meaningful interaction with peers online was one of the barriers to developing collaborative communities of online learners, and with it the opportunity to enhance affective engagement, with most students preferring face-to-face learning (Harris 2017; Lu and Churchill 2014; Mercier and Rata 2017; Montgomery et al 2015).

There is a distinction between the ways that staff and students approach learning spaces, and there is a tendency for educators to take advantage of and colonize students' online social spaces (Shraim 2014). Yet studies have indicated that as social media is not typically associated with a learning environment for students, encroachments into such territories can lead to an uncomfortable blurring of boundaries between personal and academic spaces, and a confusion of what constitutes appropriate conduct (Harris 2017; Johnston et al 2018; Lu and Churchill 2014; Selwyn 2016; Witecki and Nonnecke 2015).

Impact on Engagement: Pedagogical Design

The need to articulate more clearly the differentiation between, and desired use of, potential learning spaces is one of a number of pedagogical strategies in the literature that can broadly be grouped together in terms of 'scaffolding'. It is rarely the case that a particular platform or device can be said to have an impact on student engagement, but rather it is how it is introduced and employed (Hicks 2017; McGuinness and Fulton 2019). Just as in classroom teaching, student engagement with technology is constrained by lack of scaffolding of work (Ribeiro 2016). Unstructured use of technology can lead to disengagement (Gallegos and Nakashima

2017; Johnston et al 2018; Lu and Churchill 2014; Ryan 2013). Both cognitive and emotional engagement is enhanced, however, when learning is scaffolded (Gallegos and Nakashima 2017; Lu and Churchill 2014; Ribeiro 2016; Selwyn 2016; Witecki and Nonnecke 2015). In particular, when students are provided with parameters for the structured pedagogical use of learning technology, they are more likely to gain from its use and – crucially – develop relevant cognitive strategies (Gallegos and Nakashima 2017; McGuinness and Fulton 2019; Swinnerton et al 2017).

Scaffolding alone is insufficient if positive engagement with learning technologies is to be maximized. As noted above, technology can often be simply added to teaching and learning without consideration of its wider implications, less still the benefits of redesigning teaching so that the various components of the teaching design (e.g. face-to-face and online elements) are complementary and interdependent (Montgomery et al 2015; Vaughan and Cloutier 2017). As students' emotional responses are closely linked to the perceived value of the tasks they are set (Ryan 2013; Staines and Lauchs 2013), it is important that learning technologies are integrated meaningfully into the learning design. For all of the pressures to adopt technology within teaching (see 'institutional contexts', above), it seems an obvious but rarely stated point that course design rather than technological innovation should be the main driver for change (Lu and Churchill 2014; McGuinness and Fulton 2019; Ribeiro 2016; Shraim 2014) .

If learning technologies are to be rolled out across institutions, hidden staff costs, such as those associated with eg. ensuring effective course design, must therefore be taken into account. In addition to the purchase and maintenance of such technologies, there are indirect costs associated with developing teaching staff so that an environment in which engagement through learning technologies can be cultivated (Montgomery et al 2015). Staff digital literacies and competencies need to be developed hand-in-hand with awareness of blended and

on-line pedagogies (Johnston et al 2018; Shraim 2014), as it can be stressful for staff to facilitate technology-based teaching without the necessary level of training or qualifications (Gallegos and Nakashima 2017; Montgomery et al 2015; Shraim 2014).

Conclusion

Research for this article was conducted in 2019 and early 2020; governmental and academic measures in the light of the Covid-19 pandemic in Western Europe were just coming into force as the article was being readied for submission. Over the course of 2020, there has been a wave of publications addressing the immediate impact of the pandemic on teaching delivery, and, increasingly, calls for thinking about engagement with learning technologies in the mid- to longer-term (for instance, Tesar 2020; Whelehan 2020). Such rapid-response publications indicate the urgency and timeliness of reflecting critically on what we understand by student engagement with learning technologies, how we recognise it in all of its facets, how we enhance it in our pedagogical designs, and how we measure its efficacy.

To this end, an integrative review exploring only a narrowly defined subset of the literature is always going to be limited by its inclusion criteria. The skewing of the dataset towards first-world, non-Arts and Humanities, and blended learning contexts flattens out regional, disciplinary and pedagogical differences that might be more apparent in a larger sample (research question 2). Similarly, an often under-theorised concept of student engagement led many studies in the review towards notions of engagement that privileged the behavioural (research question 1). Even when other dimensions of student engagement were represented directly, one must remain mindful of the issue of accuracy of self-reporting (Stephens et al 2007: 240). Nevertheless, the preference in the studies towards qualitative rather than quantitative data collection methods (research question 3) provided the present paper's authors with the possibility of adopting inferential reading strategies in order to

understand the corresponding emotional and cognitive engagement of students.

On the other hand, our purpose is not to critique individual papers for what they do not set out to do: not all of the studies that met our inclusion criteria sought to balance accounts of learning technology with student engagement, and many focused more on one of these aspects than the other. An impoverished conception of student engagement as a construct in one paper need not necessarily compromise that particular paper. However, when considered at the level of the dataset, the lack of consensus of what student engagement is (research question 1), and how it might be measured (research question 3), does emerge as a weakness in the field if one is to draw meaningful conclusions about the widespread impact of learning technologies on the undergraduate experience (research question 4).

What does emerge, however, from this sample, is that certain ubiquitous narratives concerning learning technology are problematised when set against the evidence-based claims of individual studies. Clearly, however, learning technologies have the capacity to impact both positively and negatively on student engagement in all its dimensions. Going further, some provisional lessons from the literature, and calls for future study, can be offered in response to the research questions posed in this paper.

First, student engagement remains an under theorized and inconsistently employed concept within studies of learning technologies, too often associated with behaviour at the expense of other dimensions of engagement. The growing usage of learning analytics within Higher Education brings with it the potential to better understand when, and with what frequency, students might interact learning technologies, but without a richer understanding of the nature of that interaction, the data are partial and potentially misleading. In this light, it is instructive to note that the multiple references to engagement in an article such as Nguyen et al (2020) is exclusively behavioural, although the opacity with which engagement as a term is used would obscure this for the unwary or uncritical reader. Further research is

required to understand better the dimensions of student engagement, and strategies adopted for sharing this understanding with teaching staff.

Second, and following on from the institutional adoption of systems to measure engagement, when considering the contexts and learning environments in which student engagement is taking place, studies of learning technologies too often assume homogeneity within cohorts and a willingness to access materials at any time. The data point instead to the idea that digital natives are in fact a heterogeneous grouping of students with different competencies and cognitive strategies. The challenge, when focusing on improving learning, teaching and engagement, is how one is to recognise and adapt to competencies and strategies within a given cohort, and to ensure healthy working practices. Because this will vary due to many factors, such as (but not limited to) availability of resources, social context, level of study, and training within a programme, one must be wary of assuming that benefits observed in one study will be replicable elsewhere. In an increasingly global higher education environment, the impact of local and regional contexts on the nature of student engagement must not be neglected. Further work is needed to understand how one might translate the benefits of existing studies into individual practices, but also how one might best negotiate the challenges of a heterogeneous global student body.

Third, for such nuanced studies to be meaningful, one requires not just a clearer understanding of what engagement is and how this relates to context, but also a method for measuring it in a blended- or online-learning context beyond simple markers of behavioural engagement. Doing so would allow claims for the efficacy of learning technologies to be more robust and evidence-driven, and sensitive to the diverse requirements of the student community.

Finally, the data demonstrate that there is a need for use of learning technology to be scaffolded at all levels to maximise cognitive engagement. Given the heterogeneity of digital

competencies and cognitive strategies contained in the student cohort, it is not enough to assume that students will be familiar with the technologies and platforms, or understand how to use them constructively in unstructured sessions. In short, if learning technologies are to be incorporated effectively into teaching, students must be supported appropriately in their use, and staff in their approach to course design.

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Declaration of Interest Statement

No potential conflict of interest was reported by the authors.

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Tables

Table 1. Checklist to determine learning context/study methodology

	100%	Mixed	100%	
Face-to-face				Online
Online teaching				independent learning
Individual				Group based
Online synchronous work				Online asynchronous work
Purely academic				Employablity focused
Campus based				Mobile based
Few or no placements				Intensive placement
Tutor assessed				Peer assessed
How has data been collected / engagement assessed?				
Qualitative comments:				

Table 2. Overview of student engagement studies included in this review

Authors, year and country	Purpose	Data Collection	Methods of analysis	Sample and study population	Significant finding/s and outcomes
Buzzetto-More (2012) (USA)	To explore the impact of social networking systems on students' cognitive and emotional engagement	Survey[1] and students self-reporting	Content analysis and statistics	186 students in Business course (Management)	Social networking services foster social learning while engaging students in a complex array of communicative and creative endeavours.
Coleman (2018) (USA)	To determine how to best optimize a co-curricular digital badging system for maximum student engagement	Survey and focus group discussions	Statistics and content analysis	30 students (Interdisciplinary projects)	Co-curricular digital badging allows for a variety of motivations and opportunities for cognitive and emotional engagement.
Gallegos (2018) (USA)	To explore the innovative use of mobile devices	Survey	Content analysis	58 students enrolled in a nursing research class (Nursing)	Using the mobile technology of iPads enhanced students' cognitive engagement, including minimizing off-task activities, greater interpersonal interaction, and problem solving.
Harris (2017) (Australia-India)	To investigate the impact of virtual communication and online tools on student engagement	Interviews and focus group discussions	Content analysis	15 students; six from India, nine from Australia (International Communication)	Virtual communication tools facilitate activities which strengthen both cognitive and emotional engagement by enabling critical thinking skills and global citizenship.
Hicks et al (2017) (USA)	To evaluate how blogging interventions affect students' learning and engagement	Survey	Statistics	18 students (Engineering)	Students reported increased emotional and cognitive engagement; blogging enhanced collaboration, and information exchange.
Jaña et al (2015) (Chile)	To examine how projections of the instructor's digitally handwritten annotations helped	Survey, opinion, teacher observation and students' final grades.	Statistics and open-ended responses assessed	137 students and their teachers (Chemistry)	Teacher perceptions suggested cognitive engagement was strengthened and that students were

[1] We are using the "survey" as a unifying term to encompass both questionnaires and survey, without distinguishing the nature of the survey or how they are distributed.

	students' cognitive engagement in class		qualitatively		more attentive and engaged during taught sessions.
Jones et al (2010) (UK)	To examine the significance of place and location on cognitive and emotional engagement when using mobile technologies	Survey and interviews	Statistics and content analysis	First year undergraduate students and staff across faculties (interdisciplinary) in five UK universities	Students continue to use the kinds of learning spaces they used 10 years ago, although they use mobile technology in all aspects of their life and leisure.
Johnston et al (2018) (Australia)	To develop YouTube resources to increase students' cognitive engagement	From YouTube: Number of subscribers, views and comments. From university: Evaluation surveys	Statistics and thematic analysis	App. 2500 nursing students (Bioscience)	Online resources can support students' cognitive and emotional engagement using evidence-based, pedagogically enhanced videos.
Lu and Churchill (2014) (Hong Kong)	To investigate impact of social networking on cognitive engagement	Content on the social networking platform and interviews	Statistics and thematic analysis	13 first-year undergraduate students on an inter-disciplinary course	Social network analysis showed social but not high levels of cognitive engagement
McGuinness and Fulton (2019) (Ireland)	To develop interactive digital skills e-tutorials and evaluate student engagement	Survey	Statistics and thematic analysis	86 students in the School of Information & Communication Studies	Students enjoyed e-tutorials (cognitive engagement) but preferred blended learning environments with face-face teaching.
Mercier and Rata (2017) (New Zealand)	To explore how digital mapping activities support undergraduate student engagement	Survey	Website evaluation	73 students enrolled on 3 Maori Science courses	Benefits to emotional and cognitive engagement included diversified learning experiences; development of different skill sets; greater sharing of work; and place-based learning.
Montgomery et al (2015) (Canada)	To explore digital challenges of student engagement in blended learning	Field notes, journals, and student surveys	Digital analytics and thematic analysis	3 professors and students from Faculty of Education	Blended learning can be effective for enhancing cognitive engagement. It suggests 4 pedagogic scaffolds(1) designing digital resources, (2) scaffolding student learning, (3) learner customisation, and (4) promoting the lived experience.

Ribeiro (2016) (Portugal)	To develop intercultural awareness through Digital Storytelling (DS)	Survey	Thematic analysis	140 students with an undergraduate degree in Business Communication	Digital Storytelling was a tool to emotionally engage students in a serious and productive debate revolving around technology-enhanced learning and cultural differences.
Ruisoto and Juanes (2019) (Spain)	To illustrate a new digital application for collection of real-time formative assessment data	Survey	An exploratory descriptive study	40 first-year Medicine students and 40 second-year Psychology students	Results support the utility paper-based response cards to foster cognitive engagement and active learning in higher education, even with complex neuroscience.
Ryan (2013) (Ireland)	To investigate if student digital videos could act as a viable reusable peer learning resource	Survey and informal discussions	Thematic analysis and Method of Constant Comparison	43 second year undergraduate biochemistry students	Student-produced videos can be used enhance cognitive engagement and skills development.
Selwyn (2016) (Australia)	Focuses on the negative educational impact digital technology	Survey and open-ended questions	Statistics and content analysis	1658 students from 2 Australian universities enrolled in courses in medicine, business and science.	Digital technologies often lead to diminished cognitive and emotional engagement via distractions, disruptions, and inconveniences that arise.
Shraim (2014) (Palestine)	To investigate how Facebook might facilitate student-centred learning	Survey, postings and classroom observations	Statistics and content analysis	240 undergraduate students (Educational Technology course)	Technological affordances of Facebook enabled students to engage emotionally and cognitively in different learning activities, helping them to construct their own learning through personal engagement, communication and working collaboratively.
Stephens et al (2007) (USA)	To explore student perceptions of academic integrity in terms of conventional and digital cheating	Survey	Statistics	1305 undergraduate students (cross-institutional) from two universities	Students with the lowest emotional engagement used conventional cheating (such as copying or collusion), digital plagiarism or both.
Swinnerton et al (2017) (UK)	To investigate the impact of integrating a massive open	Survey and focus group discussions	Statistics and content analysis	First year medical (MBChB) students	The MOOC led to high levels of cognitive engagement, measured as

	online course (MOOC) on cognitive engagement			and 6 volunteers for a focus group	levels of usage of online resources for consolidation and revision.
Vaughan and Cloutier (2017) (Canada)	To evaluate the effectiveness of a blended program using NSSE	Survey and focus group discussions	Grounded theory and statistics. Comments categorized according to NSSE	Longitudinal study from year 1 and 4 of a single graduating cohort of students from the B.Ed. program	Recommends that digital technologies are used to increase student cognitive and emotional engagement through interaction with faculty and peers.
Witecki and Nonnecke (2015) (Canada)	To explore the relationship between students' course engagement and unstructured use of mobile devices during lectures	Survey and student course engagement questionnaire (SCEQ)	Statistics	972 cross-disciplinary undergraduate students	The use of all mobile devices was negatively correlated with cognitive and emotional engagement, but overall engagement of students was not significantly different to students who did not use mobile devices.
Yang and Chang (2012) (Taiwan)	To explore whether the use of solitary or interactive blogs affect online peer interaction and cognitive engagement.	Survey and students self-reporting	Statistics	154 graduate and undergraduate students (Electronic Commerce and Design of Internet Applications)	Engaging in dialogue in the form of blog comments is associated with positive attitudes towards online peer interaction and academic achievement.

Figures

Figure 1. Flowchart of literature review process (after Kornhaber et al, 2016, p. 1212)

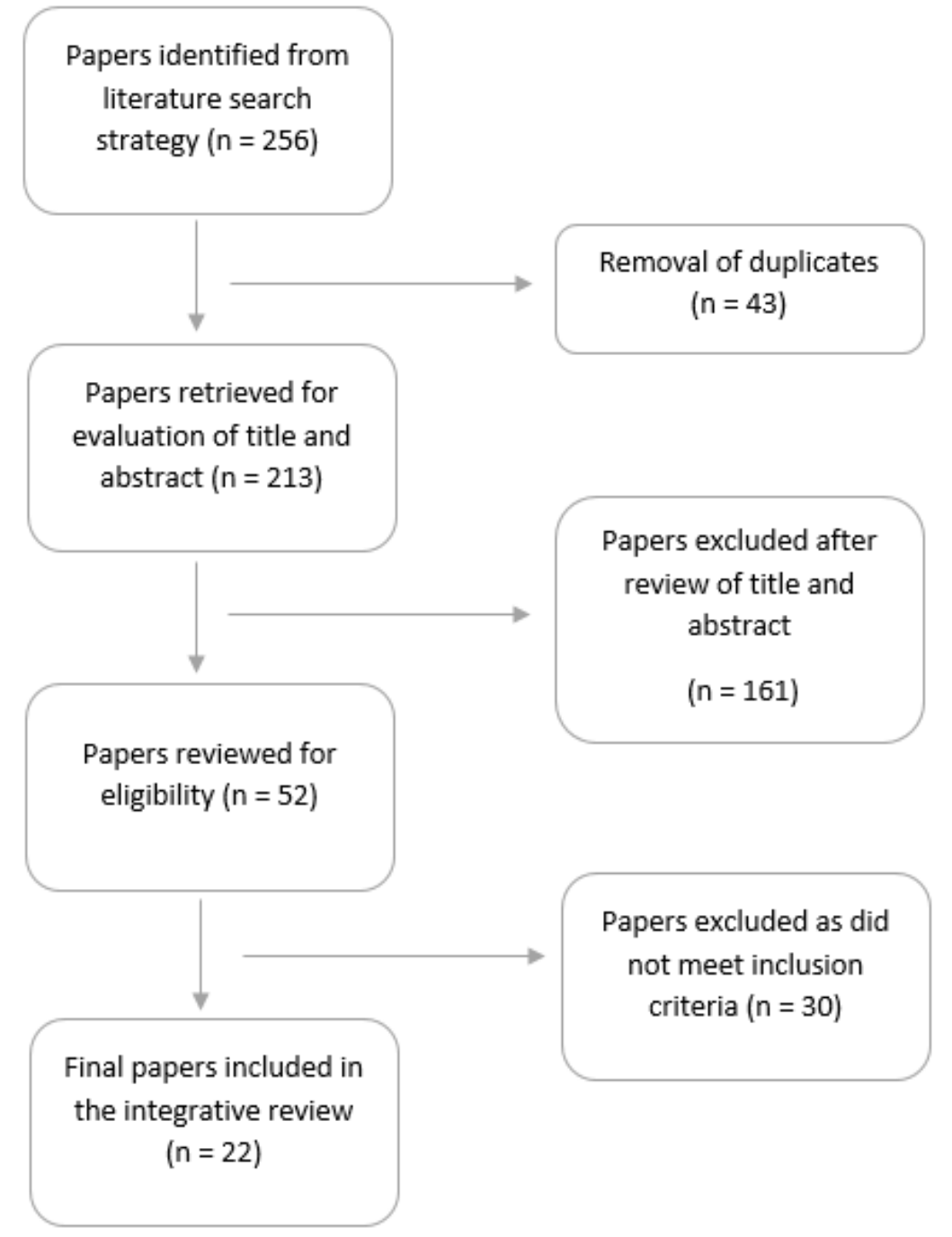

Figure 2. Use of learning technologies