Facilitating student engagement in higher education through educational technology: A narrative systematic review in the field of Education

Abstract

Developing, sustaining and improving student engagement is of vital importance to higher education instructors. Given the link that educational technology has to student engagement, and the need for preservice and in-service teachers to develop information communication and technology (ICT) skills and knowledge in order to apply them in the classroom, as well as to develop ICT skills in students, further investigation of this link in the field of Education is necessary. This narrative systematic review synthesises 42 peer-reviewed articles from across four international databases, published between 2007-2016, and is a subset of a larger systematic review. The results indicate that the majority of research has been undertaken within undergraduate preservice teacher education, predominantly in the US, Hong Kong and UK, with limited attention given to grounding research in theory. This review found educational technology supports student engagement, with behavioural and affective the most prevalent dimensions. *Social networking tools* (SNT), *knowledge organisation & sharing tools*, *text-based tools*, and *website creation tools* were the most effective at promoting engagement. However, caution is needed when employing SNT and *assessment tools*, as they were also more likely to lead to disengagement. Further research is needed on how educational technology affects disengagement, how tools are used in online teacher education programs, and how to effectively integrate SNT in Education programs.

Introduction

Fostering student engagement is of highest relevance for higher education instructors, as it leads to improved learning outcomes for students (see Bond & Bedenlier, 2019), is linked to improved persistence, retention and achievement (Finn, 2006; Kuh et al., 2008) and also relates to students' involvement within their institution (e.g., Junco, 2012). With the additional

focus of higher education institutions on developing students' '21st Century skills' (Claro & Ananiadou, 2009; Oliver & Jorre de St Jorre, 2018), the use of educational technology to enhance these skills, as well as student engagement, has received increased attention in research and practice (e.g., Redecker, 2017). The field of Education has been particularly interested in researching the use and impact of educational technology (Bond, Buntins, Bedenlier, Zawacki-Richter, & Kerres, 2020), given the need for pre- and in-service teachers to develop ICT skills and knowledge for application in the classroom, as well as to develop student ICT skills (OECD, 2018). However, teacher candidates have been shown to have particular difficulties in meaningfully using and seizing the advantages of digital technology for teaching and learning (Tondeur et al., 2012), and preparing them for the use of educational technology is an ongoing challenge for teacher educators (Liu, 2016; Ping et al., 2018; Tondeur et al., 2019).

Agreement exists on the complexity and multidimensionality of the concept of student engagement (Appleton et al., 2008; Ben-Eliyahu et al., 2018). However, ongoing disagreement and misunderstanding remains (Azevedo, 2015; Buckley, 2017; Zepke, 2018), especially in educational technology research (Bond, 2020; Bond et al., 2020; Henrie, Halverson, & Graham, 2015). Despite some arguments to the contrary (e.g., Fredricks et al., 2016; Reeve & Tseng, 2011), student engagement has three generally accepted dimensions; cognitive, affective and behavioural (Fredricks et al., 2004). Within each dimension are several facets (or indicators) of engagement and disengagement (see Appendix A), which are experienced on a continuum (Coates, 2007; Payne, 2017), depending on their activation (high or low) and valence (positive or negative) (Pekrun & Linnenbrink-Garcia, 2012). Drawing on previous research (see Bond & Bedenlier, 2019), the following understanding of student engagement guides the investigation in this study:

> Student engagement is the energy and effort that students employ within their learning community, observable via any number of behavioural, cognitive or affective indicators across a continuum. It is shaped by a range of structural and internal influences, including the complex interplay of relationships, learning activities and the learning environment. The more students are engaged and empowered within their learning community, the more likely they are to channel that energy back into their learning, leading to a range of short and long term outcomes, that can likewise further fuel engagement. (Bond et al., 2020, p. 3).

Whilst the authors of this article identified 27 literature and systematic reviews on the topic of educational technology and student engagement published up to and including 2018 (see Appendix D for a list and Bond et al., 2020, for a comprehensive examination), only one addressed preservice teachers specifically (Atmacasoy & Aksu, 2018). Another review, on the use of simulations in preservice teacher education, was later identified in an updated search. However, this review only touched upon individual facets of student engagement, whilst primarily focusing on interpersonal skills in the context of classroom management (Theelen et al., 2019). Therefore, the present article focuses on a subset of data from a larger systematic review, exploring literature on student engagement and educational technology in higher education. Subsets within the systematic review were created based on the field of study classification by UNESCO (2015), making Education one field of study consisting of, for example, teacher education and educational science. This article, therefore, seeks to answer the following questions:

1. What are the characteristics (countries, educational settings, study population, technology tools used) of and methods used in research on student engagement and educational

technology in higher education, within the field of Education, and how do they compare to the larger corpus?

2. How is educational technology research theoretically grounded within the field of Education?
3. Which facets of student engagement and disengagement are affected as a result of using educational technology in the field of Education?

Method

In order to gain an insight into how educational technology affects student engagement within the field of Education, a systematic review was undertaken using an explicit, transparent and replicable search strategy (Gough et al., 2012). To ensure more current technology was included in the review, the search strategy was directed by defined inclusion/exclusion criteria (see Table 1). The review protocol, including a thorough description of the method used, the search string development and article selection strategy, alongside the full data set, is available open access and stored on ResearchGate (https://www.researchgate.net/project/Facilitating-student-engagement-with-digital-media-in-higher-education-ActiveLeaRn). Likewise, the method and systematic review journey is discussed in detail in Bond et al. (2020) and Bedenlier, Bond, Buntins, Zawacki-Richter, & Kerres (2020B), which are also available open access. Therefore, an abridged version of the method is provided here.

After screening 18,068 titles and abstracts, 4,152 potential articles remained (see Figure 1). Due to time constraints, as well as the extraordinarily large number of relevant articles in the population, it was decided to draw a sample from this corpus (Buntins, Bond, Bedenlier, Zawacki-Richter, & Kerres, 2018) by using the method of sample size estimation (Kupper & Hafner, 1989), and using the R Package MBESS (Kelley, Lai, Lai, & Suggests, 2018). 349 articles were sampled, accepting a 5% error range, a percentage of a half and an alpha of 5%,

which were then stratified by publishing year, given that educational technology has become more differentiated within the last decade, and student engagement has become more prevalent (Zepke, 2018). Therefore, whilst the authors of this review did follow the usual systematic review process of using a boolean search string alongside stringent inclusion/exclusion criteria, it was decided to pursue a further method, in order to reduce the sample size to a smaller unbiased sample. In order to ensure inter-rater reliability, two researchers screened the first 100 articles on full text, and reached an agreement of 88% on inclusion/exclusion. Discrepancies were then discussed and an agreement was reached on the remaining 12%. Further comparison screening ensued in order to increase the level of reliability.

Table 1

Final inclusion/exclusion criteria

Inclusion Criteria	Exclusion Criteria
Published between 2007-2016	Published before 2007
English language	Not in English
Higher education	Not higher education
Empirical, primary research	Not empirical, primary research (e.g., review)
Indexed in ERIC, Web of Science, Scopus or PsycINFO	Evaluation or a description of a tool
Educational technology	No educational technology
Student engagement	No learning setting
	No student engagement

Following screening the articles on full text, 232 articles remained for data extraction, containing 243 studies. These were then coded using a comprehensive coding scheme, including codes to extract information on the execution and study design (e.g. methodology, study sample), as well as information on the mode of delivery, learning scenario (including broader pedagogies, such as social collaborative and self-determined learning, and specific pedagogies, such as flipped learning) and educational technology used. Specific examples of student engagement and/or disengagement were also coded under facets of cognitive, affective or behavioural (dis)engagement, which were identified following an extensive literature review (see Appendix A). The resulting evidence map provides more detailed information on the 243 articles, as well as the method used (see Bond et al., 2020), and likewise a systematic review on

the Arts & Humanities articles from the overall sample was also undertaken (see Bedenlier, Bond, Buntins, Zawacki-Richter, & Kerres, 2020A).

Given the large number of educational technology tools and applications identified across the 243 studies, Bower's (2016) typology of learning technologies (see Appendix B) was employed. Whilst some tools could be classified as more than one type according to the typology, "the type of learning that results from the use of the tool is dependent on the task and the way people engage with it rather than the technology itself" and therefore "the typology is presented as descriptions of what each type of tool enables and example use cases rather than prescriptions of any particular pedagogical value system" (Bower, 2016, p. 774). Please see Bower (2015) for a deeper explanation of each category.

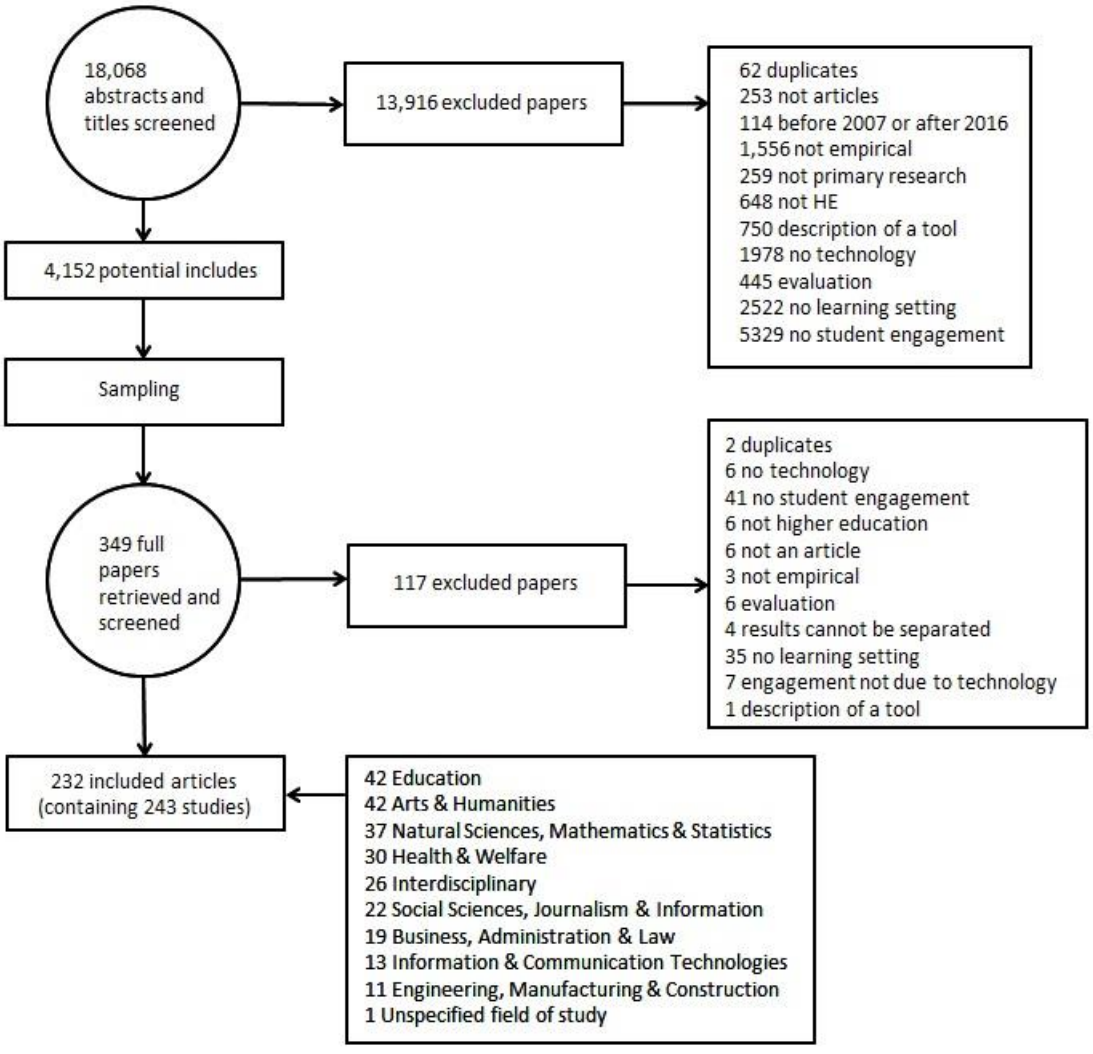


Figure 1. Systematic review PRISMA flow chart, slightly modified after Brunton and Thomas (2012, p. 86) and Moher et al. (2009, p. 8).

Overall sample description

The studies in the overall corpus were undertaken within 33 different countries, with most studies being undertaken within the United States (US) (35.4%, *n* = 86), United Kingdom (UK) (10.7%, *n* = 26) and Australia (7.8%, *n* = 19). Very few studies in the sample originated from mainland Europe, Africa, the Middle East and South America. Studies were predominantly conducted within universities (79%, *n* = 191), followed by non-specified institutions (10%, *n* = 24) and colleges (8.2%, *n* = 21), with undergraduate students the most studied participant group (60%, *n* = 146), followed by postgraduate students (14%, *n* = 33) and a combination of undergraduate and postgraduate students (9%, *n* = 41). The researched study disciplines are depicted in the PRISMA flow chart (see Figure 1). In regards to research design, quantitative methods were the most frequently employed (42%, *n* = 103), followed by mixed methods (35%, *n* = 84) and qualitative methods (23%, *n* = 56). Unsurprisingly, then, were quantitative data collection methods the most prevalent, with surveys the most frequently used (65%, *n* = 157), followed by ability tests (40%, *n* = 97) and log data (26%, *n* = 62). The most frequently employed qualitative method was document analysis (22%, *n* = 53), such as analysing student blog and discussion forum postings, followed by interviews (15%, *n* = 36) and focus groups (10%, *n* = 24).

Blended learning (45%, *n* = 109) was the most researched mode of delivery, followed by distance education (30%, *n* = 72) and face-to-face instruction (23%, *n* = 55). Social-collaborative learning (SCL) was the most often employed learning scenario (58.4%, *n* = 142), followed by self-directed learning (SDL) (43.2%, *n* = 105), and game-based learning (5.8%, *n* = 14). Across the corpus, more than 50 different educational technology tools were used, with the top five most frequently researched being Learning Management Systems (LMS) (*n* = 89), discussion forums (*n* = 80) and videos (*n* = 44). Following a modified version of Bower's

(2016) educational tools typology, 17 broad categories of tools were identified (see Appendix B), which revealed that *text-based tools* (57%, *n* = 138), *knowledge organisation & sharing tools* (43%, *n* = 104), and *multimodal production tools* (37%, *n* = 89) were the most investigated categories.

Whilst this review was designed to explore various facets of engagement that were not necessarily labelled as such, it was striking that almost all of the studies in the corpus (93%, *n* = 225) lacked a definition of student engagement. Of the 18 (7%) articles that did provide a definition, the most popular was that of active participation and involvement in university life and learning, followed by interaction, and time and effort. Less than half of the studies (41%, *n* = 100) were guided by a theoretical framework, with studies drawing on social constructivism (*n* = 18), the Community of Inquiry model (*n* = 8), Sociocultural Learning Theory (*n* = 5), and the Community of Practice model (*n* = 4).

Behavioural engagement was the most reported dimension of student engagement (86%, *n* = 209), followed by affective engagement (67%, *n* = 163) and cognitive engagement (56%, *n* = 136), with the top ten most frequently identified engagement facets evenly distributed across all three dimensions. Appearing in more than 100 studies each, and doubling the amount of the next most frequently reported facets, were *participation/interaction/involvement* (49%, *n* = 118), *achievement* (44%, *n* = 106), and *positive interactions with teachers and peers* (41%, *n* = 100). Student disengagement was considerably less identified across the corpus, with the most often facets being frustration (14%, *n* = 33), opposition/rejection (8%, *n* = 20), and disappointment and other affective disengagement (7% each, *n* = 18).

Given the large number of studies within the corpus, and the fact that different fields of study appeared to vary meaningfully in regards to the educational technology tools employed and student engagement facets identified, the authors decided to provide syntheses of research findings according to disciplinary field. In doing so, researchers and practitioners within those

disciplines are informed about research that pertains more to their own field. Therefore, this article focuses on the 42 Education studies within the corpus (see Appendix E).

Results

In the following results section, general information on studies will be shared, including study characteristics, educational settings, and technology used. The rate of studies that included a definition of student engagement, as well as the percentage of studies that were guided by a theoretical framework, will then be discussed, followed by an exploration of the student engagement and disengagement facets affected by educational technology.

Study characteristics

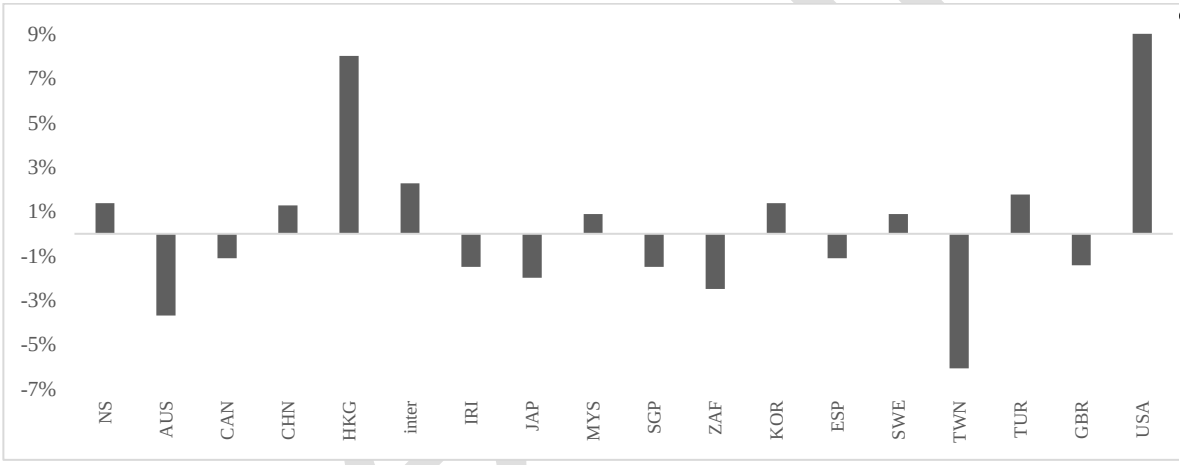
The 42 Education studies include 27 studies from the field of preservice teacher education (64.3%), two studies of which also include students from other education fields and two also include in-service teachers (see Appendix C). Another ten studies stem from general educational technology courses (23.8%), another four address in-service teachers (9.5%) and one study focuses on early childhood education (2.4%). In the case of two studies, the exact field of study could not be elicited from the articles and in another two studies, some of the participants were unclear (each 9.5%).

The 42 studies are sourced from 41 articles, with Hew (2015) reporting on two independent studies from the field of general education technology. Studies in this sub-sample were cited 41.43 times on average (SD = 58.93) and, with 32 of the 41 articles (78.1%), the majority was published in an interdisciplinary journal. Only nine articles (22.0%) appeared in disciplinary journals. In contrast, the overall sample has a share of only 49.8% interdisciplinary journals, making the education sample deviate from the corpus quite starkly in this aspect. However, Appendix C also reveals that the interdisciplinary journals are mainly educational technology journals.

Geographical characteristics. Most of the studies in this sample were undertaken within the US (42.9%, *n* = 18), followed by seven studies from each Hong Kong and the UK (9.5%). Compared to the overall sample, studies in Education originate from the US (9.0%) and Hong Kong (8.0%) considerably more often than in the other fields of study (see Table 2). By contrast, for Taiwan, studies in Education (*n* = 1) are considerably less frequent than studies from other fields in the overall sample (-6.1%). This also applies to Australia (*n* = 2), which has less studies in Education (-3.7%) than it does in other fields of study.

Table 2

Percentage deviation from the average relative frequencies of country of study



Note. NS = not stated; AUS = Australia; CAN = Canada; CHN = China; HKG = Hong Kong; inter = international; IRI = Iran; JAP = Japan; MYS = Malaysia; SGP = Singapore; ZAF = South Africa; KOR = South Korea; ESP = Spain; SWE = Sweden; TWN = Taiwan; TUR = Turkey; GBR = United Kingdom; USA = United States of America.

Educational settings. With 57.1% (*n* = 24), over half of the investigated courses used a blended learning format, followed by courses offered online (26.2%, *n* = 11) and another 12.0% of studies (*n* = 5) face-to-face courses. In the case of another 7.1% of studies (*n* = 3), the extent to which online elements are integrated into the course is not clearly identifiable. Most studies used social collaborative learning (SCL) (62.0%, *n* = 26) and almost half of the studies used elements of self-directed learning (SDL) (48.0%, *n* = 20). In 14.3% (*n* = 6), a relatively high number of studies, the learning scenario was not specified. Whilst game-based learning (GBL) and personal learning environments (PLE) were found in two studies each

(5.0%), the flipped classroom approach (FL) was used in one study only (2.4%), which also used SCL (see Table 3).

Table 3

Co-occurrence of learning scenarios across the sample (n = 42)

	SDL	SCL	GBL	PLE	other_LS	FC	NOS
Number of studies	20	26	2	2		1	6
SDL		0.60	0	1		1	0
SCL	0.41		0	0.50		0	0
GBL	0.33	0.42		0		0	0
PLE	0.40	0.40	0			0	0
other_LS	0.33	0.67	0	0			
FC	0.50	0.17	0	0	0		0
NOS	0	0	0	0	0	0	
Sum Not Education	85	116	12	5	3	6	26

Note. SDL = self-directed learning; SCL = social collaborative learning; GBL = game-based learning; PLE = personal learning environments; other_LS = other learning scenario; FC = flipped classroom; NOS = learning scenario not specified.

In order to determine how often learning scenarios occurred together, the number of common occurrences (p_{AB})were calculated relative to the maximum possible number of common occurrences, which was reported in another article by the authors as follows:

> In concrete terms, this means that in a contingency table, the cell that indicated how often two learning scenarios occurred together is used ($A^+ \wedge B^+$) and the number in this cell was determined by the smaller number of respective learning scenarios (A $\wedge$ B). Expressed as a formula,
>
> $$p_{AB} = \frac{A^+ \cap B^+}{\min\{A, B\}}$$
>
> Equation 1. (Bedenlier et al., 2020A, p. 130)

In 60% of possible cases, SCL and SDL were used in combination (n = 12). In both studies that used PLEs, SDL was also used, and in one of these two studies SCL was also found. In

comparison to the non-Education studies in the overall corpus, the proportion of blended learning studies is higher by 14.9% in the Education sample, whereas online and face-to-face settings were less often employed (see Figure 2). Furthermore, both SDL (5.3%) and SCL (4.2%) occur a little more frequently, compared to the overall corpus. This then also accounts for the fact that SDL and SCL often appear in combination in the field of Education. Across the non-Education corpus, SCL and SDL are jointly found in only 41% of possible cases.

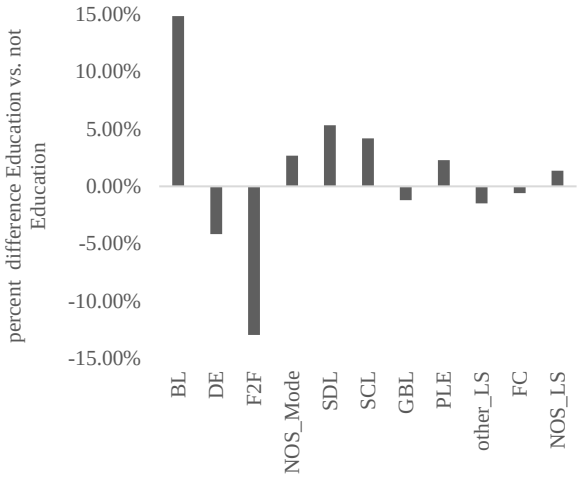


Figure 2. Percentage deviation from the average relative frequencies of mode of delivery.

Note. BL = blended learning; DE = distance education; F2F = face-to-face; NOS_Mode = not stated; SDL = self-directed learning; SCL = social collaborative learning; GBL = game-based learning; PLE = personal learning environments; other_LS = other learning scenario; FC = flipped classroom; NOS_LS = learning scenario not stated

Study population. Studies in Education investigated undergraduate students in 64.3% of studies (n = 27), and 33.3% of studies looked at graduate students (n = 14). Four of these studies focused on both undergraduate and graduate students, and five further studies did not specify a study level. The distribution of the level of study within the Education sample does not deviate significantly from that of the overall sample (X^2=4.984, p > 0.05), although the share of postgraduate students in Education is higher than in the overall group (12.4%).

Technology tools use. The educational technology most frequently used across the Education studies (see Table 4) was text-based tools (66.7%, n = 28), followed by knowledge organisation and sharing tools (57.1%, n = 24) and multimodal production tools (29.0%, n =

12). Website creation tools were used in seven studies (16.7%), whereas assessment tools and social networking tools were used in six studies each (14.3%). The combination of tools that occurred most frequently was that of text-based tools with either knowledge organisation and sharing tools (20 out of 24 studies) or social networking tools (five out of six studies) in 83% of possible cases. Website creation tools and knowledge organisation and sharing tools were used in combination in 71% of possible cases (5 out of 8 studies). Both combinations of website creation tools with assessment tools, as well as website creation tools with social networking tools, occurred in 67% of possible cases (four out of six studies).

Table 4

Co-occurrence of tools across the sample (n = 42)

	TBT	MPT	WCT	KO&S	DAT	DST	AT	SNT	SCT	Mlearning	MOOCs	VW	LS	OL	Hardware	etutors	Games
Sum Education	28	12	7	24	0	0	6	6	2	2	1	1	0	1	1	0	0
TBT		0.42	0.57	0.83			0.50	0.83	0.00	0.50	1.00	0.00		1.00	0.00		
MPT	0.62		0.57	0.58			0.33	0.00	0.50	0.50	0.00	0.00		0.00	1.00		
WCT	0.36	0.23		0.71			0.00	0.33	0.50	0.00	1.00	0.00		0.00	0.00		
KO&S	0.69	0.49	0.41				0.67	0.67	0.00	0.50	1.00	0.00		0.00	0.00		
DAT	0.00	0.00	0.00	0.50													
DST	1.00	1.00	1.00	1.00	0.00												
AT	0.56	0.44	0.09	0.51	1.00	1.00		0.00	0.00	0.00	0.00	0.00		1.00	0.00		
SNT	0.53	0.33	0.27	0.33	0.00	0.00	0.00		0.00	0.00	1.00	0.00		0.00	0.00		
SCT	0.79	0.50	0.14	0.43	0.00	1.00	0.36	0.14		0.00	0.00	0.00		0.00	1.00		
Mlearning	0.38	0.38	0.13	0.50	0.00	0.00	0.13	0.13	0.13		0.00	0.00		0.00	0.00		
MOOCs	1.00	1.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00		0.00		0.00	0.00		
VW	0.47	0.35	0.06	0.18	0.00	0.00	0.29	0.00	0.14	0.13	0.00			0.00	0.00		
LS	0.89	0.22	0.11	0.22	0.00	0.00	0.22	0.11	0.00	0.13	0.00	0.22					
OL	0.44	0.56	0.11	0.44	0.00	0.00	0.44	0.11	0.00	0.11	0.00	0.00	0.00		0.00		
Hardware	0.43	0.43	0.14	0.50	0.00	1.00	0.21	0.00	0.29	0.25	0.00	0.00	0.00	0.00			
etutors	0.50	0.00	0.00	0.25	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.00		
Games	0.00	0.33	0.00	0.33	0.50	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Sum Not Education	110	77	22	80	2	1	59	15	14	8	2	17	9	9	14	8	3

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; DAT = data analysis tools; DST = digital storytelling tools; AT = assessment tools; SNT = social networking tools; SCT = synchronous collaboration tools; ML = mobile learning; VirWor = virtual worlds; LS = learning software; OL = online learning.

When comparing these findings to that of the non-Education studies in the corpus (see Figure 3), it is interesting to see that in Education, knowledge organisation and sharing tools

was used above average (by 17.3%), as were text-based tools (by 11.9%) and social networking tools (by 6.9%). In contrast, assessment tools (15.1%) and multimodal production tools (9.7%) were employed below average in Education. In regard to the combination of tools, it was also text-based tools and knowledge organisation and sharing tools that were not only most often used, but also most often used together, whilst text-based tools and multimodal production tools were less often employed jointly in Education research than in the non-Education studies. Website creation tools and knowledge organisation and sharing tools were rarely used together in non-Education studies (41% of possible cases). Finally, in Education, multimodal production tools were used above average in combination with website creation tools, assessment tools, and knowledge organisation and sharing tools.

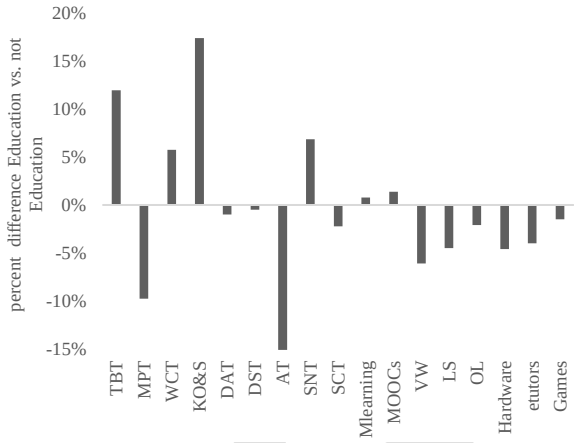


Figure 3. Percentage difference between Education (*n* = 42) and non-Education studies.

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; DAT = data analysis tools; DST = digital storytelling tools; AT = assessment tools; SNT = social networking tools; SCT = synchronous collaboration tools; ML = mobile learning; VirWor = virtual worlds; LS = learning software; OL = online learning.

Methodological characteristics. The combination of quantitative and qualitative methods occurred in 40.5% of the studies (*n* = 17), whereas 33.3% employed qualitative methods only (*n* = 14), and the remaining 26.2% of studies used solely quantitative methods (*n* = 11). Thus, the share of mixed and qualitative studies is higher than in the overall sample (7.2% and 12.4% respectively), but not significantly so ($X^2 = 5.987$, p=.050). The two most frequently used data collection methods were surveys and document analysis (both *n* = 21, 50%), followed

by log data (*n* = 12, 28.6%). Whilst more studies in this sample employed qualitative rather than quantitative methods, the number of other qualitative methods used, such as interviews (*n* = 11, 26.2%), observations (*n* = 8, 19.0%) and focus groups (*n* = 5, 11.9%), was surprisingly small.

Document analysis within Education made up 40% of the studies that used the method within the whole sample, which indicates its popularity in understanding student perceptions through rich, thick text. Examples of document analysis included that of Cook and Bissonette (2016), whose study of preservice teacher education used Twitter to enhance collaboration. They utilised a hashtag during the course to enable easy tweet archiving and data retrieval, and then used grounded theory to identify emergent themes. Surveys used by qualitative studies in the sample were all self-made and often included course evaluations (e.g., Cook & Bissonnette, 2016) or short questionnaires on student opinions of using technology within their course (e.g., Leese, 2009), whereas quantitative studies predominantly used previously validated questionnaires, such as variations on the Learning Style Inventory by Smith and Kolb (1985) (e.g., Index of Learning Styles, Felder & Solomon, 1994 as cited in Chen & Chau, 2016), Rovai's (2002) Classroom Community Scale (e.g., Chen & Chiou, 2014), and Keller and Subhiyah's (1993) Course Interest Survey (e.g., Kim & Keller, 2011).

Theoretically grounding research on student engagement and educational technology

Of the 42 studies within this corpus, 18 (43%) did not use a theoretical framework, which has been recognised as an issue within previous literature and systematic reviews (e.g., Kaliisa & Picard, 2017; Lundin et al., 2018), and with the larger corpus of this systematic review. Of the 57% (*n* = 24) that did, four drew on Garrison et al.'s (2000) Community of Inquiry framework (Gray & DiLoreto, 2016; Hemphill & Hemphill, 2007; Teng et al., 2012; Whipp & Lorentz, 2009); three on social constructivism (Cook & Bissonette, 2016; Coole &

Watts, 2009; Ikpeze, 2007) and two studies on Wenger's (1998) Community of Practice (Chandra & Chalmers, 2010; Ruane & Lee, 2016). In the article by Hew (2015), which includes two studies, both Helsing et al.'s (2004) constructive-development theory, and Hofstede's (2011) cultural dimensions classification were applied. Also reflective of the larger corpus were the number of studies that did not include a research question (36%, n = 15).

Interestingly, only five studies (12%) included a definition of student engagement, which is now considered necessary to have in any empirical research on engagement (Boekaerts, 2016). Park and Kim (2015) defined engagement as multifaceted and multidimensional, using the three dimensions of behavioural, cognitive and emotional (affective), whereas Bolden and Nahachewsky (2015) considered engagement to have only affective and behavioural components. Both Bolden and Nahachewsky (2015) and Gray and DiLoreto (2016) defined engagement as participation and involvement in the learning process, whilst for Boury et al. (2013) it was interaction with others (especially peers) and with meaningful tasks. On the other hand, Hatzipanagos and Code (2016) defined engagement as the time and effort that students spend on learning activities, and stressed its distinction from motivation. The variation in these five definitions is a prime example of how disparate the field's notion of engagement is (Henrie et al., 2015), and reiterates the 'fuzzy' character of the concept (see Bond & Bedenlier, 2019).

Student engagement and educational technology in the field of Education

The 42 studies in this corpus were coded on facets of behavioural, affective and cognitive engagement. Overall, 37 studies (88.1%) included evidence of behavioural (see Table 5), 36 (85.7%) resulted in affective and 29 (69%) in cognitive engagement, with 28 studies (66.7%) identifying all three engagement dimensions. The six most frequently cited facets of engagement were *positive interactions with peers/teachers*, *participation/involvement*, *learning from peers*, *confidence*, *enjoyment* and *achievement* (see Table 6). Whilst some theorists have considered that *achievement* is an outcome of engagement, rather than an aspect of it (e.g.,

Kahu, 2013), the decision was made in this project to code *achievement* as a facet of engaged learning.

Table 5

Student engagement frequency descriptive statistics

	Frequency	Relative Frequency	M	SD
Behavioural Engagement	37	0.88	1.73	1.10
Affective Engagement	36	0.86	2.44	2.30
Cognitive Engagement	29	0.69	2.76	1.92
Overall	3	0.07	1	-

Three studies (7%) found that educational technology enhanced engagement *overall*, but did not specify which dimensions and/or facets this referred to. These were then coded separately to the other facets. For example, whilst Gray and DiLoreto (2016) developed the Student Learning and Satisfaction in Online Learning Environments Instrument (SLS-OLE) including 'Student Engagement' on a scale from 1.00 to 6.00, they did not explicitly define which facets or domains were being measured, although their definition of student engagement included behavioural and affective aspects. Engagement, then, in this postgraduate educational leadership course was rated by 187 students to have a mean of 4.9783 (SD = .86155), with the study finding a strong and significant relationship between student engagement and learner interaction ($r = .72$, $\rho < .01$).

Table 6

Top five engagement facets across the three dimensions (n = 42)

Rank	BE	*n*	%	AE	*n*	%	CE	*n*	%
1	Participation/interaction/ involvement	21	50.0%	Positive interactions with peers/teachers	24	57.1%	Learning from peers	16	38.1%
2	Confidence	12	28.6%	Enjoyment	11	26.2%	Deep learning Self-regulation Positive self-perceptions & self-efficacy	8	19.0%
3	Achievement	11	26.2%	Enthusiasm Sense of connectedness	7	16.7%	Critical thinking	7	16.7%
4	Positive conduct Effort Attention	4	9.5%	Interest	6	14.3%	Operational reasoning Positive perceptions of teacher support	5	11.9%

5	Assume responsibility	3	7.1%	Positive attitude towards learning Motivation	5	11.9%	Staying on task/focus	4	9.5%

Note. BE = Behavioural engagement; AE = affective engagement; CE = cognitive engagement.

Behavioural engagement and educational technology. The most frequently reported dimension of engagement, although arguably also the most frequently measured due to being manifested in actions that can be observed, was behavioural engagement, with seven different facets identified as a result of educational technology (see Table 6). By far the most cited instance of behavioural engagement was *participation/interaction/involvement* (50%, *n* = 21), present in 50% of studies using text-based tools, knowledge organisation and sharing tools and social networking tools, and in 66.7% of studies involving assessment tools (see Table 7). *Participation* was captured in several studies by means of frequency data related to access to discussion boards (e.g., Gibbs & Bernas, 2008; Hemphill & Hemphill, 2007; Teng et al., 2012), with Coole and Watts (2009) finding their preservice teacher candidates' participation ranging from passive consumption of posts (51%, *n* = 79) to forming professional communities (9%, *n* = 14). *Achievement* was also found in 66.7% of studies using assessment tools where, for example, students who used a question-embedded online interactive video environment, spent more time and interacted more with learning material, as well as scoring significantly higher learning results (Vural, 2013). Chen and Chiou (2014) also showed higher mean exam scores of students enrolled in a course using online discussion boards, compared to students attending a solely face-to-face course. Students in an Introductory Educational Technology course also showed increased behavioural engagement with a Virtual Tutee System, with an improving trend in reading performance found (Park & Kim, 2015). However, whilst Hatzipanagos and Code (2016) found quizzes significantly more likely to be completed when they were mandatory, students were more likely to engage in peer-to-peer sharing of resources when open badge participation was optional.

Social networking tools such as Twitter allow students to interact with a wider audience outside of the classroom and engage within broader communities of practice, leading to increased *enjoyment* (Cook & Bissonette, 2016; Saadatmand & Kumpulainen, 2013), although more closed environments such as Ning (Arnold & Paulus, 2010) and Facebook groups (Deng & Tavares, 2013) can enable vibrant discussions, where less confident students can feel more at ease to contribute. Cheng et al. (2015) found that undergraduate Education students' initiative and prompt *interaction* in discussions, was directly linked to their overall course *achievement*, with Cheng and Chau (2016) also finding that participation in networked learning and materials development, rather than using LMS to access course materials, were more likely to promote *achievement* and *satisfaction*. Jabbour (2014) found that, not only did mobile learning stimulate *interaction* between peers, but it also resulted in improved learning outcomes.

Table 7

Relative frequency (percentages) of behavioural engagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Participation/Interaction/Involvement	50.0	50.0	41.7	42.9	50.0	66.7	50.0
Confidence	28.6	39.3	25.0	28.6	41.7	16.7	16.7
Achievement	26.2	25.0	25.0	14.3	20.8	66.7	16.7
Following Rules	9.5	14.3	0.0	0.0	12.5	0.0	16.7
Effort	9.5	3.6	16.7	0.0	4.2	0.0	16.7
Attention	9.5	7.1	16.7	0.0	8.3	16.7	33.3
Assume Responsibility	7.1	7.1	8.3	0.0	8.3	33.3	16.7

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools.

Using technology within preservice teacher courses, enabled students to feel more *confident* with their technology skills, and to feel more confident with their ability to then apply those skills once teaching their own students. Studies which used asynchronous text-based tools, such as discussion forums (e.g., Smidt et al., 2014) and wikis (e.g., Chandra & Chalmers, 2010), and website creation tools, such as blogs (e.g., Granberg, 2010), were particularly con-

fidence-building for students, due to the ability to compose posts and edit them, prior to posting, which also promoted deeper reflection and *attention*. Students also reported exerting more *effort* with tasks that were authentic and held meaning for them personally (e.g., Bolden & Nahachewsky, 2015). First and third year preservice teachers in an undergraduate education program found using a peer mentoring discussion forum through Blackboard to be an excellent tool for sharing classroom experiences, concerns and achievements (Ruane & Lee, 2016). Student interactions were dense and they were able to develop *confidence* in sharing with their peers, alongside their growing teaching confidence, developing language of empathy and connectedness. In this case, the facilitators did not moderate participation, asking only that students post two to three times per week, which allowed a more student-led discussion, appreciated also by students in the study by Hew (2015). The study by Sharma and Tietjen (2016) found that discussions were more frequent, open and equal when students participated within one course blog, as opposed to having individual blogs and project groups, but that instructor feedback and presence within online environments is an important factor in student participation (Lee & Lee, 2016).

Affective engagement and educational technology. Educational technology had a positive effect on 11 different facets of affective engagement in this sample (see Table 8). Of these, *positive interactions with peers/teachers* was by far the most cited affective facet (57.1%, $n = 24$) and the highest overall, with *enthusiasm* an important factor in developing trust within group work situations (Bulu & Yildirim, 2008). Studies that used social networking tools ($n = 6$) reported particularly high levels of *positive interaction* and *enjoyment*. *Positive interactions* also occurred using simple communication forms such as e-mail to address students in a personalised way (Alcaraz-Salarirche et al., 2011), and wikis, which were seen as having "helped the instructors better understand the students and it helped the students better understand the experience" (Boury et al., 2013, p. 76) during an international teaching placement. Students

were found to be very supportive of others in a web-based course and interacted more with the instructor than in the corresponding face-to-face course (Mentzer et al., 2007). Hexom and Menoher (2012) argue, that in online learning settings, the quality of interaction is also related to the length of a course, which enables a more personal relationship between students and the instructor to develop, as more opportunities exist that actually allow for interactions (p. 149).

Table 8

Relative frequency (percentages) of affective engagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Enthusiasm	16.7	7.1	16.7	0.0	16.7	33.3	33.3
Interest	14.3	10.7	8.3	0.0	16.7	16.7	16.7
Sense of belonging	9.5	14.3	0.0	14.3	16.7	0.0	33.3
Positive interactions	57.1	57.1	50.0	57.1	54.2	33.3	83.3
Positive Attitude	11.9	7.1	8.3	0.0	8.3	16.7	0.0
Connectedness	16.7	17.9	33.3	14.3	25.0	16.7	33.3
Pride	9.5	7.1	16.7	14.3	8.3	0.0	16.7
Satisfaction	9.5	7.1	8.3	0.0	8.3	0.0	16.7
Wellbeing	9.5	10.7	0.0	0.0	12.5	0.0	16.7
Enjoyment	26.2	17.9	8.3	14.3	25.0	33.3	66.7
Motivation	11.9	10.7	8.3	0.0	12.5	16.7	16.7

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools

Using social networking tools that students are already familiar with, such as Facebook (e.g., Deng & Tavares, 2013; Lee & Lee, 2016) and Twitter (e.g., Saadatmand & Kumpulainen, 2013), removed technological skill barriers, and encouraged more informal networks to develop (Cook & Bissonette, 2016), with *community* developing easier when students could link contributions to specific student profiles (Arnold & Paulus, 2010). Apps with push notifications meant that responses to student queries were quickly answered, enabling them to easily "seek support" and "solve problems" with each other (p. 172), leading to an enhanced *sense of connectedness* and *belonging*.

Enjoyment was also found in 33.3% of studies using assessment tools, with Park and Kim's (2015) study of a Virtual Tutee System finding that students were more likely to experience *enjoyment*, and less likely to experience *boredom* and *anger*. With one student saying "I have really been enjoying these posts. I have not posted a thread because what I have read has answered a lot of my questions" (Ruane & Lee, 2016, p. 91). Enjoyment does not, therefore, automatically mean active participation. Mixed results were found in the study by Grimley et al. (2012), whose participants predominantly state that they enjoyed the computer game that was used for instructional purposes, but closer analysis of high and low achieving students then revealed different levels of concentration and individual perceptions of study success (p. 635). *Interest* is a facet that was investigated, for example, in its relation to concentration when using mobile learning (Yang et al., 2015), and one student in a TESOL course found it particularly effective when students were allowed to drive the discussion in a weekly class forum, being responsible for choosing an article and asking their peers questions, as this related discussion directly then to their own interests (Smidt et al., 2014), and again highlights the importance of meaningful tasks.

Students in a blended course were more *motivated* to contribute to the wiki if other students contributed (Yusop & Basar, 2014), and Kim and Keller's (2011) study on the use of motivational and volitional email messages in preservice teacher education found that, whilst they did not have a significant effect on motivation, students' volition and attitudes towards technology improved.

Cognitive engagement and educational technology. Found slightly less in the studies in this sample, cognitive engagement was coded through 10 different facets (see Table 9), with the most predominant one being *learning from peers*. It was not surprising to see that *learning from peers* was found in 66.7% of studies using social networking tools, as opposed to only

16.7% of studies using assessment tools. The fact that students learn from their peers was apparent in a number of cases when the respective technology enabled students to share their work and thereby learn from others, such as via social networking sites in the study by Arnold and Paulus (2010) or Bolden and Nahachewsky (2015), stating that students "benefitted from this sharing [of podcasts] by having the opportunity to celebrate achievement, collaboratively develop knowledge, represent selves and connect to others" (p. 22). Giving feedback on other groups' work (Chandra & Chalmers, 2010), being able to follow what others are doing (Cook & Bissonnette, 2016) and essentially practicing what one of Ruane and Lee's (2016) participants found to be "learning 'from' her classmates, as opposed to offering advice and ideas 'to' others" (p. 91), is what this category revolves around.

Table 9

Relative frequency (percentages) of cognitive engagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Learning from peers	38.1	46.4	50.0	57.1	50.0	16.7	66.7
Deep Learning	19.0	10.7	16.7	28.6	20.8	16.7	50.0
Self regulation	19.0	21.4	16.7	0.0	25.0	16.7	16.7
Positive self perception & self efficacy	19.0	21.4	33.3	42.9	25.0	16.7	33.3
Follow through /care thoroughness	19.0	14.3	25.0	28.6	20.8	33.3	33.3
Critical Thinking	16.7	17.9	8.3	14.3	20.8	16.7	16.7
Operational reasoning	11.9	7.1	33.3	14.3	12.5	0.0	0.0
Positive perception of teacher support	11.9	14.3	8.3	0.0	12.5	0.0	0.0
Staying on task/focus	9.5	7.1	16.7	0.0	4.2	16.7	0.0
Investment in learning	7.1	7.1	16.7	14.3	8.3	16.7	16.7

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools

Whereas *learning from peers* is clearly understood as a social process, *deep learning* was primarily documented - naturally - as an internal process, with one preservice teacher candidate saying that "I took more in than I normally do" (Quinn & Kennedy-Clark, 2015, p. 7) with reference to using pre-recorded lectures in the context of flipped learning, with 81% of students in the course (n = 29) approving of this concept as such. Another student stated that the mere fact of concisely typing one's thoughts out, lead to thoroughly recapitulating course

content (Deng & Tavares, 2013, p. 171), although the system that was used in the course (Moodle) was not perceived as encouraging engagement in the discussion forums per se, and the perceived benefit of contributing to the forums was also strongly related to their peers engaging as well.

Online discussions, as a means to foster dialogue within a course, were used in the study by Szabo and Schwartz (2011) who found statistically significant differences in *critical thinking* abilities between two student cohorts, one of which was offered in traditional mode and the other class added online discussions. Pre- and post-tests revealed that *critical thinking* significantly increased for students in the latter course (p. 85). *Self-regulation* is also one of the facets of cognitive engagement indicated in a number of studies, such as the one by Shonfeld and Ronen (2015), who investigated an online science education course enrolling excellent, average and learning disabled students, which found that the latter group indicated a growth in their self-directed learning levels between pre- and post-questionnaire (p. 19). The aspect of more personalised learning was stressed by a student in the study by Quinn and Kenney-Clark (2015), enabling the student to "go at your own pace" (p. 8) through controlling the recorded video lecture. Related to *self-regulation* is *follow-through/care/thoroughness* that was expressed through students engaging in the non-required readings of their peers' blogs, leading the course instructor to conclude that *"*In my view, educational technology is most effective when students make it their own and initiate some use by themselves" (p. 194). This is similarly found in the study by Bolden and Nahachewsky (2015) on music education, who found one student going back over her self-created podcast until she was satisfied with what she really wanted to express in this assignment (p. 25).

Positive self-perception and self-efficacy was reported in several studies in regard to students learning how to confidently use technology. Examples included Szabo and Schwartz' (2011) study leading a student to want to apply technology in their own teaching, Saadatmand

and Kumpulainen (2013) reporting one of their student's competency increase in using tools through jointly working with her peers in personal learning environments, Chandra and Chalmers (2010) having one student feeling more competent about knowing wikis and confidently setting them up (p. 47), and Bolden and Nahachewsky's (2015) mature student growing accustomed to using new software (p. 24). Thus, whilst other areas of *positive self-perception* were also reported in the studies, it is interesting to see that knowledge about and the use of technology emerged to be one apparent challenge for students that could, however, be overcome by them.

Student disengagement and educational technology in the field of Education

Studies in this sample were also coded on 12 different facets of behavioural, affective and cognitive disengagement. Overall, 17 studies (41%) resulted in affective, 12 (29%) in behavioural, and 10 (24%) in cognitive disengagement (see Table 10). The five most frequently cited disengagement facets were *frustration*, *disappointment*, *worry/anxiety*, *avoidance* and *half-hearted/task incompletion* (see Table 11).

Table 10

Student disengagement frequency descriptive statistics

	Frequency	Relative Frequency	M	SD
Behavioural Disengagement	12	0.29	1.83	1.11
Affective Disengagement	17	0.41	2.00	1.12
Cognitive Disengagement	10	0.24	2.00	0.82

Table 11

Top five disengagement facets across the three dimensions

Rank	BD	*n*	%	AD	*n*	%	CD	*n*	%
1	Half-hearted/task incompletion	5	11.9%	Frustration	8	19.0%	Avoidance	5	11.9%
2	Unfocused/inattentive Distracted	3	7.1%	Disappointment	7	16.7%	Opposition/Rejection Pressured Other	4	9.5%
3				Worry/Anxiety	6	14.3%			
4				Other	5	11.9%			
5				Boredom	3	7.1%			

Note. BD = Behavioural disengagement; AD = affective disengagement; CD = cognitive disengagement.

Behavioural disengagement and educational technology. Behavioural disengagement was indicated by only three facets (see Table 12), with the most prominent of these being *half-hearted/task incompletion*, particularly when using social networking tools. In these studies, engaging students in online discussion forums and on social media was difficult, due to students not wanting to share their ideas publicly (Deng & Tavares, 2013), not wanting to engage with other group members (Granberg, 2010; Ikpeze, 2007), or finding the extra online requirements onerous, as one student explained: "I am not going to spend more time with the online class than I have to. I will just write my post, fulfil the requirements, and then get on with my day." (Smidt et al., 2014, p. 58). Students in a preservice teacher TESOL course found using Ning to chat with class members, especially whilst physically sitting in that class, to lack authenticity, although some did acknowledge that this helped less confident students to express their opinions (Arnold & Paulus, 2010).

Table 12

Relative frequency (percentages) of behavioural disengagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Half-hearted	11.9	14.3	8.3	28.6	16.7	0.0	33.3
Unfocused	7.1	0.0	8.3	0.0	4.2	0.0	0.0
Distracted	7.1	0.0	8.3	0.0	4.2	0.0	0.0

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools

Students in a flipped learning preservice teacher literacy unit found themselves occasionally unfocused whilst watching videos lectures and easily distracted (Quinn & Kennedy-Clark, 2015), which highlights the importance of ensuring good quality video production and keeping videos short (see Akçayır & Akçayır, 2018). In a study on the use of mobile phone devices within an undergraduate Education course (Jabbour, 2014), some students were ob-

served using them to play games or message friends during class, rather than completing assigned tasks. Likewise, whilst students found using a computer game enjoyable and useful in reinforcing learning concepts in an educational psychology unit, some admitted that it was difficult to stay focused during gameplay and others questioned "how much [they were] taking in" (Grimley et al., 2012, p. 633).

Affective disengagement and educational technology. Five affective disengagement facets were coded (see Table 13), with *frustration* the most frequent (19.0%, $n = 8$). Frustration was expressed in various ways across the studies, relating very often to technical aspects of the technology used, but also to the human interactions around them. Students in the study by Deng and Tavares (2013) used the words "very troublesome" and "totally difficult to use" when referring to Moodle (p. 170), or complained about "bugs" (Grimley et al., 2012, p. 633) in the system, whereas one student was "openly frustrated about her group members' lackluster attitude to the discussions" (Ikpeze, 2007, p. 395) and other students complained about the disorganised way a specific class was held (Whipp & Lorentz, 2009). In the study by Abendroth et al. (2011), one student tried to create a video by using too advanced techniques and was frustrated when the video did not work as expected (p. 150) and students in another study reported that they always needed to rely on tutorials to be able to correctly use the video analysis tool that was part of the course set up (Shepherd & Hannafin, 2011, p. 201). *Disappointment* also related primarily to the interaction with others, such as the impression that others were not overly interested in the given tasks (Bulu & Yildirim, 2008) or that discussion strands just "hanging in the air" (Granberg, 2010, p. 10). Interestingly, in two cases *worry/anxiety* appeared to be linked to the instructors' presence in the Moodle environment (Deng & Tavares, 2013) or their facilitation of discussions (Hew, 2015) with students then feeling worried about not being knowledgeable enough and "posting the 'wrong things'" (p. 30). One student also com-

mented on the fact that *boredom* can arise when instructors – through overly regulating discussion boards – seem to rule out "any chance for creativity or individuality" (Smidt et al., 2014, p. 52).

Table 13

Relative frequency (percentages) of affective disengagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Frustration	19.0	14.3	25.0	14.3	16.7	0.0	33.3
Disappointment	16.7	14.3	25.0	14.3	16.7	0.0	33.3
Anxiety	14.3	17.9	8.3	0.0	20.8	0.0	33.3
other	11.9	10.7	8.3	0.0	16.7	16.7	33.3
Boredom	7.1	3.6	0.0	0.0	4.2	16.7	0.0

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools

Cognitive disengagement and educational technology. There were only three cognitive facets of disengagement coded in this sample (see Table 14), alongside *other*, with *avoidance* the most prominent, followed closely by *opposition/rejection* and *pressured*. Student *avoidance* of tasks was particularly seen in studies that involved social networking tools. Preservice teachers in a blended TESOL course did not interact with other students on the class Ning site, beyond what was required (Arnold & Paulus, 2010). This was also found in studies using institutional LMS, such as Blackboard (e.g., Ikpeze, 2007) and Moodle (e.g., Deng & Tavares, 2013), with some students citing family or work commitments as the reason for their lack of participation (Leese, 2009). In a study investigating preservice teacher perceptions of Moodle and Facebook (Deng & Tavares, 2013), students showed minimal interest in using the LMS, seeing it more as a tool to use for assimilative tasks, such as downloading course materials, whereas a Facebook group was "more immediate and direct than Moodle" and was easier to use as it was already "part of [their] lives" (p. 171).

Table 14

Relative frequency (percentages) of cognitive disengagement facets by technology type

	all	TBT	MPT	WCT	KO&S	AT	SNT
Rejection	9.5	7.1	8.3	0.0	12.5	0.0	16.7
Avoidance	11.9	14.3	0.0	14.3	16.7	0.0	50.0
Pressured	9.5	14.3	0.0	0.0	16.7	0.0	16.7
other	9.5	10.7	8.3	14.3	4.2	0.0	16.7

Note. TBT = text-based tools; MPT = multimodal production tools; WCT = website creation tools; KO&S = knowledge organisation and sharing tools; AT = assessment tools; SNT = social networking tools

In a study using Twitter (Cook & Bissonette, 2016), students found it difficult to move their ideas into a more public domain online, with one student expressing "I talk in class because it helps me learn, it's expected and I know my classmates are listening to me, but on Twitter I wasn't always sure who I was talking to" (p. 102), which led to some students *opposing* use of the tool. Some students opposed the idea of engaging in online discussions, because they wanted to avoid confrontation resulting from miscommunication (Ikpeze, 2007), and others felt *pressured* when having to interact in a teacher facilitated discussion (Hew, 2015). However, students in two studies (Quinn & Kennedy-Clark, 2015; Smidt et al., 2014) believed that the use of too much technology in general was not a good thing. One student said that they would be "teach[ing] students in a real classroom in a real school, in person" (Smidt et al., 2014, p. 54), and therefore saw engaging with technology a waste of time, with one student in a blended course stating that they "didn't apply for online distance uni[versity]" (Quinn & Kennedy-Clark, 2015, p. 7).

Discussion

This article reviewed 42 publications focused on how educational technology affects student engagement in higher education within the field of education. This subset was analysed in relation to the larger systematic review corpus, in order to identify specific characteristics pertaining to educational technology use and student engagement in this field.

Study contexts and methodology

With the vast majority of studies stemming from undergraduate teacher education, this confirms the focus of prior educational technology research on undergraduate students (e.g.,

Hew & Cheung, 2013), however it could also be a reflection on the increasing realisation of the importance of preservice education programs in preparing preservice teachers for integrating educational technology in the classroom (Admiraal et al., 2017; Mouza, 2019). Unfortunately, five studies within the sample did not provide full information about the study level, which makes it difficult for readers to know whether the study can be applied to their own context. More precise and explicit details about participants and study context (country, institution, study level etc.) are needed in future empirical research.

There was a high number of studies employing qualitative and mixed methods, however a comparatively low number of studies using interviews, observations and focus groups. Given the complex nature of student engagement (see Bond & Bedenlier, 2019), it is important to use data collection methods that provide thick descriptions of how people perceive educational technology, rather than relying solely on statistical data, which focuses more on aspects of behavioural engagement (Fredricks et al., 2004; Henrie et al., 2015). As was found in this review, enjoyment does not always equal active participation, and nor does frequent accessing of course material necessarily equate to positive affective engagement. Caution should also be given towards relying on self-developed student evaluation surveys as the sole data source, as this can pose challenges regarding construct validity and problematic results in turn (Döring & Bortz, 2016).

As with the overall sample, and research in educational technology generally (Bond, 2018; Bond, Zawacki-Richter, & Nichols, 2019), countries from the global south were underrepresented. This could partially be due to the search strategy and the sampling employed, which focused on English-language publications, indexed within four databases. The inclusion of databases specific to those regions (e.g. African Journals Online, www.ajol.info) might have resulted in a higher proportion of included articles, and should be considered vital when undertaking future reviews.

Grounding Education research in theory

As found in other reviews (e.g., Henrie et al., 2015), and within the larger corpus, student engagement remains an elusive and complex concept in Education, with only five studies (12%) in this sample including a definition of engagement. Whilst it is possible that this finding is due to the search strategy employed, as the term 'student engagement' was not searched for explicitly, it is also highly likely that this is due to issues of differing conceptualisation (Tai, Ajjawi, Bearman, & Wiseman, 2020). Due to the ongoing disagreements surrounding this meta-construct, it is therefore vital that articles investigating aspects of engagement include a definition of their understanding, to enable the study results to be easily interpreted (Appleton et al., 2008; Christenson et al., 2012). It is also important that studies focusing on just one aspect of engagement, relate them to the larger framework of student engagement (Bond & Bedenlier, 2019), and consider how they are connected, as engagement and disengagement exist on a continuum (Pekrun & Linnenbrink-Garcia, 2012).

Mirroring current conversations within the field of educational technology (e.g., Castañeda & Selwyn, 2018; Crook, 2019; Hew et al., 2019), 43% of the articles in this sample did not use a theoretical framework. Those studies that did, drew heavily on approaches related to constructivist theory and practice. With theories including the Community of Inquiry framework, social constructivism and Communities of Practice, as well as then making use of social collaborative learning scenarios (SCL), this is consistent and also reflective of an overarching trend in educational technology research, of giving students the opportunity to shape their learning processes (Bond, Zawacki-Richter, & Nichols, 2019). However, as emerged in some studies within the sample (e.g., Smidt et al., 2014), the use of technology should then also integrate with these approaches and not be overly prescriptive, so that students are encouraged to take responsibility for their learning, as well as their construction of meaning.

Also surprising here was that no articles in this sample used the Technological Pedagogical Content Knowledge (TPACK) framework (Koehler & Mishra, 2005), which was developed in response to precisely this lack of theory guiding the integration of technology within education (Rosenberg & Koehler, 2015). Another systematic review (Voogt et al., 2013), using the exact same four databases as the present review, found and synthesised 44 empirical journal articles on the use and measurement of TPACK published up to 2011, therefore this omission was likely due to either the sampling strategy, or the lack of treatment of student engagement within the articles, as articles using TPACK might be more focused on teacher agency and teacher professional development. An updated search for literature from 2017-2019 would likely find an increased number of articles using and/or investigating TPACK.

Educational technology and student engagement and student disengagement

Across the 42 Education studies, engagement was identified more often than disengagement, with behavioural and affective engagement the two most prevalent dimensions. Whilst it is not possible to establish a causal relationship between an application of technology and a specific facet of engagement, tentative conclusions can be drawn. Making learning in Education a social endeavour, the facet most often found for cognitive engagement was *learning from peers*, which was related to a variety of tools, with social networking tools and website creation tools being the two tools with the highest values (see Table 9). Facets of behavioural engagement were particularly evident when text-based tools, knowledge organisation and sharing tools, and social networking tools were used. Whilst *participation/interaction/involvement* and *achievement* were related to assessment tools, assessment tools were not overly conducive to promoting other behavioural engagement. In terms of affective engagement, knowledge organisation and sharing tools and social networking tools were particularly effective with, not surprisingly, social networking tools resulting in very high numbers of studies indicating *positive interactions with peers and teachers*, as well as *enjoyment*. However, at the same time, social

networking tools also emerged as a somewhat ambivalent tool, as it is also related to *half-hearted* as a facet of behavioural disengagement, as well as *avoidance* as a part of cognitive disengagement.

Thus, technology in education does not guarantee better learning per se (Tamim et al., 2011), and might even be regarded as "unhelpful" (Selwyn, 2016, p. 1008) by students. Selwyn (2016) identifies "distraction" and "difficulty" (p. 1010) as two major reasons why technology can be considered "unhelpful", both of them also found in this review when students reported being *distracted* when watching educational videos (Quinn & Kennedy-Clark, 2015) or *frustrated* when technology was considered a burden and not an asset. This review has shown that *frustration* was the facet of disengagement most often identified across the 42 studies (see Table 14). Students reported *frustration* related to the technical aspects of technology as such (e.g., Deng & Tavares, 2013; Shepherd & Hannafin, 2011) but the same feeling also arose due to their limited abilities to use certain functions of it (e.g., Abendroth et al., 2011). Extending this to other studies in the field, these findings reiterate the perceived challenge of educational technology use in teacher education, with teacher candidates often having a hard time adjusting to technology (Tondeur et al., 2012). However, as studies in this review have also shown, students gain *confidence* when using technology as part of a course and are subsequently more inclined to also use technology upon entering the K-12 classroom (e.g., Chandra & Chalmers, 2010; Smidt et al., 2014). To acknowledge the ambivalence of educational technology use in this regard also then entails further consideration of *dis*engagement, given the various conceptualisations that were identified in the systematic review by Chipchase et al. (2017), ranging from non-engagement/non-participation to a multifaceted construct. It is also important, then, for future studies to further delineate disengagement, and to further explore how educational technology affects disengagement, in order to provide a more balanced and holistic picture of technology use in Education.

Deviating from the overall corpus, most of the scenarios in Education are based on hybrid approaches, combining face-to-face formats with the use of digital tools or online elements. Interestingly, the flipped classroom as a distinct form of blended learning was only employed in one study in this corpus (Quinn & Kennedy-Clark, 2015). Hence, given the increased use of flipped learning in K-12 education and its positive effect on student engagement (e.g., Akçayır & Akçayır, 2018), it seems advisable to integrate blended approaches such as flipped learning more prominently in teacher education. As teacher candidates are also likely to implement this in their classroom, exploring its implementation during preservice education can provide time for experimentation, tweaking and feedback (Admiraal et al., 2017). Furthermore, courses that are solely offered online were less often explored in this Education sample. Whilst countries with established distance education programs (e.g. Australia) have been offering online teacher education courses for some time, many other higher education systems might only be recently embarking on this journey (Qayyum & Zawacki-Richter, 2018). Therefore, further research is warranted into the use of educational technology within online teacher education across different contexts.

This review has highlighted the importance of considering students' technological skills and knowledge, and to provide students with adequate training and preparation in the tools being used in courses, otherwise this is likely to lead to frustration and disengagement. It is also important to help students overcome initial feelings of concern over sharing ideas and collaborating with peers, as this is an important aspect of teaching, and this review has shown that collaboration is an important factor leading to engagement. Whilst some studies reported that using social networking tools was considered a burden by students, participating in course discussions (e.g. through Facebook groups) and wider communities of practice (CoP) online (e.g. Twitter), led to feelings of *connectedness*, *confidence* and *enjoyment*. These results inspire the suggestion that introducing preservice teachers to online CoPs early, might enable them to

develop valuable networks with both beginning and established teachers, which could help them feel less isolated whilst on placements, and which would be a valuable resource for them in their teaching careers. There are healthy teaching communities on Twitter, for example, that regularly share information about lesson ideas, upcoming professional development and career opportunities, and ideas for integrating technology in the classroom (see e.g. hashtags #NQT for beginning teachers, #EduTwitter, #MFLtwitterati for modern foreign language teachers). Therefore, future research exploring how to successfully integrate SNT into preservice education courses would be valuable.

Conclusion

This systematic review of a subset of studies (n = 42) from a larger systematic review (see Bond et al., 2020), synthesised research investigating educational technology and student engagement in the field of Education. Results revealed that behavioural engagement was by far the most affected domain, followed by affective and cognitive engagement. Disengagement was found less frequently, however affective disengagement was promoted the most, with studies finding students experienced frustration, disappointment and worry or anxiety in particular.

In the context of Education, two approaches to the application of educational technology seem to be prominent in and characteristic for this field of study: using technology to enhance communication and social exchange, and using technology for self-directed learning. The review also found that educational technology was particularly effective at enhancing behavioural and affective engagement when text-based tools, knowledge organisation & sharing tools, and social networking tools were used, although some caution is needed when employing social networking tools, as they can also result in frustration and disengagement.

This review highlighted the need for studies to provide full study design information, and to align research with theory. Studies investigating student engagement must also include a definition, in order to move conversations forward, and further studies into how educational

technology affects disengagement would be particularly useful. The review also highlighted a number of other research gaps, including further investigation of online Education, as well as postgraduate courses, alongside research exploring the use of educational technology by in-service teachers, such as the use of online communities of practice. Further research in contexts outside of the US, Hong Kong and UK would also provide further insight, with the use of qualitative methods particularly welcome.

Whilst every effort was made to ensure that the review was carried out rigorously and transparently, a structural bias is nevertheless inherent, having only searched English language databases and included journal articles published from 2007 to 2016, due to the length of time it takes to conduct such a rigorous review (see Borah et al., 2017). Furthermore, the decision to use a sampling technique on the overall sample may have led to important articles being left out of this review. These limitations would need to be addressed in further research, by widening the number of databases searched, as well as including researchers from other dominant academic languages, e.g. Spanish, and focusing the review either on a shorter time frame or on a particular field of study from the beginning (see Bedenlier, et al., 2020A).With the ever-evolving variety of educational technology tools available, a further update of this review to include research from the years 2017-2019 is also suggested, in order to gain further and more recent insight into successful teaching and learning with educational technology in the field of Education.

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References

Abdool, P. S., Nirula, L., Bonato, S., Rajji, T. K., & Silver, I. L. (2017). Simulation in Undergraduate Psychiatry: Exploring the Depth of Learner Engagement. *Academic Psychiatry : the Journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry*, *41*(2), 251–261. https://doi.org/10.1007/s40596-016-0633-9

Abendroth, M., Golzy, J. B., & O'Connor, E. A. (2011). Self-created YouTube recordings of microteachings: Their effects upon candidates' readiness for teaching and instructors' assessment. *Journal of Educational Technology Systems*, *40*(2), 141–159. https://doi.org/10.2190/ET.40.2.e

Admiraal, W., van Vugt, F., Kranenburg, F., Koster, B., Smit, B., Weijers, S., & Lockhorst, D. (2017). Preparing pre-service teachers to integrate technology into K–12 instruction: Evaluation of a technology-infused approach. *Technology, Pedagogy and Education*, *26*(1), 105–120. https://doi.org/10.1080/1475939X.2016.1163283

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education*, *126*, 334–345. https://doi.org/10.1016/j.compedu.2018.07.021

Alcaraz-Salarirche, N., Gallardo-Gil, M., Herrera-Pastor, D., & Serván-Núñez, M. J. (2011). An action research process on university tutorial sessions with small groups: Presentational tutorial sessions and online communication. *Educational Action Research*, *19*(4), 549–565. https://doi.org/10.1080/09650792.2011.625713

Alrasheedi, M., Capretz, L. F., & Raza, A. (2015). A Systematic Review of the Critical Factors for Success of Mobile Learning in Higher Education (University Students' Perspective). *Journal of Educational Computing Research*, *52*(2), 257–276. https://doi.org/10.1177/0735633115571928

Appleton, J., Christenson, S. L., & Furlong, M. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools*, *45*(5), 369–386. https://doi.org/10.1002/pits.20303

Arnold, N., & Paulus, T. (2010). Using a social networking site for experiential learning: Appropriating, lurking, modeling and community building. *The Internet and Higher Education*, *13*(4), 188–196. https://doi.org/10.1016/j.iheduc.2010.04.002

Atmacasoy, A., & Aksu, M. (2018). Blended learning at pre-service teacher education in Turkey: A systematic review. *Education and Information Technologies*, *23*(6), 2399–2422. https://doi.org/10.1007/s10639-018-9723-5

Azevedo, R. (2015). Defining and measuring engagement and learning in science: Conceptual, theoretical, methodological, and analytical issues. *Educational Psychologist*, *50*(1), 84–94. https://doi.org/10.1080/00461520.2015.1004069

Bedenlier, S., Bond, M., Buntins, K., Zawacki-Richter, O., & Kerres, M. (2020A). Facilitating student engagement through educational technology in higher education: A systematic review in the field of arts & humanities. *Australasian Journal of Educational Technology*, *36*(4), 126–150. https://doi.org/10.14742/ajet.5477

Bedenlier, S., Bond, M., Buntins, K., Zawacki-Richter, O., & Kerres, M. (2020B). Learning by Doing? Reflections on Conducting a Systematic Review in the Field of Educational Technology. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic Reviews in Educational Research* (pp. 111–127). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-27602-7_7

Ben-Eliyahu, A., Moore, D., Dorph, R., & Schunn, C. D. (2018). Investigating the multidimensionality of engagement: Affective, behavioral, and cognitive engagement across science activities and contexts. *Contemporary Educational Psychology*, *53*, 87–105. https://doi.org/10.1016/j.cedpsych.2018.01.002

Betihavas, V., Bridgman, H., Kornhaber, R., & Cross, M. (2016). The evidence for 'flipping out': A systematic review of the flipped classroom in nursing education. *Nurse Education Today*, *38*, 15–21. https://doi.org/10.1016/j.nedt.2015.12.010

Boekaerts, M. (2016). Engagement as an inherent aspect of the learning process. *Learning and Instruction*, *43*, 76–83. https://doi.org/10.1016/j.learninstruc.2016.02.001

Bolden, B., & Nahachewsky, J. (2015). Podcast creation as transformative music engagement. *Music Education Research*, *17*(1), 17–33. https://doi.org/10.1080/14613808.2014.969219

Bond, M. (2020). *Facilitating student engagememt through educational technology: Current research, practices and perspectives*. University of Oldenburg, Germany. https://doi.org/10.13140/RG.2.2.24728.75524

Bond, M. (2018). Helping doctoral students crack the publication code: An evaluation and content analysis of the Australasian Journal of Educational Technology. *Australasian Journal of Educational Technology*, *34*(5), 168–183. https://doi.org/10.14742/ajet.4363

Bond, M., & Bedenlier, S. (2019). Facilitating Student Engagement Through Educational Technology: Towards a Conceptual Framework. *Journal of Interactive Media in Education*, *2019*(1), 1–14. https://doi.org/10.5334/jime.528

Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, *17*(1), 1–30. https://doi.org/10.1186/s41239-019-0176-8

Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. *British Journal of Educational Technology*, *50*(1), 12–63. https://doi.org/10.1111/bjet.12730

Borah, R., Brown, A. W., Capers, P. L., & Kaiser, K. A. (2017). Analysis of the time and workers needed to conduct systematic reviews of medical interventions using data from the PROSPERO registry. *BMJ Open*, *7*(2), e012545. https://doi.org/10.1136/bmjopen-2016-012545

Boury, T. T., Hineman, J. M., Klentzin, J. C., & Semich, G. W. (2013). The use of online technology to facilitate pre-service teachers' engagement and cultural competency development during an international field placement: Reflections from Austria. *International Journal of Information and Communication Technology Education*, *9*(3), 65–79. https://doi.org/10.4018/jicte.2013070105

Bower, M. (2016). Deriving a typology of Web 2.0 learning technologies. *British Journal of Educational Technology*, *47*(4), 763–777. https://doi.org/10.1111/bjet.12344

Bower, M. (2015). A typology of Web 2.0 learning technologies. *EDUCAUSE Digital Library*. Retrieved 20 June 2019, from http://www.educause.edu/library/resources/typology-web-20-learning-technologies

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, M., Ribeiro, C., & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*, *94*, 178–192. https://doi.org/10.1016/j.compedu.2015.11.003

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, *27*, 1–13. https://doi.org/10.1016/j.iheduc.2015.04.007

Brunton, J., & Thomas, J. (2012). Information management in systematic reviews. In D. Gough, S. Oliver, & J. Thomas (Eds.), *An introduction to systematic reviews.* (pp. 83–106). London: SAGE.

Buckley, A. (2017). The ideology of student engagement research. *Teaching in Higher Education*, *23*(6), 718–732. https://doi.org/10.1080/13562517.2017.1414789

Bulu, S. T., & Yildirim, Z. (2008). Communication behaviors and trust in collaborative online teams. *Educational Technology & Society*, *11*(1), 132–147. Retrieved from https://pdfs.semanticscholar.org/5bce/a7b2be7b5c908c1e7d9f2a2d931c4b9d4789.pdf

Buntins, K., Bond, M., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2018). *Fuzzy concepts and large literature corpi: Addressing methodological challenges in systematic reviews*. Research Synthesis 2018, University of Trier, Germany. Retrieved from https://www.researchgate.net/publication/325693933_Fuzzy_concepts_and_large_literature_corpi_Addressing_methodological_challenges_in_systematic_reviews

Castañeda, L., & Selwyn, N. (2018). More than tools? Making sense of the ongoing digitizations of higher education. *International Journal of Educational Technology in Higher Education*, *15*(1). https://doi.org/10.1186/s41239-018-0109-y

Chandra, V., & Chalmers, C. (2010). Blogs, wikis and podcasts – Collaborative knowledge building tools in a Design and Technology course. *Journal of Learning Design*, *3*(2), 35–49. Retrieved from https://files.eric.ed.gov/fulltext/EJ903924.pdf

Chen, B. H., & Chiou, H.-H. (2014). Learning style, sense of community and learning effectiveness in hybrid learning environment. *Interactive Learning Environments*, *22*(4), 485–496. https://doi.org/10.1080/10494820.2012.680971

Cheng, G., & Chau, J. (2016). Exploring the relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course. *British Journal of Educational Technology*, *47*(2), 257–278. https://doi.org/10.1111/bjet.12243

Cheng, M. M., Su, C. Y., Zhang, J. P., & Yang, Y. H. (2015). Analyzing temporal patterns of groups and individuals in an online learning forum. *International Journal of Emerging Technologies in Learning*, *10*(5), 66–71. https://doi.org/10.3991/ijet.v10i5.4722

Cheston, C. C., Flickinger, T. E., & Chisolm, M. S. (2013). Social media use in medical education: A systematic review. *Academic Medicine : Journal of the Association of American Medical Colleges*, *88*(6), 893–901. https://doi.org/10.1097/ACM.0b013e31828ffc23

Chipchase, L., Davidson, M., Blackstock, F., Bye, R., Colthier, P., Krupp, N., Nickson, W., Turner, D., & Williams, M. (2017). Conceptualising and measuring student disengagement in higher education: A synthesis of the literature. *International Journal of Higher Education*, *6*(2), 31-42. https://doi.org/10.5430/ijhe.v6n2p31

Christenson, S. L., Reschly, A. L., & Wylie, C. (Eds.). (2012). *Handbook of Research on Student Engagement*. https://doi.org/10.1007/978-1-4614-2018-7

Claro, M., & Ananiadou, K. (2009). *21st Century Skills and Competences for New Millennium Learners in OECD Countries* (OECD Education Working Papers No. 41). https://doi.org/10.1787/218525261154

Coates, H. (2007). A model of online and general campus-based student engagement. *Assessment & Evaluation in Higher Education*, *32*(2), 121–141. https://doi.org/10.1080/02602930600801878

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, *59*(2), 661–686. https://doi.org/10.1016/j.compedu.2012.03.004

Cook, M. P., & Bissonette, J. D. (2016). Developing preservice teachers' positionalities in 140 characters or less: Examining microblogging as dialogic space. *Contemporary Issues in Technology & Teacher Education*, *16*(2), 82–109. Retrieved from https://www.citejournal.org/volume-16/issue-2-16/english-language-arts/developing-preservice-teachers-positionalities-in-140-characters-or-less-examining-microblogging-as-dialogic-space/

Coole, H., & Watts, M. (2009). Communal e-Learning styles in the online classroom. *Research in Education*, *82*(1), 13–27. https://doi.org/10.7227/RIE.82.2

Crompton, H., Burke, D., Gregory, K. H., & Gräbe, C. (2016). The Use of Mobile Learning in Science: A Systematic Review. *Journal of Science Education and Technology*, *25*(2), 149–160. https://doi.org/10.1007/s10956-015-9597-x

Crook, C. (2019). The "British" voice of educational technology research: 50th birthday reflection. *British Journal of Educational Technology*, *50*(2), 485–489. https://doi.org/10.1111/bjet.12757

Deng, L., & Tavares, N. J. (2013). From Moodle to Facebook: Exploring students' motivation and experiences in online communities. *Computers & Education*, *68*, 167–176. https://doi.org/10.1016/j.compedu.2013.04.028

Döring, N., & Bortz, J. (2016). *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften*. https://doi.org/10.1007/978-3-642-41089-5

Finn, J. (2006). *The adult lives of at-risk students: The roles of attainment and engagement in high school (NCES 2006-328).* Retrieved from U.S. Department of Education, National Center for Education Statistics website: https://nces.ed.gov/pubs2006/2006328.pdf

Fredricks, J., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Fredricks, J., Filsecker, M., & Lawson, M. A. (2016). Student engagement, context, and adjustment: Addressing definitional, measurement, and methodological issues. *Learning and Instruction*, *43*, 1–4. https://doi.org/10.1016/j.learninstruc.2016.02.002

Garrison, R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gibbs, W. J., & Bernas, R. S. (2008). Interactional and structural characteristics of communication and social interactions during computer-mediated communication. *Journal of Computing in Higher Education*, *20*(1), 3–33. https://doi.org/10.1007/BF03033430

Gough, D., Oliver, S., & Thomas, J. (Eds.). (2012). *An introduction to systematic reviews*. London ; Thousand Oaks, Calif: SAGE.

Granberg, C. (2010). Social software for reflective dialogue: Questions about reflection and dialogue in student teachers' blogs. *Technology Pedagogy and Education*, *19*(3), 345–360. https://doi.org/10.1080/1475939X.2010.513766

Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation*, *11*(1), 1-20. Retrieved from https://files.eric.ed.gov/fulltext/EJ1103654.pdf

Grimley, M., Green, R., Nilsen, T., & Thompson, D. (2012). Comparing computer game and traditional lecture using experience ratings from high and low achieving students. *Australasian Journal of Educational Technology*, *28*(4), 619–638. https://doi.org/10.14742/ajet.831

Hatzipanagos, S., & Code, J. (2016). Open badges in online learning environments: Peer feedback and formative assessment as an engagement intervention for promoting agency. *Journal of Educational Multimedia and Hypermedia*, *25*(2), 127–142. Retrieved from https://www.learntechlib.org/primary/p/173130/

Helsing, D., Drago-Severson, E., & Kegan, R. (2004). Applying constructive-developmental theories of adult development to ABE and ESOL practices. In J. Comings, B. Garner, & C. Smith (Eds.), *Review of Adult Learning and Literacy* (Vol. 4, pp. 157–197). Routledge.

Hemphill, L. S., & Hemphill, H. H. (2007). Evaluating the impact of guest speaker postings in online discussions. *British Journal of Educational Technology*, *38*(2), 287–293. https://doi.org/10.1111/j.1467-8535.2006.00622.x

Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning: A review. *Computers & Education*, *90*, 36–53. https://doi.org/10.1016/j.compedu.2015.09.005

Hew, K. F. (2015). Student perceptions of peer versus instructor facilitation of asynchronous online discussions: Further findings from three cases. *Instructional Science*, *43*(1), 19–38. https://doi.org/10.1007/s11251-014-9329-2

Hew, K. F., & Cheung, W. S. (2013). Use of Web 2.0 technologies in K-12 and higher education: The search for evidence-based practice. *Educational Research Review*, *9*, 47–64. https://doi.org/10.1016/j.edurev.2012.08.001

Hew, K. F., Lan, M., Tang, Y., Jia, C., & Lo, C. K. (2019). Where is the "theory" within the field of educational technology research? *British Journal of Educational Technology*, *50*(3), 956–971. https://doi.org/10.1111/bjet.12770

Hexom, D., & Menoher, J. (2012). Addressing the affective domain in online university courses. *International Journal of Learning*, *18*(8), 141–152. https://doi.org/10.18848/1447-9494/CGP/v18i08/47710

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, *2*(1). https://doi.org/10.9707/2307-0919.1014

Hunsu, N. J., Adesope, O., & Bayly, D. J. (2016). A meta-analysis of the effects of audience response systems (clicker-based technologies) on cognition and affect. *Computers & Education*, *94*, 102–119. https://doi.org/10.1016/j.compedu.2015.11.013

Ikpeze, C. (2007). Small group collaboration in peer-led electronic discourse: An analysis of group dynamics and interactions involving preservice and inservice teachers. *Journal of Technology and Teacher Education*, *15*(3), 383–407. Retrieved from https://www.learntechlib.org/primary/p/21043/

Jabbour, K. K. (2014). An analysis of the effect of mobile learning on Lebanese higher education. *Informatics in Education*, *13*(1), 1–15. Retrieved from https://eric.ed.gov/?id=EJ1064345

Joksimović, S., Poquet, O., Kovanović, V., Dowell, N., Mills, C., Gašević, D., Dawson, S., Graesser, A.C., & Brooks, C. (2018). How Do We Model Learning at Scale? A Systematic Review of Research on MOOCs. *Review of Educational Research*, *88*(1), 43–86. https://doi.org/10.3102/0034654317740335

Junco, R. (2012). The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. *Computers & Education*, *58*(1), 162–171. https://doi.org/10.1016/j.compedu.2011.08.004

Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, *38*(5), 758–773. https://doi.org/10.1080/03075079.2011.598505

Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: The African perspective. *Turkish Online Journal of Educational Technology - TOJET*, *16*(1), 1–18. Retrieved from https://files.eric.ed.gov/fulltext/EJ1124918.pdf

Kay, R. H., & LeSage, A. (2009). Examining the benefits and challenges of using audience response systems: A review of the literature. *Computers & Education*, *53*(3), 819–827. https://doi.org/10.1016/j.compedu.2009.05.001

Keller, J. M., & Subhiyah, R. (1993). *Course interest survey*. Tallahassee, FL: Instructional Systems Program, Florida State University.

Kelley, K., Lai, K., Lai, M. K., & Suggests, M. (2018). *Package "MBESS."* Retrieved from https://cran.r-project.org/web/packages/MBESS/MBESS.pdf

Kim, C., & Keller, J. M. (2011). Towards technology integration: The impact of motivational and volitional email messages. *Educational Technology Research and Development*, *59*(1), 91–111. https://doi.org/10.1007/s11423-010-9174-1

Koehler, M., & Mishra, P. (2005). What happens when teachers design educational technology? The development of Technological Pedagogical Content Knowledge. *Journal of Educational Computing Research*, *32*(2), 131–152. https://doi.org/10.2190/0EW7-01WB-BKHL-QDYV

Kuh, G. D., Cruce, T. M., Shoup, R., Kinzie, J., & Gonyea, R. M. (2008). Unmasking the effects of student engagement on first-year college grades and persistence. *The Journal of Higher Education*, *79*(5), 540–563. https://doi.org/10.1080/00221546.2008.11772116

Kupper, L. L., & Hafner, K. B. (1989). How appropriate are popular sample size formulas? *The American Statistician*, *43*(2), 101–105. https://doi.org/10.1080/00031305.1989.10475628

Lee, H. Y., & Lee, H. W. (2016). Comparing social network analysis of posts with counting of posts as a measurement of learners' participation in Facebook discussions. *Turkish Online Journal of Educational Technology*, *15*(1), 11–19. Retrieved from https://files.eric.ed.gov/fulltext/EJ1086199.pdf

Leese, M. (2009). Out of class-out of mind? The use of a virtual learning environment to encourage student engagement in out of class activities. *British Journal of Educational Technology*, *40*(1), 70–77. https://doi.org/10.1111/j.1467-8535.2008.00822.x

Li, J., van der Spek, E. D., Feijs, L., Wang, F., & Hu, J. (2017). Augmented Reality Games for Learning: A Literature Review. In N. Streitz & P. Markopoulos (Eds.), *Lecture Notes in Computer Science. Distributed, Ambient and Pervasive Interactions* (Vol. 10291, pp. 612–626). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-58697-7_46

Liu, P. (2016). Technology integration in elementary classrooms: Teaching practices of student teachers. *Australian Journal of Teacher Education*, *41*(3), 87–104. https://doi.org/10.14221/ajte.2016v41n3.6

Lundin, M., Bergviken Rensfeldt, A., Hillman, T., Lantz-Andersson, A., & Peterson, L. (2018). Higher education dominance and siloed knowledge: A systematic review of flipped classroom research. *International Journal of Educational Technology in Higher Education*, *15*(1), 1-30. https://doi.org/10.1186/s41239-018-0101-6

Mahatmya, D., Lohman, B. J., Matjasko, J. L., & Farb, A. F. (2012). Engagement across developmental periods. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 45–63). Boston, MA: Springer US. Retrieved from http://link.springer.com/10.1007/978-1-4614-2018-7_3

Martin, A. J. (2012). Part II Commentary: Motivation and engagement: Conceptual, operational, and empirical clarity. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (Vol. 52, pp. 303–311). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4614-2018-7_14

McCutcheon, K., Lohan, M., Traynor, M., & Martin, D. (2015). A systematic review evaluating the impact of online or blended learning vs. Face-to-face learning of clinical skills in undergraduate nurse education. *Journal of Advanced Nursing*, *71*(2), 255–270. https://doi.org/10.1111/jan.12509

Mentzer, G., Cryan, J., & Teclehaimanot, B. (2007). Two peas in a pod? A comparison of face-to-face and web based classrooms. *Journal of Technology and Teacher Education*, *15*(2), 233–246. Retrieved from https://www.learntechlib.org/primary/p/19863/

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *British Medical Journal*, *339*, 1-8. https://doi.org/10.1136/bmj.b2535

Mouza, C. (2019). Editorial: New technologies for teacher professional learning. *Contemporary Issues in Technology and Teacher Education*, *19*(1). Retrieved from https://www.citejournal.org/volume-19/issue-1-19/editorial/editorial-new-technologies-for-teacher-professional-learning

Nguyen, L., Barton, S. M., & Nguyen, L. T. (2015). iPads in higher education-Hype and hope. *British Journal of Educational Technology*, *46*(1), 190–203. https://doi.org/10.1111/bjet.12137

Nikou, S. A., & Economides, A. A. (2018). Mobile-based assessment: A literature review of publications in major referred journals from 2009 to 2018. *Computers & Education*, *125*, 101–119. https://doi.org/10.1016/j.compedu.2018.06.006

OECD (2018). *Teaching for the Future: Effective Classroom Practices to Transform Education*. Retrieved from OECD website: http://dx.doi.org/10.1787/9789264293243-en.

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, *25*, 85–95. https://doi.org/10.1016/j.iheduc.2015.02.002

Oliver, B., & Jorre de St Jorre, T. (2018). Graduate attributes for 2020 and beyond: Recommendations for Australian higher education providers. *Higher Education Research & Development*, *37*(4), 821–836. https://doi.org/10.1080/07294360.2018.1446415

Park, S., & Kim, C. (2015). Boosting learning-by-teaching in virtual tutoring. *Computers & Education*, *82*, 129–140. https://doi.org/10.1016/j.compedu.2014.11.006

Payne, L. (2017). Student engagement: Three models for its investigation. *Journal of Further and Higher Education*, *3*(2), 1–17. https://doi.org/10.1080/0309877X.2017.1391186

Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 259–282). https://doi.org/10.1007/978-1-4614-2018-7_12

Ping, C., Schellings, G., & Beijaard, D. (2018). Teacher educators' professional learning: A literature review. *Teaching and Teacher Education*, *75*, 93–104. https://doi.org/10.1016/j.tate.2018.06.003

Qayyum, A., & Zawacki-Richter, O. (Eds.). (2018). *SpringerBriefs in Education*. *Open and Distance Education in Australia, Europe and the Americas*. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-13-0298-5

Quinn, M., & Kennedy-Clark, S. (2015). Adopting online lecturing for improved learning: A case study from teacher education. *Journal of University Teaching and Learning Practice*, *12*(3), 1-19. Retrieved from http://ro.uow.edu.au/jutlp/vol12/iss3/9

Redecker, C. (2017). *European Framework for the Digital Competence of Educators*. Luxembourg: Publications Office of the European Union.

Redmond, P., Heffernan, A., Abawi, L., Brown, A., & Henderson, R. (2018). An online engagement framework for higher education. *Online Learning*, *22*(1). https://doi.org/10.24059/olj.v22i1.1175

Reeve, J., & Tseng, C.-M. (2011). Agency as a fourth aspect of students' engagement during learning activities. *Contemporary Educational Psychology*, *36*(4), 257-267. https://doi.org/10.1016/j.cedpsych.2011.05.002

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, *47*(3), 186–210. https://doi.org/10.1080/15391523.2015.1052663

Rovai, A. P. (2002). Development of an instrument to measure classroom community. *The Internet and Higher Education*, *5*(3), 197–211. https://doi.org/10.1016/S1096-7516(02)00102-1

Ruane, R., & Lee, V. (2016). Analysis of discussion board interaction in an online peer mentoring site. *Online Learning*, *20*(4), 79–99. Retrieved from https://files.eric.ed.gov/fulltext/EJ1124635.pdf

Saadatmand, M., & Kumpulainen, K. (2013). Content aggregation and knowledge sharing in a personal learning environment: Serendipity in open online networks. *International Journal of Emerging Technologies in Learning (IJET)*, *8*(S1), 70-77. https://doi.org/10.3991/ijet.v8iS1.2362

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: a critical review of the literature. *International Journal of Educational Technology in Higher Education*, *14*(1), 253. https://doi.org/10.1186/s41239-017-0063-0

Selwyn, N. (2016). Digital downsides: exploring university students' negative engagements with digital technology. *Teaching in Higher Education*, *21*(8), 1006–1021. https://doi.org/10.1080/13562517.2016.1213229

Sharma, P., & Tietjen, P. (2016). Examining patterns of participation and meaning making in student blogs: A case study in higher education. *American Journal of Distance Education*, *30*(1), 2–12. https://doi.org/10.1080/08923647.2016.1119605

Shepherd, C., & Hannafin, M. (2011). Supporting preservice teacher inquiry with electronic portfolios. *Journal of Technology and Teacher Education*, *19*(2), 189–207. Retrieved from https://www.learntechlib.org/primary/p/30265/

Shonfeld, M., & Ronen, I. (2015). Online learning for students from diverse backgrounds: Learning disability students, excellent students and average students. *IAFOR Journal of Education*, *3*(2), 13–29. Retrieved from https://eric.ed.gov/?id=EJ1100564

Skinner, E., & Pitzer, J. R. (2012). Developmental dynamics of student engagement, coping, and everyday resilience. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 21–44). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4614-2018-7_2

Smidt, E., Bunk, J., McGrory, B., Li, R., & Gatenby, T. (2014). Student attitudes about distance education: Focusing on context and effective practices. *IAFOR Journal of Education*, *2*(1), 40–64. https://doi.org/10.22492/ije.2.1.02

Smith, D., & Kolb, D. A. (1985). *User guide for the learning style inventory*. Boston: McBer & Company.

Smith, T., & Lambert, R. (2014). A systematic review investigating the use of Twitter and Facebook in university-based healthcare education. *Health Education*, *114*(5), 347–366. https://doi.org/10.1108/HE-07-2013-0030

Sosa Neira, E. A., Salinas, J., & Benito, B. de (2017). Emerging Technologies (ETs) in Education: A Systematic Review of the Literature Published between 2006 and 2016. *International Journal of Emerging Technologies in Learning (iJET)*, *12*(05), 128. https://doi.org/10.3991/ijet.v12i05.6939

Szabo, Z., & Schwartz, J. (2011). Learning methods for teacher education: the use of online discussions to improve critical thinking. *Technology Pedagogy and Education*, *20*(1), 79–94. https://doi.org/10.1080/1475939x.2010.534866

Tai, J., Ajjawi, R., Bearman, M., & Wiseman, P. (2020). Conceptualizations and Measures of Student Engagement: A Worked Example of Systematic Review. In O. Zawacki-Richter, M. Kerres,

S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic Reviews in Educational Research* (pp. 91–110). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-27602-7_6

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4–28. https://doi.org/10.3102/0034654310393361

Teng, D. C.-E., Chen, N.-S., Kinshuk, & Leo, T. (2012). Exploring students' learning experience in an international online research seminar in the Synchronous Cyber Classroom. *Computers & Education*, *58*(3), 918–930. https://doi.org/10.1016/j.compedu.2011.10.018

Theelen, H., van den Beemt, A., & Brok, P. den. (2019). Classroom simulations in teacher education to support preservice teachers' interpersonal competence: A systematic literature review. *Computers & Education*, *129*, 14–26. https://doi.org/10.1016/j.compedu.2018.10.015

Tondeur, J., Scherer, R., Baran, E., Siddiq, F., Valtonen, T., & Sointu, E. (2019). Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. *British Journal of Educational Technology*, *50*(3), 1189-1209. https://doi.org/10.1111/bjet.12748

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, *59*(1), 134–144. https://doi.org/10.1016/j.compedu.2011.10.009

UNESCO Institute for Statistics. (2015). *International Standard Classification of Education: Fields of education and training 2013 (ISCED-F 2013) Detailed field descriptions*. https://doi.org/10.15220/978-92-9189-179-5-en

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge - a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109–121. https://doi.org/10.1111/j.1365-2729.2012.00487.x

Vural, O. F. (2013). The impact of a question-embedded video-based learning tool on e-Learning. *Educational Sciences: Theory and Practice*, *13*(2), 1315–1323. Retrieved from https://eric.ed.gov/?id=EJ1017292

Webb, L., Clough, J., O'Reilly, D., Wilmott, D., & Witham, G. (2017). The utility and impact of information communication technology (ICT) for pre-registration nurse education: A narrative synthesis systematic review. *Nurse Education Today*, *48*, 160–171. https://doi.org/10.1016/j.nedt.2016.10.007

Wenger, E. (1998). *Communities of practice: Learning, meaning, identity.* Cambridge: Cambridge University Press.

Whipp, J. L., & Lorentz, R. A. (2009). Cognitive and social help giving in online teaching: an exploratory study. *Educational Technology Research and Development*, *57*(2), 169–192. https://doi.org/10.1007/s11423-008-9104-7

Yang, X. M., Li, X. J., & Lu, T. (2015). Using mobile phones in college classroom settings: Effects of presentation mode and interest on concentration and achievement. *Computers & Education*, *88*, 292–302. https://doi.org/10.1016/j.compedu.2015.06.007

Yusop, F. D., & Basar, A. M. M. A. (2014). Effective integration of wiki for collaborative learning in higher education context. *World Applied Sciences Journal*, *30*(30 A), 85–90. https://doi.org/10.5829/idosi.wasj.2014.30.icmrp.13

Zepke, N. (2014). Student engagement research in higher education: questioning an academic orthodoxy. *Teaching in Higher Education*, *19*(6), 697–708. https://doi.org/10.1080/13562517.2014.901956

Zepke, N. (2018). Student engagement in neo-liberal times: what is missing? *Higher Education Research & Development*, *37*(2), 433–446. https://doi.org/10.1080/07294360.2017.1370440

Appendix A – Facets of student engagement and disengagement

Engagement Facets

Cognitive engagement	Affective engagement	Behavioural engagement
Purposeful	Enthusiasm	Attendance
Integrating ideas	Sense of belonging	Study habits
Doing extra to learn more	Satisfaction	Developing agency
Follow through/care/thoroughness	Curiosity	Participation/involvement
Positive self-perceptions & self-efficacy	Sees relevance	Developing multidisciplinary skills
Preference for challenging tasks	Sense of connectedness to school/university	Attention/focus
Teaching self & peers	Positive interactions with peers & teachers	Time on task/staying on task/persistence
Use of sophisticated learning strategies	Positive attitude about learning/values learning	Interaction (peers, teacher, content, technology)
Positive perceptions of teacher support	Interest	Accessing course material
Critical thinking	Enjoyment	Identifying opportunities and challenges
Setting learning goals	Sense of wellbeing	Supporting & encouraging peers
Self-regulation	Pride	Attempting
Operational reasoning	Vitality/zest	Homework completion
Trying to understand	Excitement	Positive conduct
Reflection	Desire to do well	Action/initiation
Concentration/focus	Feeling appreciated	Confidence
Deep learning	Manages expectations	Assuming responsibility
Learning from peers		Asking teacher or peers for help
Justifying decisions		

Disengagement Facets

Cognitive disengagement	Affective disengagement	Behavioural disengagement
Aimless	Boredom	Procrastination
Unwilling	Anger	Half-hearted
Apathy	Shame	Mentally withdrawn
Helpless	Dislike	Absent
Opposition/rejection	Disinterest	Giving up
Hopeless	Sadness	Unfocused/inattentive
Resigned	Self-blame	Burned out/exhausted
Avoidance	Disappointment	Poor conduct
Pressured	Frustration	Restlessness
	Worry/anxiety	Distracted
	Overwhelmed	Unprepared
		Task incompletion

Sourced from a range of literature:

Appleton et al., 2008; Filsecker & Kerres, 2014; Fredricks et al., 2016; Fredricks et al., 2004; Henrie et al., 2015; Kahu, 2013; Mahatmya et al., 2012; Martin, 2012; Redmond et al., 2018; Reeve, 2012; Skinner & Pitzer, 2012; Zepke, 2014

Appendix B – Educational technology tool typology, based on Bower (2016)

Text-based tools	Multimodal production tools	Website creation tools	Knowledge organisation and sharing	Data analysis tools
Discussion forums	Animations	Blogs	Cloud storage	Learning analytics dashboard
Collaborative writing tools	Tutorials	ePortfolios	Bookmarking	
Readings	Recorded lectures		LMS	
Newsletter	Videos		Diary tool in Moodle	
Text	Podcast/Vodcast			
RSS	Screencast			
Interactive textbook	Authoring tools			
Annotation tools	Voice recorder			
Email				
Chat				
Instant messaging				
Wikis				

Digital Storytelling tools	Assessment tools	Social networking tools	Synchronous collaboration tools	Mobile learning
Storyboards	eAssessment	Social platforms	Audio-Video conferencing	Apps
	Quizzes	Microblogging		mLearning
	ARS			
	Open badges			

Virtual worlds	Learning software	Online learning	Hardware	Peer e-tutors
Virtual lab	Language learning software	Homepage	Tablets	Peer e-tutors
Simulations	Presentation software		Hardware	
Virtual worlds			Interactive whiteboards	

Games
Games

Appendix C – Brief bibliometric information for included studies

Author	Year	Journal	Citations	Field of Study
Abendroth et al.	2008	Community College Journal of Research and Practice	7	Preservice teachers
Alcaraz-Salarirche et al.	2014	Frontiers in Psychology	50	Preservice teachers
Arnold & Paulus	2010	Internet and Higher Education	317	Preservice teachers
Bolden & Nahachewsky	2015	Music Education Research	8	Preservice teachers
Boury et al.	2013	International Journal of Information and Communication Technology Education	2	Preservice teachers
Bulu & Yilidim	2008	Educational Technology & Society	51	Preservice teachers
Chandra & Chalmers	2010	Journal of Learning Design	31	Preservice teachers
Chen & Chiou	2014	Interactive Learning Environments	40	Preservice teachers
Cheng et al.	2015	International Journal of Emerging Technologies in Learning	1	Preservice & In-Service teachers
Cheng & Chau	2016	British Journal of Educational Technology	65	General ed. technology course
Cook & Bissonnette	2016	Contemporary Issues in Technology and Teacher Education	7	Preservice teachers
Coole & Watts	2009	Research in Education	27	Preservice teachers
Deng & Tavares	2013	Computers & Education	224	Preservice teachers
Gibbs & Bernas	2008	Journal of Computing in Higher Education	2	Preservice teachers
Granberg	2010	Technology Pedagogy and Education	41	Preservice teachers
Gray & DiLoreto	2016	International Journal of Educational Leadership Preparation	41	In-service teachers
Grimley et al.	2012	Australasian Journal of Educational Technology	21	General ed. technology course
Hatzipanagos & Code	2016	Journal of Educational Multimedia and Hypermedia	1	Unsure
Hemphill & Hemphill	2007	British Journal of Educational Technology	38	General ed. technology course
Hew (Study 1)	2015	Instructional Science	40	General ed. technology course
Hew (Study 2)	2015	Instructional Science	40	General ed. technology course
Hexom & Menoher	2012	International Journal of Learning	1	Unsure
Ikpeze	2007	Journal of Technology and Teacher Education	58	Preservice & In-Service teachers
Jabbour	2014	Informatics in Education	28	General ed. technology course
Kim & Keller	2011	Educational Technology Research and Development	35	Preservice teachers
Lee & Lee	2016	Turkish Online Journal of Educational Technology	5	General ed. technology course
Leese	2009	British Journal of Educational Technology	62	Early childhood
Mentzer et al.	2007	Journal of Technology and Teacher Education	116	Preservice teachers
Park & Kim	2015	Computers & Education	15	Preservice teachers & others
Quinn & Kennedy-Clark	2015	Journal of University Teaching and Learning Practice	3	Preservice teachers
Ruane & Lee	2016	Online Learning	4	Preservice teachers
Saadatmand & Kumpulainen	2013	International Journal of Emerging Technologies in Learning	32	General ed. technology course
Sharma & Tietjen	2016	American Journal of Distance Education	8	General ed. technology course
Shepherd & Hannafin	2011	Journal of Technology and Teacher Education	22	Preservice teachers
Shonfeld & Ronen	2015	IAFOR Journal of Education	2	Preservice teachers
Smidt et al.	2014	IAFOR Journal of Education	2	Preservice teachers
Szabo & Schwartz	2011	Technology Pedagogy and Education	78	Preservice teachers & others
Teng et al.	2012	Computers & Education	36	General ed. technology course
Vural	2013	Educational Sciences: Theory and Practice	56	Preservice teachers
Whipp & Lorentz	2009	Educational Technology Research and Development	79	In-service teachers
Yang et al.	2015	Computers & Education	34	Preservice teachers
Yusop & Basar	2014	World Applied Sciences Journal	10	Preservice teachers

Appendix D - Literature reviews (LR), systematic reviews (SR) and meta-analyses (MA) on student engagement and technology in higher education (HE)

Year	Author(s)	Type	Context	Focus
2009	Kay & LeSage	LR	Any	ARS*
2011	Tamim et al.	MA	Any	Student achievement
2012	Connolly et al.	SR	Any	Digital games
2013	Cheston et al.	SR	HE (medical education)	Social media
2013	Hew & Cheung	LR	Any	Web 2.0 tools
2014	Smith & Lambert	SR	HE (healthcare)	Twitter and Facebook
2015	Alrasheedi et al.	SR	HE	Mobile learning
2015	Broadbent & Poon	SR	HE	Online learning
2015	Henrie et al.	LR	Any	SE Measurement
2015	McCutcheon et al.	SR	HE (undergrad nursing)	Online/blended learning vs face-to-face
2015	Nguyen et al.	SR	HE	iPads
2015	O'Flaherty & Phillips	LR	HE	Flipped classroom
2016	Boyle et al.	SR	Any	Computer games and serious games
2016	Crompton et al.	SR	Any (Science)	Mobile learning
2016	Hunsu et al.	MA	Any	ARS* on cognition and affect
2016	Betihavas et al.	SR	HE (nursing)	Flipped learning outcomes
2017	Kaliisa & Picard	SR	HE (Africa)	Mobile learning
2017	Li et al.	LR	Any	Augmented Reality Games
2017	Schindler et al.	LR	HE	Web-conferencing, blogs, wikis, Facebook, Twitter, digital games
2017	Abdool et al.	SR	HE (undergrad psychiatry)	Simulations
2017	Sosa Neira et al.	SR	Any	Emerging Technologies
2017	Webb et al.	SR	HE (pre-nurse registration)	OER, podcasts & social media, computer based assessment, ARS, e-portfolios, nurse faculty adoption, simulation
2018	Atmacasoy & Aksu	SR	HE (pre-service teacher education in Turkey)	Blended Learning
2018	Joksimovic et al.	SR	HE	MOOCs
2018	Lundin et al.	SR	Any	Flipped learning
2018	Nikou & Economides	LR	Any	Mobile-based assessment
2018	Redmond et al.	LR	HE	Online learning

* Audience response systems

Appendix E - List of studies in the sample (n = 42)

Author	Year	Country	Institution	Study Level	Mode of Delivery	Study Duration	Approach	Participants	Ed Tech	BE	AE	CE	BD	AD	CD	O
Abendroth et al.	2008	USA	College	Post	Blended	1 Semester	AR, GT	11		X	X	X		X		
Alcaraz-Salarirche et al.	2014	Spain	University	Undergrad	Blended	1 year	AR	N/S		X	X	X			X	
Arnold & Paulus	2010	USA	University	Both	Blended	N/S	CS	8		X	X	X	X		X	
Bolden & Nahachewsky	2015	Canada	University	Undergrad	N/S	N/S	CS	9		X	X	X				
Boury et al.	2013	USA	University	Undergrad	Blended	16 weeks	CS	42		X	X	X				
Bulu & Yilidim	2008	Turkey	University	Undergrad	Blended	15 weeks	CS	32		X	X	X	X	X		
Chandra & Chalmers	2010	Australia	University	Undergrad	N/S	10 weeks	Q	200		X	X	X				
Chen & Chiou	2014	Taiwan	University	N/S	Blended	1 semester	QE	81(I) 59(C)		X	X					
Cheng et al.	2015	China	University	Undergrad	Blended	8 weeks	NE	32		X						
Cheng & Chau	2016	Hong Kong	N/S	Undergrad	Blended	11 weeks	NE	78		X						
Cook & Bissonnette	2016	USA	University	Undergrad	F2F	1 semester	CS	20		X	X	X	X	X	X	
Coole & Watts	2009	UK	University	Post	Blended	1 year	CS	154		X		X				
Deng & Tavares	2013	Hong Kong	University	Undergrad	Blended	1 year	EQ	14		X	X	X	X	X	X	
Gibbs & Bernas	2008	USA	University	Undergrad	Blended	6 weeks	NE	46		X	X					
Granberg	2010	Sweden	University	Undergrad	Blended	1 year	MM	56		X		X	X	X		
Gray & DiLoreto	2016	USA	University	Post	Distance	1 semester	NE	187			X					X
Grimley et al.	2012	UK	University	Undergrad	F2F	12 weeks	NE	108		X	X	X	X	X		X
Hatzipanagos & Code	2016	UK	University	Both	F2F	N/S	Q	128		X	X			X		
Hemphill & Hemphill	2007	USA	University	Post	Distance	16 weeks	NE	16		X	X					
Hew (Study 1)	2015	Hong Kong	N/S	Undergrad	Blended	1 semester	CS	39		X	X	X		X	X	
Hew (Study 2)	2015	Hong Kong	N/S	Post	Blended	N/S	CS	65		X	X	X		X	X	
Hexom & Menoher	2012	USA	University	Post	Distance	2 years	NE	N/S			X					
Ikpeze	2007	USA	University	Post	Blended	1 semester	CS	13		X	X	X	X	X	X	
Jabbour	2014	Lebanon	University	Undergrad	F2F	1 semester	NE	38		X	X	X	X	X		
Kim & Keller	2011	USA	University	Undergrad	F2F	4 weeks	E/RCT	56		X		X				
Lee & Lee	2016	South Korea	University	N/S	N/S	N/S	E/RCT	108		X	X					

Note: N/S = Not stated, Post = Postgraduate, Undergrad = Undergraduate, Both = Postgraduate and Undergraduate, Blended = Blended learning, F2F = Face-to-face, Distance = Distance education, AR = Action Research, GT = Grounded Theory, CS = Case Study, Q = Qualitative study (approach unclear), QE = Quasi-Experimental, NE = Non-Experimental, EQ = Explorative Qualitative, MM = Mixed Methods, E/RCT = Experimental/RCT, I = Intervention, C = Control, BE = Behavioural engagement, AE = Affective engagement, CE = Cognitive engagement, BD = Behavioural disengagement, AD = Affective disengagement, CD = Cognitive disengagement, O = Overall engagement

= Text-based Tools, = Multimodal Production Tools, = Website Creation Tools, = Knowledge Organisation & Sharing Tools, = Assessment Tools, = Social Networking Tools, = Synchronous Collaboration Tools, = Mobile Learning, = MOOC, = Virtual Worlds, = Online Learning, = Hardware

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Studies continued (n = 42)

Author	Year	Country	Institution	Study Level	Mode of Delivery	Study Duration	Approach	Participants	Ed Tech	BE	AE	CE	BD	AD	CD	O
Leese	2009	UK	University	Undergrad	Blended	N/S	Q	74		X	X	X			X	
Mentzer et al.	2007	USA	College	N/S	Distance, F2F	1 semester	E/RCT	36			X					
Park & Kim	2015	USA	University	Undergrad	Blended	N/S	MM/NE	18		X	X	X		X		X
Quinn & Kennedy-Clark	2015	Australia	University	Undergrad	Blended	1 semester	MM/CS	84		X	X	X	X	X	X	
Ruane & Lee	2016	USA	University	Undergrad	Distance	1 semester	Q	6		X	X	X				
Saadatmand & Kumpulainen	2013	International	University	N/S	Distance	1 semester	Ethnography	12			X	X				
Sharma & Tietjen	2016	USA	N/S	Post	Distance	2 semesters	MM/NE	12		X	X	X				
Shepherd & Hannafin	2011	USA	University	Undergrad	Blended	1 semester	Q	6		X	X			X	X	
Shonfeld & Ronen	2015	N/S	N/S	Undergrad	Distance	N/S	MM/NE	9		X	X	X	X			
Smidt et al.	2014	USA	University	Both	Blended, Distance	N/S	Q	36		X	X	X	X	X	X	
Szabo & Schwartz	2011	USA	University	Undergrad	Distance, F2F	1 semester	MM, E/RCT	93		X	X	X				
Teng et al.	2012	International	N/S	Post	Distance	1 semester	MM/NE	17		X	X		X	X		
Vural	2013	Turkey	University	N/S	Distance	1 semester	NE	318		X						
Whipp & Lorentz	2009	USA	University	Post	Blended	N/S	CS	21			X	X	X	X		
Yang et al.	2015	China	University	Undergrad	Blended	1 semester	QE	258		X	X	X				
Yusop & Basar	2014	Malaysia	University	Both	Blended	14 weeks	QE	30		X	X	X				

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