ARTICLE

Facilitating Student Engagement Through Educational Technology: Towards a Conceptual Framework

Melissa Bond and Svenja Bedenlier

The concept of student engagement has become somewhat of an enigma for educators and researchers, with ongoing discussions about its nature and complexity, and criticism about the depth and breadth of theorising and operationalisation within empirical research. This equally applies to research conducted in the field of educational technology and its application in schools and higher education. Recognising the inherent role that technology now plays in education, and the potential it has to engage students, this paper draws on a range of student engagement literature and conceptualises a provisional bioecological framework of student engagement that explicitly includes technology as one influential factor. This paper first proposes a definition of student engagement and provides an exploration of positive student engagement indicators. It then presents a bioecological framework, and the microsystemic facets of technology, teacher and curriculum are further explored in their relation to fostering student engagement. Based on this framework, implications for further theory-based research into student engagement and its relation to educational technology are discussed and recommendations for educators are given.

Introduction

The concept of student engagement has become somewhat of an enigma for educators and researchers, with ongoing discussions about its nature and complexity, and criticism about the depth and breadth of theorising and operationalisation within empirical research (e.g. Kahn, 2014; Zepke, 2018a). The role that digital technology plays in affecting student engagement is a particular area of interest, as it has become a central feature within the student educational experience (Henderson, Selwyn and Aston, 2017; Selwyn, 2016). Recognition is growing of the importance of digital literacy and information and communications technology (ICT) skills (Organisation for Economic Co-operation and Development [OECD], 2015; Redecker, 2017), as is evidence of technology's potential to increase self-efficacy, self-regulation and involvement within the wider educational community (Alioon and Delialioğlu, 2019; Junco, 2012). The field of educational technology has, however, lacked theoretical guidance (Antonenko, 2015; Karabulut-Ilgu, Jaramillo Cherrez and Jahren, 2018), with the operationalisation and understanding of student engagement being a particular issue (Henrie, Halverson and Graham, 2015). Calls have been made, therefore, for a strengthening of theoretical under-

standing and the use of theory within empirical research in the field (e.g. Hennessy et al. 2019; Hew et al. 2019), as well as for further understanding of how educational technology can affect student engagement in particular (e.g. Castañeda and Selwyn, 2018; Nelson Laird and Kuh, 2005). Although recent efforts have investigated the interplay of engagement and educational technology, these have been limited to informal learning contexts (e.g. MOOCs, see Joksimović et al. 2018) and online learning in higher education (e.g. Redmond et al. 2018).

This paper forms part of the first author's PhD by publication, which is an exploration into the complexity of the ever-evolving concept of student engagement, in an effort to gain further understanding of how technology interacts with and affects aspects of the learning environment in both school and higher education contexts. It also forms the theoretical basis of a larger research project on student engagement and technology in higher education.[1] The present paper presents a bioecological student engagement framework developed by the first author, in order to guide and ground further research on this complex topic. The model includes influences on student engagement at the macro, exo, meso and micro levels, with a particular focus on the microsystem – the student's immediate learning environment – as this is where practitioners are able to exert the most influence. Recommendations are then provided on how the framework can be used by practitioners, and how it can help improve practice.

Carl von Ossietsky Universität Oldenburg, DE

Corresponding author: Melissa Bond
(melissa.bond@uni-oldenburg.de)

What is student engagement?

Student engagement has long been recognised as an enigmatic and multifaceted meta-construct (Appleton, Christenson and Furlong, 2008; Fredricks, Blumenfeld and Paris, 2004), with seminal works such as Astin's (1999) theory of involvement and Kahu's (2013; Kahu and Nelson, 2018) sociocultural conceptualisation of engagement, influencing ongoing conversations about the nature of and research into engagement (e.g. Boekaerts, 2016; Eccles, 2016). Often confused with motivation, which is seen as an antecedent and the force that energises behaviour (Lim, 2004; Reschly and Christenson, 2012), engagement is defined as:

> 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. Manuscript in preparation: 2–3)

This definition arose in part out of literature stressing the importance of agentic engagement (Reeve, 2012; Reeve and Tseng, 2011); the more students have a say within their learning environment, the more engagement and achievement are likely to increase (Peters et al. 2019; Reeve, 2013; Zepke, 2018b), the more likely they are then to feedback positively into the learning environment (Matos et al. 2018). The concept of social engagement (Finn and Zimmer, 2012; Linnenbrink-Garcia, Rogat and Koskey, 2011), where students' affect is influenced by social elements within the learning environment, is also represented within the acknowledgement of social, alongside internal, influences.

Dimensions and indicators of student engagement

Cognitive, affective and behavioural engagement are the three widely accepted dimensions of student engagement (Fredricks et al. 2004; Fredricks, Filsecker and Lawson, 2016). Cognitive engagement relates to deep learning strategies, self-regulation and understanding; affective engagement relates to positive reactions to the learning environment, peers and teachers, as well as their sense of belonging and interest; and behavioural engagement relates to participation, persistence and positive conduct. However, each dimension of engagement comprises a range of indicators (see **Table 1**), experienced on a continuum at varying times (Coates, 2007; Payne, 2017), depending on their activation (low or high) and valence (positive or negative) (Pekrun and Linnenbrink-Garcia, 2012). The term 'indicators' is used here, following the use by Fredricks et al. (2004), and is understood in the sense of indicating or being a manifestation of student engage-

ment and is expressed—and eventually observable and measurable—through cognitive, affective or behavioural action or reaction. The authors do, however, acknowledge that sometimes these are referred to as 'facets' of engagement (e.g. Coates, 2009). It is also important to note that, although not discussed at length in the present paper, disengagement needs to be included as well, when talking about engagement; not necessarily as a distinct concept, but rather as residing on the other side of a continuum of (dis)engagement, expressed either as an active action of disengaging from a learning context or even as a character trait (e.g. Chipchase et al. 2017).

Sociocultural positioning of student engagement

Engagement does not occur in a vacuum; rather, it is impacted and influenced by many contextual factors, and it is vital that these wider influences be considered when exploring student engagement (Appleton et al. 2008; Kahu, 2013; Quin, 2017). Within her conceptual framework of student engagement in higher education, Kahu (2013, p. 766) differentiated between sociocultural influences, such as the political and social environment; structural influences, such as the university context and student background; and psychosocial influences, such as the teaching environment, teacher-student relationships and student motivation. By considering the wider sociopolitical context that influences student engagement, a more holistic and clearer understanding of the concept can be gained, which allows educators more insight into how to further build engagement and ultimately improve outcomes for students (Appleton et al. 2008). Kahu's framework has been criticised, however, for a lack of clear focus on what students were engaging with (Ashwin and McVitty, 2015), which resulted in a revised framework emphasising the 'educational interface' (Kahu and Nelson, 2018). However, given the emphasis that has been placed on the possibility of technology playing a formative role in student engagement (Coates, 2007; Nelson Laird and Kuh, 2005; Schindler et al. 2017), further theorising of how technology fits within a framework of engagement is warranted.

Bronfenbrenner and colleagues (e.g. Bronfenbrenner, 1979, 1986; Bronfenbrenner and Ceci, 1994) developed a bioecological model of external influences affecting families and child development, used to guide a range of research on child learning and parent engagement (e.g. Ansong et al. 2017; Heatly and Votruba-Drzal, 2018). This model has been particularly useful in educational practice, as it provides a conceptual framework for understanding how multiple settings and actors influence students at the same time (e.g. Sontag, 1996). Nested within a system of intertwined milieus, the individual student sits at the centre of the microsystem, which encompasses their immediate setting, e.g. classroom, or home. The mesosystem level represents the interactions between microsystems, as well as between the micro and exosystems. The exosystem includes the wider social structures that impact on the learner, such as educational institutions, the media, government, the world of work and social services, and the macrosystem encompasses the wider

Table 1: Indicators of student engagement (Adapted from Bond et al. Manuscript in preparation).

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

economic, social, legal, political and educational systems in which the other systems are located. This model was used, in conjunction with Schwab's (1973) framework of curriculum redevelopment, to develop a bioecological model of influences on student engagement, as the theoretical framework for a case study on flipped learning in secondary classrooms (Bond, 2019). The interconnected dimensions of curriculum, students, teachers and milieus (school, classrooms, family/parents, community) within Schwab's (1973) framework, as well as the inclusion of technology by Willis et al. (2018) in their study of parent engagement with their child's learning, allowed the first author to visualise more easily the interconnected, fluid relationship between the external influences on student engagement. This model is a vehicle through which to explore and visualise further how technology affects student engagement.
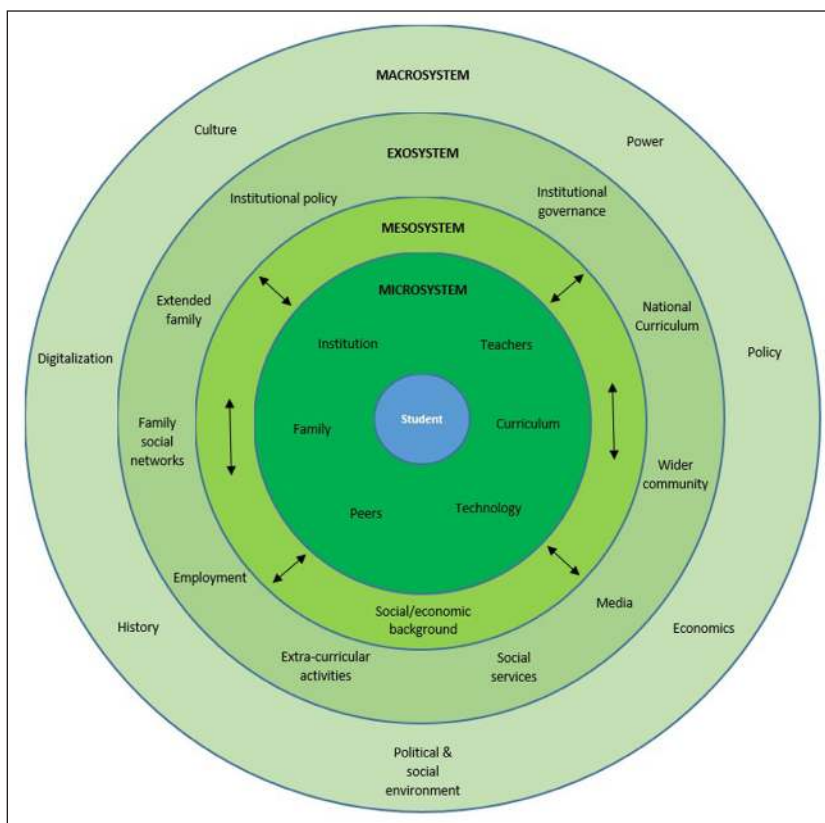
Bioecological student engagement framework

There are a range of structural and psychosocial influences that affect the learning environment, learning processes, student engagement and subsequent outcomes at all levels of the bioecological model (see **Figure 1**). Drawing on educational technology literature from two systematic reviews (Bond, Manuscript in preparation; Bond et al. Manuscript in preparation), as well as wider literature, technological influences on student engagement

are examined at each of the macro, exo, meso and microsystem levels.

Macrosystem

The rapid onset of digitalisation is having, and will continue to have, a profound effect on governmental policy and educational institutions (EDUCAUSE, 2018). Each country is reacting to digital transformation in different ways, with some, e.g., Germany (see Bond et al. 2018), investing heavily in research and development, including specific funding calls for research projects. The German government sponsored higher education think tank, Hochschulforum Digitalisierung, has recognised that "the use of digital media contributes to the improvement of higher education teaching"; however, "there is no shortage of digital teaching and learning innovations at universities but their structural and strategic advancement is deficient" (Hochschulforum Digitalisierung, 2016: n.p.). Therefore, funding is being provided by the Bundesministerium für Bildung und Forschung (BMBF – German Ministry of Education and Research) on the topics of 'Adaptive learning and assessment environments', 'Interactivity and multi-mediality of digital learning environments', 'Researching theory and practice in digital learning environments', and digitalisation in higher education (Bundesministerium für Bildung und Forschung, Referat Digitaler Wandel in der Bildung, 2018), alongside peer-to-peer coaching for

MACROSYSTEM

Culture

Power

EXOSYSTEM

Institutional policy

Institutional governance

MESOSYSTEM

MICROSYSTEM

Extended family

National Curriculum

Policy

Digitalization

Institution

Teachers

Family social networks

Family

Student

Curriculum

Wider community

Peers

Technology

Employment

Media

Economics

History

Social/economic background

Extra-curricular activities

Social services

Political & social environment

Figure 1: Bioecological model of influences on student engagement, based on Bond (2019) and adapted from Bronfenbrenner and colleagues (Bronfenbrenner, 1979, 1986; Bronfenbrenner and Ceci, 1994).

institution leaders and educators, to implement digital learning strategies and develop technological pedagogical skills. These projects will inform teaching and learning, and influence technology integration (infrastructure) and application (within the classroom) (Hochschulforum Digitalisierung, 2016).

In Australia, digitalisation has meant the introduction of a National Broadband Network (NBN), in an attempt to "bridge the digital divide" (NBN Co., 2018: 2), as well as boost the national gross domestic product. However, the process has been marred by cost blowouts (Tucker, 2015) and delays (Alizadeh, 2017), with Australia still lagging well behind other nations in Internet speed, ranked 50th in the world (Akamai, 2017). This has had implications for families, especially those in rural areas where the NBN has yet to roll out and/or who cannot afford to buy credit on pre-paid Internet dongles or mobile phones. For example, within a case study on the flipped learning approach in rural South Australia (Bond, 2019), a lack of access to the NBN has contributed to reduced parent engagement with students' learning and within the school community, as well as having had a direct impact on students' ability to engage with their learning.

Exosystem
Institutions that develop a culture of student success, with high expectations of both students and staff, and that invest in support services and infrastructure, such as reliable Internet connections and technology (e.g. desktop computers, wifi repeaters), are far more likely to

promote positive student engagement (Almarghani and Mijatovic, 2017; Peters et al. 2019; Umbach and Wawrzynski, 2005; Zepke, 2018a). Institutional leadership and attitudes have a direct bearing on student learning, as well as on teacher attitudes towards using educational technology (Cheng and Weng, 2017). This includes institutional policies on teacher professional development and the expectation of technology use within teaching and learning (Gerick, Eickelmann and Bos, 2017), policies about staffing of classes (Hill and Tyson, 2009), which may impede the development of effective relationships between educators, students and their families, as well as policies on student technology use, such as Bring Your Own Device (BYOD) programs (Adhikari, Mathrani and Scogings, 2016). It is particularly important to remain cognisant of potential digital divide issues (Adams Becker et al. 2018), including student ownership and use of devices that are incompatible with institutional devices, as this can impact participation and engagement (Bond, 2019).

Mesosystem
The mesosystem level reflects the relationships between elements of the exosystem and the microsystem. However, it also represents a student's background and social milieu (Eng, Szmodis and Mulsow, 2014), and the interplay of their (family) socioeconomic status and geographical location. This can impact on family income and their ability to afford devices (Adhikari et al. 2016; Hohlfeld, Ritzhaupt and Barron, 2010; Warschauer and Xu, 2018),

as well as their access to the Internet (Beckmann, 2010; Bond, 2019), and thereby affect their attitudes towards technology (Hollingworth et al. 2011). Therefore, it is vital that low-cost hardware and software are made available to students and families, to reduce this digital divide (Adams Becker et al. 2018; Daniels and Holtman, 2014), but also that institutions conduct needs analyses, so as to deepen understanding of real and potential barriers for students and families (Education Endowment Foundation, 2018; Goodall and Vorhaus, 2011). Further ideas for increasing technology access include opening up computer labs to students and families (Lewin and Luckin, 2010) or establishing loan equipment schemes (Hohlfeld et al. 2010).

Microsystem

The microsystem technology-enhanced learning environment is reflective of other models that have focused on the relationship between learner-teacher-content (Bundick et al. 2014; Martin and Bolliger, 2018; Moore, 1989), including interaction with peers, teachers, authentic and worthwhile tasks (Kearsley and Shneiderman, 1998; Lim, 2004), and technology (Koehler and Mishra, 2005). These 'external' relationships, or the 'inter-individual factors' (Bundick et al. 2014), play a vital role in ongoing student wellbeing, sense of connectedness, engagement and success (Aldridge and McChesney, 2018; Wimpenny and Savin-Baden, 2013). It is also important to consider that a student's life load, including employment, health, finances and family problems, can impact the amount that a student can become actively involved within school or university life (Baron and Corbin, 2012), and to recognise that there are 'internal' psychosocial influences (see **Figure 2**), or 'intra-individual factors', that influence student engagement. These include a student's self-concept, skills, motivation, self-efficacy, self-regulation, subject/discipline interest and wellbeing (Bandura, 1995; Reschly and Christenson, 2012; Zepke, 2014), as well as their prior technology experience and acceptance (Moos and Azevedo, 2009), as negative feelings about technology are related to disengagement (Bartle, Longnecker and Pegrum, 2011; Howard, Ma and Yang, 2016).

Learning environment and technology

There are a variety of factors that influence student engagement when using technology (see **Figure 3**). Students' access to technology is an issue, which may also impact on their level of confidence and prior level of experience (Zweekhorst and Maas, 2015). Assuming that technology and the Internet can be accessed, the provision of technical (and sometimes emotional) support is necessary, to ensure not losing students along the way due, for example, to anxiety of receiving lower grades as a result of technology issues (Mejia, 2016). Potential problems can be mitigated through introductory sessions to the technology being used (Shepherd and Hannafin, 2011) or having a continuous technical support team present (Levin, Whitsett and Wood, 2013). Providing thorough and clear explanations of *how* technology is to be used (Lim, 2004; Peck, 2012; Salaber, 2014), including an emphasis on using ICT for self-directed learning (Sumuer, 2018), and *why* it is being employed in a specific course setting (Cakir, 2013; Northey et al. 2015; Skinner, 2009) is also helpful, if not necessary, to ensure student engagement. Consideration should be given to allowing students a choice in which technologies are used (Martin and Bolliger, 2018), as familiar technology can eradicate issues of low technology confidence (Northey et al. 2018). Including out-of-class technology activities in assessment has also been shown to improve engagement and student buy-in (Northey et al. 2018; Zhu, 2006).
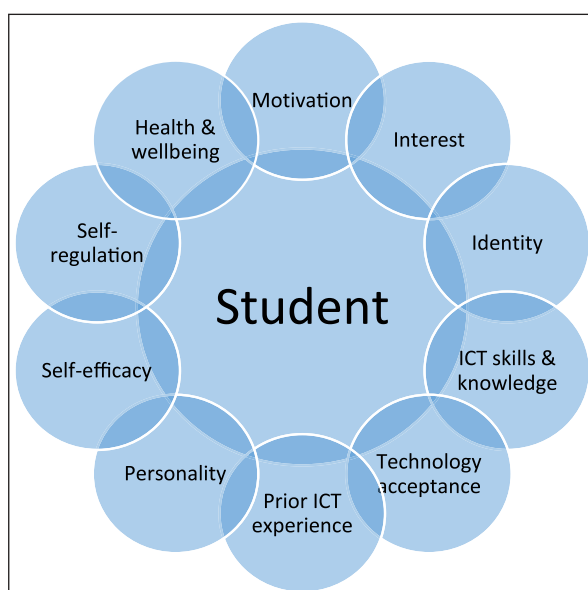
Figure 2: Internal psychosocial influences on student engagement.
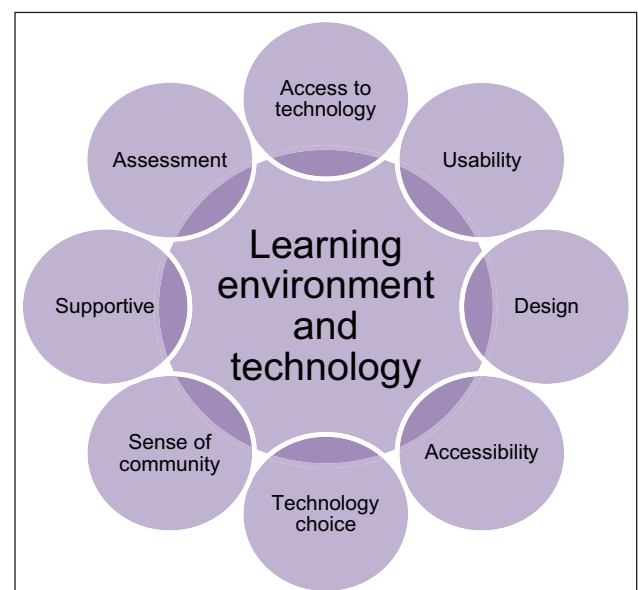
Figure 3: Learning environment and technology influences on student engagement.

Teacher

Engagement is more likely to develop when student-teacher relationships are strong (Martin and Bolliger, 2018; Quin, 2017; Zepke and Leach, 2010; Zhang and Aasheim, 2011) and when students perceive the teacher to be knowledgeable, supportive, invested and effective (Beer, Clark and Jones, 2010; Zhu, 2006) (see **Figure 4**). Teachers are more likely to employ and be successful using technology when they are confident that they have the skills to use it (Jääskelä, Häkkinen and Rasku-Puttonen, 2017; Marcelo and Yot-Domínguez, 2019). Ongoing professional development is crucial to ensure that teachers have the requisite technology knowledge and skills, and can actually foster student engagement (Bigatel and Williams, 2015). Providing regular, personalised, clear and constructive feedback can also enhance engagement (Ma et al. 2015; Martin and Bolliger, 2018; Whipp and Lorentz, 2009) and influence student agency (Coates, 2007), alongside the use of humour within online discussions (Imlawi, Gregg and Karimi, 2015). By giving feedback in the form of asking questions, students are encouraged to reflect more deeply (Alcaraz-Salarirche et al. 2011). Providing ongoing encouragement to students to contact teachers proactively when needed has also been found to be particularly effective (Leese, 2009), as has providing ongoing attention and follow-up with students (Zhang et al. 2014).
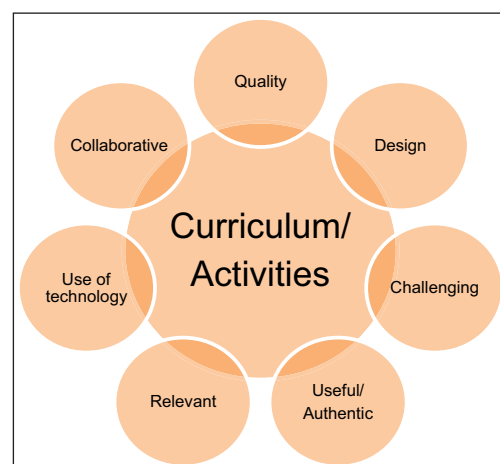
Curriculum

The learner-content relationship is crucial (Xiao, 2017). Therefore content that is relevant and challenging (Bundick et al. 2014; Cakir, 2013; Coates, 2007), and taught using active and collaborative learning techniques (Almarghani and Mijatovic, 2017; Umbach and Wawrzynski, 2005; Wimpenny and Savin-Baden, 2013), has been shown to be highly effective at promoting student engagement (see **Figure 5**). Designing meaningful learning activities is essential, relating directly to students and/or content. For example, Abate, Gomes and Linton (2011) stress the importance of choosing appropriate and meaningful questions when using audience response systems, to avoid student disengagement. It is important to avoid redundantly doubling up on activities, such as using both online journals and online discussions (Ruckert et al. 2014), and activities should be related to *real life* (e.g. Alshaikhi and Madini, 2016), as this makes them more useful to students. Likewise, ensuring that technology-enhanced activities are of high quality was found to be one aspect to engage students successfully, the lack of it resulting in students asking for "greater content rigor, depth, and relevancy" (Eick and King Jr., 2012: 29) in, for example, YouTube videos used in class.

Peers

Creating learning communities in which students can interact collaboratively with others to build effective peer-peer relationships—with or without technology—is extremely valuable to engagement (Nelson Laird and Kuh, 2005; Northey et al. 2015; Zepke and Leach, 2010) (see **Figure 6**). Students who collaborate actively in the group space, as part of the flipped learning approach, for example, have been found to experience deeper learning, increased con-

Figure 5: Curriculum/activity influences on student engagement.
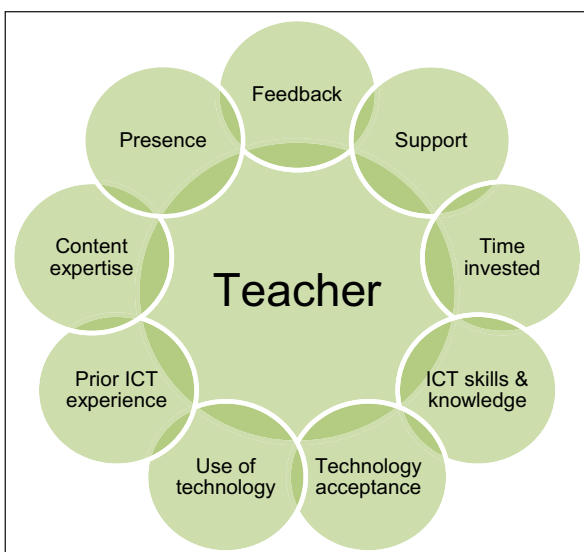
Figure 4: Teacher influences on student engagement.
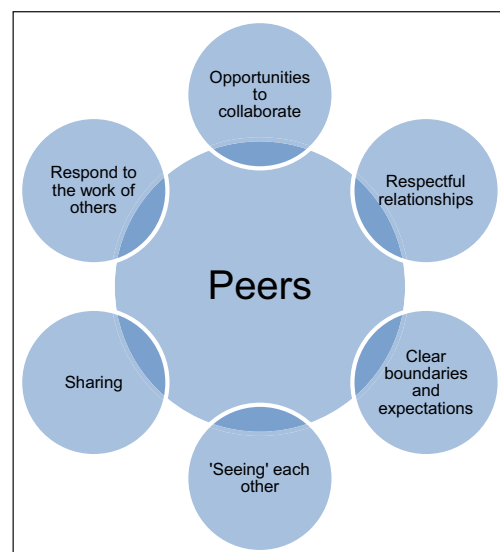
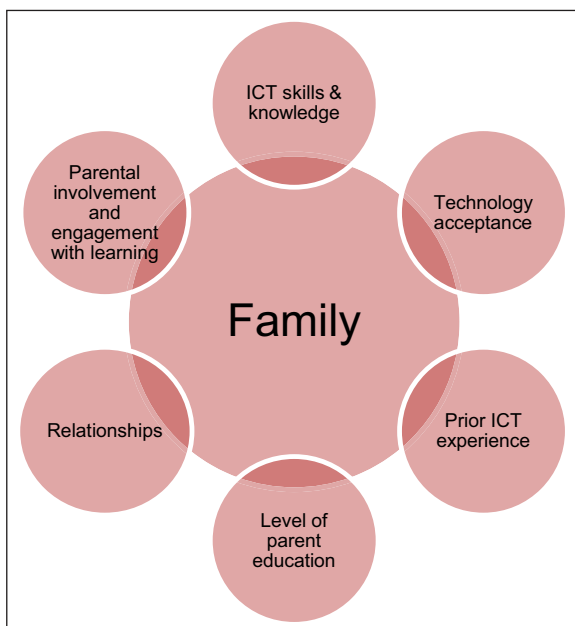**Figure 6:** Peer influences on student engagement.

fidence and greater achievement (D'addato and Miller, 2016; de Araujo, Otten and Birisci, 2017; Grypp and Luebeck, 2015; Lee, 2018). Yildiz (2009), in her investigation of social presence in the online classroom, found that knowing what class members look like and having well-meaning social interactions, was conducive to increased confidence and sense of knowing each other. However, students in the study by Sullivan and Longnecker (2014, p. 397) referred to the course requirement of having to post comments to fellow students' blogs as "the worst aspect of the blog". Thus, peer interaction, and the value and meaning attached to it, is strongly related to how learning activities and digital tools are designed and used within a course.

Family
Family relationships, level of parent education, and parental involvement and engagement with student learning can play a large role in student engagement (Diogo, Silva and Viana, 2018; Doctoroff and Arnold, 2017; Howell, 2013) (see **Figure 7**), as well as in students' motivation towards schooling (Heatly and Votruba-Drzal, 2018), achievement (Castro et al. 2015; Hill and Tyson, 2009), self-efficacy (Vekiri, 2010) and psychological wellbeing (Wong et al. 2018). In particular, families can also affect the level of student involvement with, use of and attitude towards technology (Krause, 2014; Stevenson, 2008), with students also often learning their computing skills from their parents (Ihme and Senkbeil, 2017).

Outcomes
Enhanced student engagement through using technology can lead to a number of short and long term academic and social outcomes (see **Figure 8**), termed proximal and distal consequences by Kahu (2013). Short term outcomes include increased discipline specific knowledge and higher order thinking skills (Nelson Laird and Kuh, 2005; Salaber, 2014), increased motivation (Akbari et al. 2016), enhanced

Figure 7: Family influences on student engagement.
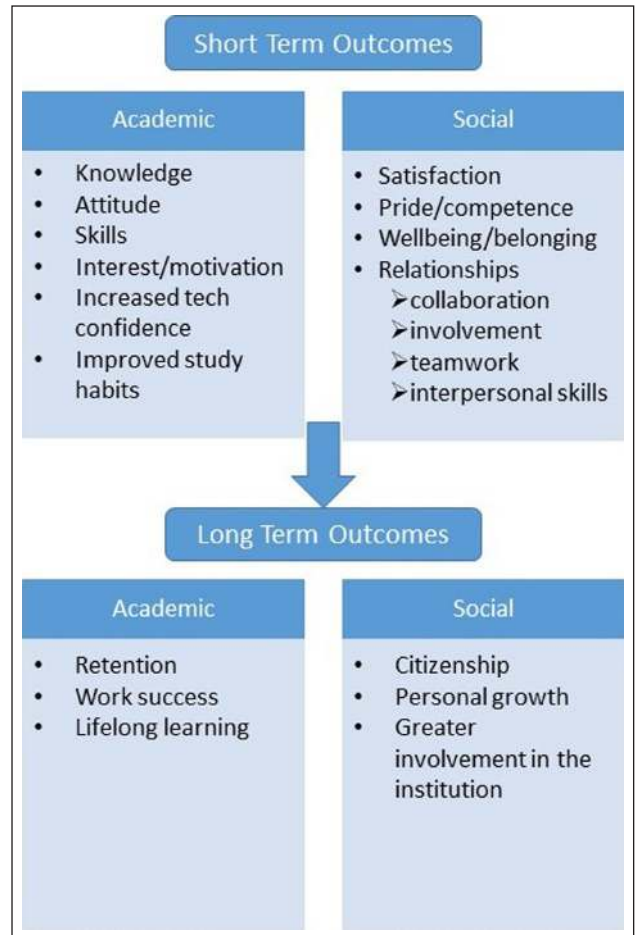
**Figure 8:** Short and long term outcomes of student engagement.

sense of belonging and wellbeing (Lear, Ansorge and Steckelberg, 2010), and improved relationships through peer-to-peer learning and collaboration (Zweekhorst and Maas, 2015). Long term outcomes include lifelong learning (Karabulut-Ilgu et al. 2018), enhanced personal development (Alioon and Delialioğlu, 2019), and increased involvement in the wider educational community (Chen, Lambert and Guidry, 2010; Junco, 2012).

Student engagement within a technology-enhanced learning (TEL) microsystem
Bringing these ideas together, the following framework shows the interplay between the TEL microsystem, student engagement and ensuing outcomes (see **Figure 9**). It reflects the definition of student engagement initially provided, whereby engagement is influenced by a range of internal and external factors. The more students are engaged and empowered within their learning community, the more likely it is that engagement will lead to a range of outcomes, and the more likely it is that this energy, effort and engagement will then feed back into the activities and learning environment.

Conclusion
In this article, the authors have synthesised a range of student engagement and educational technology literature, and sought to present an in-depth analysis of a bioeco-
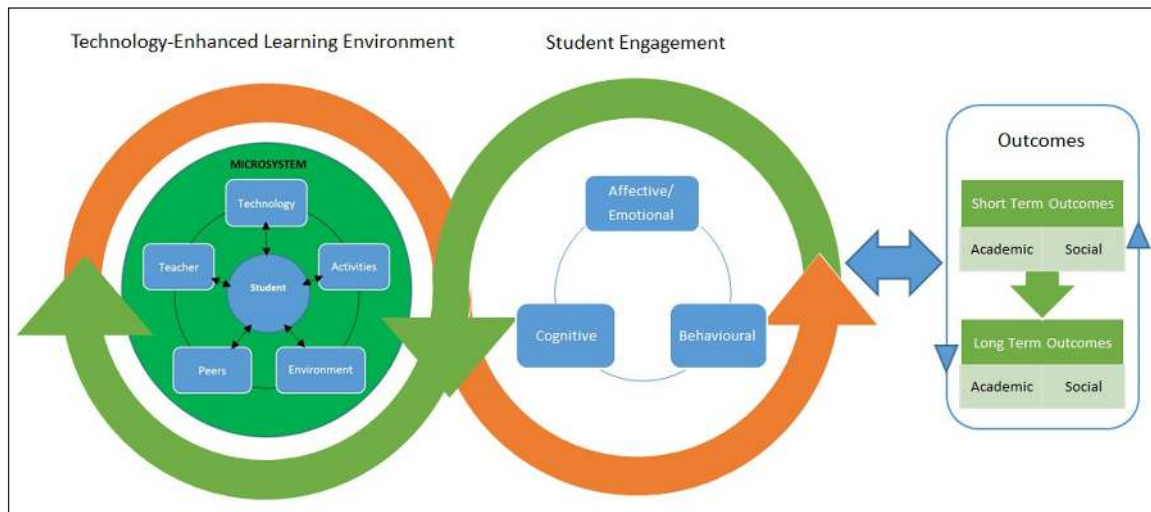
Figure 9: Student engagement framework.

logical student engagement framework, conceptualising how educational technology can influence engagement in the K-12 and higher education classroom. Although the body of literature exploring the interplay between student engagement and technology continues to grow, there is an obvious gap in its theoretical understanding and grounding (e.g. Henrie et al. 2015). With its focus on the macro, exo, meso and micro levels, this framework zooms in on the microsystem of the classroom and its constituents—these are also ultimately the factors that can be impacted by educators and further elaborated on by educational research. Owing to a lack of space in the present paper, further work is needed to examine the macro, exo and meso levels. Although the framework presented in this contribution is only one way of viewing this complex phenomenon, it offers a clear conceptual structure that other researchers, instructional designers, policy advisors and practitioners may find useful, and could help guide future student engagement research.

Grounding future research

By understanding the range of influences on student engagement, researchers could choose to focus on how certain factors affect engagement, and use the model presented here to frame their investigation and subsequent results discussion. So too, research may focus on one or all three engagement dimensions (e.g. cognitive engagement), and/or individual or multiple indicators of engagement (e.g. critical thinking and learning from peers). Using the first author's flipped learning case study as an example (Bond, 2019), the bioecological model was used to frame the results and identify recommendations for schools on successful flipped learning implementation. A new model was then presented, which clearly reflected the influences pertaining to that particular case study. The merit of applying a strong theoretical grounding and framework for analysing student engagement and educational technology is in substantiating research, which is still, however, lacking (Castañeda and Selwyn, 2018). For example, the results of an extensive review of educational technology literature revealed that only 174 of

503 studies (35%) actually used a theoretical framework (Hew et al. 2019), and much research specifically investigating student engagement lacked appropriate definition and operationalisation (Henrie et al. 2015). As Antonenko (2015, p. 53) concisely states, "conceptual frameworks should be viewed as an instrument for organizing inquiry and creating a compelling theory-based and data-driven argument for the importance of the problem, rigor of the method, and implications for further development of theory and enhancement of practice".

Implications for practice

The model presented in this paper is of interest to practitioners to raise and focus their attention to the different layers of their students' environments. Although most educators have this perspective, this model places technology as an integral part of this environment, identifying it as an influential factor, that can equally be influenced through the educator in his or her practice. Whereas educators are able to influence the meso and macrosystem components only marginally, they do have the power and responsibility to ensure that the microsystem is set up in a way that is conducive to student engagement—especially in regard to using educational technology. This involves reflection on their own ability and confidence in using technology, as well as seeing themselves as facilitators and initiators of technology use within (and outside of) the classroom, as stressed in the analysis of the microsystem components of the framework presented here. Practitioners are encouraged to use the figures provided in this paper (e.g. **Figure 4**) to conduct periodic (self-)assessments, reflecting on the extent to which these factors are having a positive influence.

Providing ongoing support to enable students' actual use of technology, as well as ensuring instructor presence throughout the course, has been seen as a crucial element for engaged students. As has been argued, the integration of educational technology facilitates engagement if students find it meaningful, related to real life, and can act without anxiety. In this context, providing opportunities for students to engage agentically in their learning, through

activity and technology choice, as well as through collaborative activities, can also enhance engagement. Through thoughtful engagement with and application of technology, and by providing students with opportunities for active participation, student engagement can be nurtured.

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Competing Interests

The authors have no competing interests to declare.

Author Contributions

The first author conducted the literature review and developed the framework. The second author contributed to the conceptualisation of the microsystem. Both authors wrote the conclusion and developed the overall flow of the paper.

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