Disrupting Education Using Smart Mobile Pedagogies

Matthew Kearney [1]✉

Email matthew.kearney@uts.edu.au

Kevin Burden [2]

Sandy Schuck [1]

[1] STEM Education Futures Research Centre, University of Technology Sydney, Ultimo, NSW, Australia

[2] University of Hull, Hull, UK

Abstract

As mobile technologies become more multifaceted and ubiquitous in society, educational researchers are investigating the use of these technologies in education. A growing body of evidence shows that traditional pedagogies still dominate the educational field and are misaligned with the diverse learning opportunities offered by the use of mobile technologies. There is an imperative to question those traditional notions of education, including how, where and when teaching and learning are enacted, and to explore the possible mediating roles of new mobile technologies. New smart pedagogies, which embrace the affordances offered by mobile technologies, have the potential to disrupt notions of schooling.

In this chapter, we examine the nature of smart pedagogies and their intersection with mobile pedagogies. We unpack notions of innovation and disruption. We then discuss smart mobile learning activities for school students identified from a Systematic Literature Review, together with the pedagogical principles underpinning them. We argue to encourage smart pedagogies, teacher educators should support teachers to implement 'feasible disruptions'. Consequently, implications for teacher education are explored.

Keywords

Mobile learning
Smart pedagogies
Innovation
Disruption
Systematic Literature Review
Learning principles
School education
Teacher education

1. Disrupting Education Using Smart Mobile Pedagogies

AQ1

This chapter deconstructs the notion of smart mobile pedagogies. We consider the construct of smart learning and investigate what pedagogies are aligned with smart learning. The chapter examines what these pedagogies may look like and provides examples of smart mobile pedagogies articulated in a Systematic Literature Review (SLR) recently completed by the authors. We discuss what makes a smart mobile pedagogy disruptive, unpack notions of innovation and disruption and examine what principles underpin smart and innovative mobile pedagogies. We investigate the value of disruption in new pedagogies and suggest a 'feasible disruption' model as being most likely to succeed in implementing innovation with smart

mobile pedagogies. The chapter comprises three main foci: the first considers and discusses the notion of smart learning and smart pedagogies (Sect. 2), the second analyses ideas of innovation and disruption (Sect. 3) and the third considers a Systematic Literature Review conducted by the authors and identifies the principles that contribute to effective mobile learning (m-learning) or to underpinning smart mobile pedagogies (Sect. 4). We then draw on themes from these three foci to consider implications for teacher education in Sect. 5.

2. What Are Smart Learning and Smart Pedagogies?

Within the education literature,
Smart learning
the word ‘smart’ is often used interchangeably to describe the spaces within which learning occurs (i.e. smart learning environments), the teaching strategies and approaches adopted by educators (i.e. smart pedagogies) and the outcomes and processes experienced by students (i.e. smart learning). Smart learning emphasises the autonomy and independence of the learner in an environment that is responsive and adaptive to their individual learning needs (Kim, Cho, & Lee, 2013; Lee, Zo, & Lee, 2014; Middleton, 2015). Smart learning is a student-centric perspective on learning which does not align easily with traditional didactic models of instruction in which the teacher sits at the heart of the educative process and the student is granted little opportunity to exercise any agency. Therefore, the primary focus of this section is what constitutes smart learning and allied to this, smart pedagogies, which are defined as those activities and teaching strategies that are conducive to, and enabling of, smart learning.

Whilst interpretations of what constitutes smart learning vary, with some focusing more on the technological drivers behind it (Hwang, 2014; Kim, Song, & Yoon, 2011; Lee et al., 2014; Lias & Elias, 2011; Scott & Benlamri, 2010) and others emphasising its more learner-centric and holistic characteristics (Gwak, 2010; Kim et al., 2013; Middleton, 2015), the essential elements are broadly agreed and can be summarised as learning that is:

1. Highly situated and authentic (Lias & Elias, 2011).
2. Adaptive and responsive to changing learning habits and behaviours (Hwang, 2014; Zhu, Yu, & Riezebos, 2016).
3. Learner-centric, self-directed and empowering (Kim et al., 2013; Middleton, 2015).
4. Highly personalised and customised to the individual (Hwang, 2014).
5. Interactive and dynamic (Huang, Yang, & Hu, 2012).
6. Seamless and highly contextual (Hwang, 2014; Scott & Benlamri, 2010).
7. Collaborative, interdependent and highly social (Kim et al., 2013).

These smart learning characteristics are not entirely new, and many of them such as collaboration, personalisation and learner centeredness have been actively promoted by some educators for many years in order to make learning more engaging, purposeful and meaningful (Kearney, Schuck, Burden, & Aubusson, 2012). However, the conditions and technologies are now aligning in ways that make these learning approaches more feasible and achievable than was previously the case. New developments include a combination of technical developments, such as ubiquitous personal devices, rich digital media, cloud computing and learning analytics, allied to the power of social networking and social media in bringing together what Middleton refers to as a ‘perfect storm’ of smart learning (2015, p. 15).

2.1. Technological Drivers

As the first generation of mobile phones has matured, they have developed into complex, multifaceted personal devices that provide access to a bewildering range of applications, tools and services, customised

around the individual owner. This second generation of mobile phones, known as smart devices, combines advanced technical features, networked services, context awareness, geolocation, augmented reality, Big Data, learning analytics, wearable technologies, artificial intelligence (AI) and the Internet of Things (IoT) (Kim et al., 2011; Lee et al., 2014). It is the combination of all of these emerging technologies and services, rather than any single one, which has brought about the requisite conditions for smart learning to flourish at this point in time (Middleton, 2015).

Allied to these technical developments are infrastructure developments such as the exponential increase in bandwidth and connectivity available through services such as 4G/5G, ubiquitous Wi-Fi and unlimited data plans which mean students can access learning anywhere, anytime without worrying about the cost or robustness of the connection. The characteristics of smart learning described above have become possible as a result of a combination of various vectors which typically include growing connectivity (e.g. from wired Internet to wireless Internet to broadband Wi-Fi) and device sophistication (e.g. from desktop to mobile phone to smart device). This has facilitated a paradigmatic shift from e-Learning or first-generation use of computers in education to mobile learning (m-learning) and now 'smart learning' where access to pervasive broadband connectivity on smart, personal devices is blurring many of the barriers or boundaries that have previously kept formal and informal learning apart (see Lee et al., 2014).

2.2. Paradigm Shifts: From E–Learning to Smart Learning

e-Learning developed with the emergence of desktop technologies and web browsers in the 1990s, but it was highly 'tethered' and static in nature (Traxler, 2007), constrained by the physical infrastructures of the era (e.g. hard-wired ethernet and electrical cables). These technologies were usually purchased institutionally, leading to a corporate mindset towards learning in which the individual student had limited agency or control over how they used and interacted with the technology. Consequently e-Learning has tended to resemble traditional, formal learning in its structures, practices and underlying pedagogical approaches (Zhang, 2010). It has supplemented and extended the reach of traditional learning making it available at times and in spaces that were previously inaccessible for learners (e.g. learning at a distance), but the fundamental nature of learning itself has not altered.

In contrast, the emergence and application of mobile technologies have seen a paradigmatic shift in approaches to learning, a shift which is highly variable across different settings and contexts. Initially the introduction of mobile technologies in learning was also 'tethered' like e-Learning because of limited wireless phone connectivity (initially 2G and then 3G) and unreliable Wi-Fi connectivity. Unlike the e-Learning paradigm, which was browser focused, the m-learning paradigm relies upon agile, mobile devices which belong to the individual. In this respect the mobile learning paradigm represents a shift away from corporate technologies, owned and therefore controlled by the institution, to more personal and pervasive devices that are inherently individual and more customised. But in practice the predicted benefits of this shift to m-learning have not been fully realised, and many instantiations of mobile technology resemble the e-Learning paradigm where practice is largely restricted to formal teaching spaces and students are granted limited opportunities to exercise independence and choice. Indeed, our own research over a number of different studies that include schools, teacher education and universities (Burden & Kearney, 2016; Kearney, Burden, & Rai, 2015) suggests educators are exploiting a relatively limited range of m-learning affordances, and it is not common to find mobile technologies used to customise the learning experience of students or to make learning more authentic and realistic.

The promise of smart learning is that it returns control of learning to the student regardless of the context they are learning in. It increases their independence and enables them to feel more empowered which has not been evident in any of the previous technology paradigms:

> Smart learning assumes that the learner is at the heart of their learning: teachers, peers, technologies and the learning environment are, in effect, support actors and props to that purpose. (Middleton, 2015, p. 15)

The implications of this statement for teachers and educators are profound since it is not simply a matter of tinkering with current teaching models which might be compared to rearranging the deck chairs on the Titanic. With adaptive technologies, learning analytics and other cloud-based services, smart learning may be feasible without smart pedagogies, but the reverse is not true. Smart pedagogies are redundant without smart

learning. It is imperative therefore that educators take the growth of smart learning seriously and understand its mechanisms and implication in order that they can design and align sympathetic and complementary smart pedagogies.

Once we recognise the significance and meaning of this shift to a more learning-centric paradigm of education, the implications that stem from it also make greater sense. In the smart learning paradigm, learners are empowered to exercise much greater agency, identifying their own learning pathways, outcomes and assessment opportunities. These freedoms challenge many of the restrictions that have traditionally bounded learning to particular places and times. Formal and informal learning becomes an artificial binary since learners are free to select the spaces and times when they prefer to learn. There are greater opportunities to work and learn collaboratively, supported by the power of crowdsourced learning and social media networks. Consequently, learning can be individualised and customised whilst still retaining the values and importance attached to social learning with peers. Learning is not restricted to face-to-face contexts, overcoming a hurdle that neither e-Learning nor m-learning has managed to completely address.

2.3. Smart Mobile Pedagogies Aligned to Smart Learning

We define smart pedagogies as the teaching strategies, activities and teacher-initiated approaches that support and enable smart learning to flourish. They are not conventional teaching approaches since these would be misaligned with the smart learning principles outlined in this section, particularly those that emphasise the autonomy and agency of the learner. Table 1 below summarises a selection of possible smart pedagogies alongside the smart learning characteristics they are intended to support. It should be noted that all of these pedagogies are ones afforded by smart devices and ubiquitous connectivity; hence, we use the term ‘smart mobile pedagogies’. For the purposes of conciseness, the smart learning characteristics mentioned above have been grouped according to their attributes.

Table 1

Smart mobile pedagogies aligned to smart learning characteristics

Characteristics of smart learning that is		Corresponding smart mobile pedagogies
Situated and authentic		**Seamless pedagogies** that recognise the seamless nature of learning, enabling learners to extend their learning across several contexts Examples might include: · pedagogy utilises all spaces as valid learning contexts · pedagogy rooted in authentic, real-world contexts, using authentic tasks and tools · pedagogies rooted in the interests and experiences of learners
Adaptive and responsive to changing learning habits and behaviours	Personalised and adaptive learning	**Customised pedagogies** Examples might include: · teaching approaches that promote self-regulated and self-motivated learning strategies · self-paced pedagogies · differentiated learning pathways **Context-aware pedagogies:** · teaching strategies that offer instant and adaptive support to learners based on contextual factors
Learner-centric, self-directed and empowering		
Personalised and customised to the individual		
Interactive and dynamic		**Creative and multimodal pedagogies:** · That encourage learners to engage and be active rather than passive.
Seamless and contextual		**Context-aware pedagogies:** · Teaching strategies that offer instant and adaptive support to learners based on contextual factors.

Characteristics of smart learning that is	Corresponding smart mobile pedagogies
Collaborative, interdependent and social	**Collaborative pedagogies that support and encourage learners to construct and participate in networks** Examples might include: · pedagogies supporting social networking · global and intercultural pedagogies

The alignment of smart pedagogies and smart learning characteristics provides a clearer idea of what smart mobile pedagogies can encompass. Potentially these pedagogies are inherently innovative and possibly disruptive. The next section deconstructs notions of innovation in education, with a particular focus on smart mobile pedagogies.

3. Innovation and Disruption

This section examines notions of innovation in education, particularly in relation to digital pedagogies. The word 'innovation' is used liberally across education literature, policies and reports (Moyle, 2010) to describe new ideas, products, approaches or processes (Fenwick, 2016). Innovations can be small or large-scale but need to go beyond superficial change to introduce new ideas or practices that are impactful and valuable to individuals or communities (Denning, 2004; Fenwick, 2016; Linfors & Hilmola, 2016). In an education context, for example, innovation could mean new curriculum, pedagogy or assessment solutions to improve student outcomes (Danaher, Gururajan, & Hafeez-Baig, 2009).

Interpretations of 'innovation', or the extent to which an idea or process is new or impactful, will ultimately depend on one's perception and context (Caldwell, 2018). Subsequently, some writers emphasise a 'frame of reference' (Moyle, 2010, p. 11) as critical to discussion of innovation. Tornatzky and Fleischer (1990) suggest that innovation needs to be impactful at least to the people or organisation carrying out the innovation, whilst Potgieter (2004) suggests that innovation in education needs to be 'an idea, practice, object or combination of these that is perceived as new by staff' (p. 271).

There are two ends of the innovation 'spectrum'. At the more conservative end are 'sustaining innovations', described as an adaption of existing approaches (Christensen, Horn, & Johnson, 2008; Fenwick, 2016) and a trade-off with established practices and paradigms (Christensen, 1997). Alternatively, at the radical end of the spectrum, 'disruptive' innovation is extremely different to the status quo and can initiate a paradigm shift (Christensen, 1997), transforming existing, dominant practices. In education, disruptive innovations create new practices, purposes and processes (e.g. of learning), new relationships between students and teachers and potentially a change in the nature of school and its relationship with the community: '…the innovation as a whole can be considered a 'disruption' to prevalent practices' (Law, 2008, p. 428). These new practices may demand reimaging of schooling, for example, allowing students 'to personalise education to fit their needs' (Christensen et al., 2008, p. 243). In the case of innovative pedagogies supported by technology (or digital pedagogies), sustaining innovation would support existing, prevalent technology-enhanced practices to achieve existing curriculum goals, whilst disruptive innovative digital pedagogies would promote new technology-mediated practices to achieve new goals and replace traditional approaches (Hedberg, 2006; Law, 2008). Or as Selwyn (2017, p. 32) explains, disruptive innovation 'is not about using technology to do the same things differently, but using technology to do fundamentally different things'.

Most of the education literature tends to discuss sustained innovation designed to simply improve the quality of established practices rather than supplant them. However, there is debate over which end of the spectrum is ideal for school contexts. Sustaining innovations set out to adapt existing approaches (critics label such changes as mere 'renovations') but ensure enhanced quality of existing practices (Fenwick, 2016). In contrast, disruptive innovations are radically different to the status quo, and their implementation can initially be less successful than the traditional practices they are attempting to replace. Another issue is the pace and scope of implementation of innovations. A gradual, incremental approach is often advocated in schools – institutions that are well-known for their conservatism and resistance to change (Law, 2003; Zhao, Pugh, Sheldon, & Byers, 2002). For instance, Zhao et al. (2002) studied a number of innovations in schools and found that an 'evolutionary rather than revolutionary' approach to innovations was more likely to succeed:

‘Innovations that were the most distant from the teachers’ existing practices and school culture were less likely to succeed…’ (p. 512).

Innovation in schools is typically discussed with a focus on pedagogical innovation. There is general consensus that pedagogical innovations in schools attempt to change ‘traditional teaching’ that is assumed to be isolated, knowledge-focused and teacher-centred (Hedberg, 2006; Law, 2008). For example, in their discussion of innovative teaching, Zhu, Wang and Engels (2013) argue for less traditional approaches, drawing on social constructivist learning theory to emphasise active participation, collaboration in real learning situations and authentic learning tasks.

There is an increasingly well-accepted argument for schools to supplement or replace traditional pedagogical approaches with more innovative approaches to help students develop the diverse knowledge, skills and attitudes needed for living and working in the twenty-first century (OECD, 2018; Voogt, Erstad, Dede, & Mishra, 2013; Zhu et al., 2013) and to prepare them for careers that may not yet exist (Dede, 2011). Voogt et al. (2013) argue specifically for curriculum change, including an emphasis on new literacies, linking learning between formal and informal settings and new assessment frameworks, whilst Law (2008) makes similar arguments for pedagogical renewal: ‘…pedagogical innovation is becoming increasingly important in the 21C when the focus in education shifts toward lifelong learning and knowledge creation, demanding changes in educational goals, as well as curriculum and pedagogical processes’ (p. 427). Zhu et al. (2013) explain the need for innovative teaching: ‘It seems that innovative teaching is necessary for the present and future of education to help students reach their potential’ (p. 9).

Innovative digital pedagogical approaches, or what Law (2008) calls ‘ICT-using pedagogical innovations’, typically explore the use of learning technologies to support new strategies that might change or replace traditional teaching approaches. Hedberg (2006) advocates the use of innovative digital pedagogies that facilitate a shift towards constructivist pedagogical approaches adopting student-centred learning strategies. He argues that these approaches give students control over choice of learning topics and sequences and typically encompass emphasis on their creation, evaluation and synthesis processes. Social interaction and social construction of knowledge are also emphasised, as well as a shift in focus ‘from assessment of the end product to assessment of the learning journey’ (p. 179). He also suggests that disruptive digital pedagogies need learning spaces that support a shift from the learner as ‘a passive participant toward an active engaged constructor of their own experience’ (p. 181). For example, when discussing ‘online learning’, Hedberg suggests a revolutionary move away from simply replicating traditional (classroom-based) teaching practices in an online environment. In a similar way, in their discussion of innovative mobile digital pedagogies, Schuck, Kearney and Burden (2017) discuss ‘Third Space learning’ as a disruption to existing practices: ‘The ways that portable, multi-functional mobile devices can untether the learner from formal institutional learning give scope for learning to be conceptualised in an expanded variety of places, times and ways’ (p. 121).

In Law’s earlier (2003) study of innovative classroom practices, she used six dimensions of innovation/change in the context of digital pedagogies: intended learning objectives/curriculum goals, pedagogical roles of teacher, roles of learners, nature and sophistication of technology used, connectedness of classroom (i.e. collaboration with people outside of the school) and learning outcomes exhibited by the learner. These dimensions were used by Law (2003) to explore the innovations from each case in her study and to gauge the extent of change. She also highlighted the overall extent of innovations using categories ranging from ‘Traditional’ to ‘Some new elements’ to ‘Emergent’ to ‘Innovative’ to ‘Most innovative’ (p. 174).

More recently, a team at The Open University in the UK has issued an annual report since 2012 on ‘new forms of teaching, learning and assessment for an interactive world’ (Ferguson et al., 2017), focusing on ‘novel or changing theories and practices of teaching, learning and assessment for the modern technology-enabled world’ (p. 6). The group defines digital pedagogical innovation as ‘new pedagogies making use of technologies to go further, to open up new possibilities’ (p. 8). For example, they discuss ‘crowd learning’ pedagogy as allowing learners to ‘update and revise knowledge, offering a more personal and local perspective than centrally published media’ (p. 8); and they describe ‘citizen inquiry’ approaches as learners use technology to ‘explore new areas of knowledge and to investigate together’ (p. 8).

However, Ferguson et al. (2017) deliberately avoid technocentric discussion in their focus on new pedagogies: 'By examining innovative pedagogies, we aim to ride the roller coaster of technology adoption, highlighting ways of teaching, learning and assessing that can be successful both now and in the future' (p. 9). Law (2008) also warns that innovative digital pedagogies do not depend on the technology but rather on the intended use of the technology and the educational context. She argues that technology per se is not a catalyst but a 'lever' for changed practices. 'Technology is leveraged by teachers as a disruptive force (or resource) in realising pedagogical innovations' (p. 428).

3.1. Innovation with Smart Mobile Technologies

The discussion above has alluded in several cases to the potential disruption that smart learning, allied with smart pedagogies, poses for traditional educational structures and practices. These cases parallel the disruptive forces that Middleton recognises at the heart of his smart learning model (2015). Smart learning is predicated on the personal ownership of agile, mobile smart devices, and this challenges and disrupts the traditional model of technology ownership which is corporate and designed to control how learners access and use technology within, but not beyond, an institution. Given their growing ubiquity and pervasiveness, smart devices also challenge existing models of classroom organisation, even raising fundamental questions around the future utility and necessity of traditional classrooms, and therefore of schools themselves (Schuck et al., 2017). If learners are capable of accessing learning resources and the allied services that make deep learning a reality independently and without direct intervention and control from teachers, smart learning also begins to challenge the notion of 'delivering' learning which underpins most formal models of learning in schools. A fundamental challenge to the orthodox model of learning is social media and social networking which, Middleton claims, disrupts the one-to-many model of learning in which the teacher 'delivers' learning to the many. Social networks structure learning in an entirely different manner where multiple nodes and the network itself are all capable of supporting distributed but connected learning in a process Siemens terms 'connectivism' (Siemens, 2005). And finally, smart learning disrupts the content and transmission model of learning which situates learners as passive consumers of pre-packaged learning content – predominantly of a text-based nature – that is consumed but not created. Smart learning promises to realise many of the aspirations behind knowledge construction and co-authorship (Bereiter & Scardamalia, 2014) as user-generated content is accessed and repurposed rather than simply consumed.

In these multiple but related instances, smart learning and smart pedagogies have the potential to be hugely disruptive trends that challenge many of the norms and mores that education traditionally holds in high esteem.

4. Smart Mobile Pedagogical Innovation and Disruption

This section details the process and findings of a recent Systematic Literature Review (SLR)
Systematic literature review (SLR)
conducted by the authors, exploring innovative mobile digital pedagogies in school education. An SLR comprises more than an ad hoc search of literature. It uses a set of criteria and a well-defined procedure to scan various databases for articles that fit the criteria. As noted in previous studies, 'It is a methodical and meticulous process of collecting and collating the published empirical studies of acceptable quality with systematic criteria for selection to reduce researcher bias and provide transparency to the process' (Bano, Zowghi, Kearney, Schuck, & Aubusson, 2018, p. 33). We initiated a Systematic Literature Review with a focus on the following research question: How does the use of mobile technologies support innovative teaching and learning practices for school-aged learners? Three major search terms were derived: 'mobile learning', 'innovation' and 'school-aged learners'. From these major search terms, synonyms and alternative terms were identified. For example, informed by the literature on digital pedagogical innovation (see previous section), the 'innovation' component of the search string included words such as 'disrupt', 'renew' and 'redefine', as well as phrases such as 'new practice', 'new teaching approach' and 'emerging learning strategy'. The search string was applied on a range of databases to ensure that relevant studies were not missed.

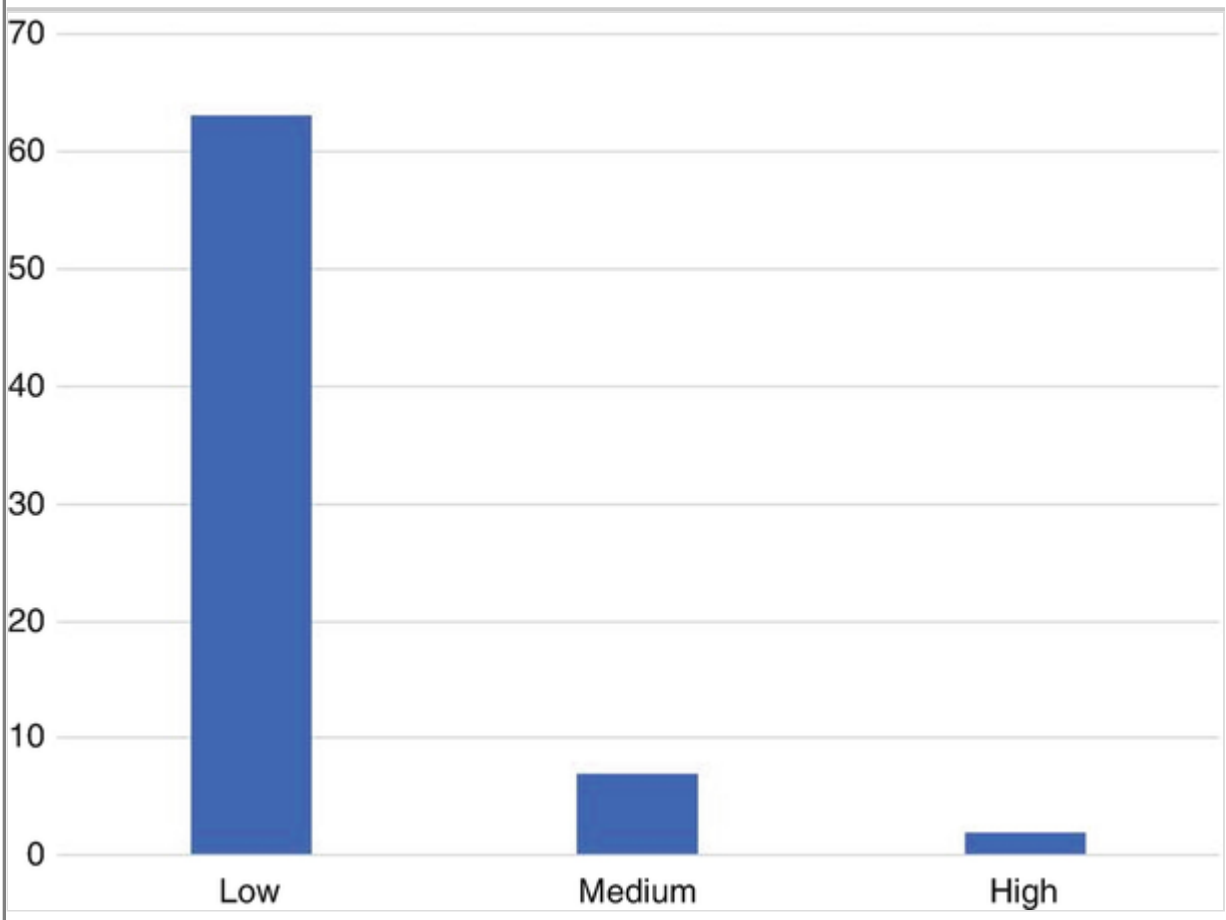
This initial search and selection process yielded 208 papers. A further selection process was then carried out by the team of three researchers and a research assistant. Pairs of researchers applied the following selection

criteria to all 208 papers included in the search results: the paper was published in English between 2010 and 2017; the SCImago journal ranking (SJR) of the paper was in the top two quartiles; the study targeted school-aged learners (5–18 years); the study adopted a rigorous methodology and compelling evidence was presented; the paper focused on innovative mobile pedagogies (as defined in the previous section); and strategies and approaches were identified (e.g. as interventions). If these criteria were not met, the paper was excluded. Issues related to the possible exclusion of papers were resolved through inter-researcher discussion at team meetings, and any remaining questions were resolved by reading the full text of papers. Different team members randomly checked among the results to reduce selection bias. At the conclusion of this process, there were 72 papers selected as being suitable for inclusion in this SLR.

As a final step, the research team scrutinised the final selection of 72 papers to identify studies that investigated or described practices that contained elements of disruptive innovation, again informed by the literature on digital pedagogical innovation (see previous section). Only nine papers were identified as containing medium to high levels of disruptive innovation practices in the context of m-learning, with the remaining 63 papers focusing on sustaining digital pedagogical innovations. Four of these nine papers were from Singaporean projects with primary/elementary school-aged learners, three focusing on science learning (Looi, Sun, & Xie, 2015; Toh, So, Seow, & Chen, 2017; Zhang et al., 2010) and one on language learning (Wong, Chai, Zhang, & King, 2015). The remaining five papers were from projects in South Korea (Ahn & Lee, 2016), focusing on language learning of middle school students; Israel (Barak & Ziv, 2013), focusing on middle school environmental education; the Netherlands (Schmitz, Klemke, Walhout, & Specht, 2015), focusing on the context of health education; Australia (Bower, Howe, McCredie, Robinson, & Grover, 2014), focusing on secondary school visual arts; and the USA (Akom, Shah, Nakai, & Cruz, 2016), focusing on community learning. Of these nine papers, only two papers (Akom et al., 2016; Toh et al., 2017) focused on practices that were perceived by the research team as demonstrating high levels of mobile pedagogical innovation, containing pedagogical elements that could potentially disrupt traditional practices (see Fig. 1 below). In Sect. 4.2 we expand on how these last two papers were innovative and disruptive.

Fig. 1

Level of disruptive practices discussed in the final set of 72 papers



4.1. Principles Underlying Smart Pedagogies

As indicated above, our SLR identified a set of 72 papers that discussed innovative or disruptive use of mobile pedagogies. One of the tasks that the authors did subsequent to identifying innovative and disruptive pedagogies in this review was to identify a set of pedagogical principles that were apparent in the selected papers. These pedagogical principles are now embedded in a survey that investigates their relative importance in the design of effective mobile pedagogical activities. At time of writing, a Delphi panel and an international group of school teachers who are engaged in m-learning are being surveyed to discover their perceptions of the relative rankings of the principles. In this sub-section of the chapter, we will outline the set of principles identified and consider their alignment with the seven characteristics of smart learning identified above (see Table 1) and the corresponding smart mobile pedagogies. We consider how much disruption is feasible, desirable and able to be implemented within the constraints of a teacher's role. We will also discuss implications for other stakeholders involved in disruptive mobile learning. Implications for teacher education are examined.

The set of principles identified from the SLR originally comprised a group of 42 distinct principles. By grouping like principles together, the list was narrowed down to a group of 21 principles. See Table 2 for details of these principles and the descriptions.

Table 2

Principles underpinning innovative smart mobile pedagogies emerging from SLR

~~Seamless learning:~~ Seamless learning: Activity occurs across a variety of physical and/or virtual settings AQ2
~~Digital play:~~ Digital play: Activity involves explorations without an explicit curriculum goal
~~Student agency:~~ Student agency: Students have the choice of how to do the activity
~~Student autonomy:~~ Student autonomy: Students determine the activity
~~Gamification:~~ Gamification: Applies elements of games such as competitions, random events, scoring
~~Customisation:~~ Customisation: Learning pathways are adapted to individual input
~~Authentic environment:~~ Authentic environment: Activity occurs in situ (i.e. it occurs in its original or natural location)
~~Simulation:~~ Simulation: Conducting realistic virtual task, e.g. Google expedition
~~Context-awareness:~~ Context-awareness: Activity adapts to environmental stimuli, for example, new vocabulary is determined by external items
~~Data sharing:~~ Data sharing: Learners share digital artefacts with peers
~~Artefact construction:~~ Artefact construction: Learners make digital object, e.g. video, music, game
~~Co-construction:~~ Co-construction: Learners use collaborative authoring tools, e.g. Google docs
~~Reflection:~~ Reflection: Learners reflect in multimodal ways, e.g. with vlogs, colours, sound
~~Real-world processes:~~ Real-world processes: Learners engage in activities similar to those done by practitioners, e.g. testing aerodynamics of object with app
~~Real-world tools:~~ Real-world tools: Activity uses app as tool, e.g. to compose music or paint a picture
~~Role-play:~~ Role-play: Learners assemble tools and methods and enact roles, e.g. citizen journalist
~~Peer review:~~ Peer review: Learners review each other's contributions, e.g. via blogs
~~Codesign for mobile learning:~~ Codesign for mobile learning: Students and teachers 'mobilise activities', i.e. transform them into ones with mobile features

~~**Intergenerational learning:**~~ Intergenerational learning: Learners across different generations work together, e.g. capturing an oral history
~~**Bridging:**~~ Bridging: Learners work across formal and informal contexts
~~**Community-based:**~~ Community-based: Learners conduct a community activity or project, e.g. monitoring litter

We are arguing that these 21 principles, or variations of these, underpin the innovative and effective activities that are discussed in the m-learning literature. When referencing these principles, it can be seen that they are closely aligned to the smart pedagogies indicated in Table 1.

Given the lag in take-up of disruptive pedagogies by school teachers, the following recommendation is suggested: that the type of innovation we should be encouraging in education of school-aged students incorporates change that is not merely involving small increments in innovation or what we have called sustaining innovations but ones that have some elements of disruption in them. Indeed, we should not expect all teachers to embrace radical innovation as this expectation is likely to lead to a low take-up of innovation of any kind, given that it will be too challenging for most to adopt such disruptive practices. Rather we suggest that we encourage innovation somewhere between conservative and radical and view disruption as being on a continuum. An important aspect of disruption, we argue, is that it is feasible. Our next step with our Delphi panel in the research under discussion will be to ask them to identify the most feasible of several disruptive scenarios, so that these can be used as examples to assist teachers in developing their own feasible but disruptive pedagogies for mobile learning.

4.2. Illustrative Examples of Potential Disruption

To make this discussion more concrete, we revisit the aforementioned two papers from our SLR (Akom et al., 2016; Toh et al., 2017) that were the only ones found to focus on practices that contained pedagogical elements that could potentially disrupt traditional practices. We will then use these two examples to discuss the benefits and constraints of implementing such disruptive activities, with respect to the principles for effective m-learning identified above and with respect to their feasibility for implementation by most teachers engaged in mobile learning. These two illustrations show the smart pedagogies we suggest can disrupt traditional ways of learning.

The first illustration comes from an article by Akom et al. (2016). These authors describe how they utilised a digital platform called Streetwyse, as part of an activity which allowed young people to codevelop and participate in a community health promotion. They found that participation in this activity promoted the young people's self-esteem and supported the development of their leadership skills, environmental awareness and academic engagement. The authors worked with 90 young people, in a particular community, and focused on food availability. They mapped locations and information of retail food/drink stores in the urban area in which they lived. They found the majority of products sold were either liquor or foods with high salt and sugar content such as chips, soda drinks and confectionaries. They used available data to make recommendations about healthy food that should be stocked in the stores.

If the article is analysed for the pedagogical principles that are present, from the list above, it can be seen that there are a number of such pedagogical principles built into the scenario: seamless learning occurred as the students moved throughout the community and educational institution, student agency and autonomy were clearly present, the activity took place in an authentic environment, data sharing occurred between the young people and they used real-world processes to analyse and map the locality and codesigned the Streetwyse app they worked with. The activity is also quite disruptive as it called for a different way of working with young people, one that promoted their activism and authority.

The second illustration discusses practices emerging from the Toh et al. (2017) study from our SLR. Their paper describes how children (aged 9–10 years old) in their study used mobile devices across a range of informal and formal learning contexts to support their science learning through their daily lives via two case studies. Both cases described activities that were underpinned by an inquiry-based learning approach where the children's devices were promoted by their teachers as a 'cultural tool and learning hub' (p. 305), helping

them to exploit their mobility across ‘time and space’. The first case study described a child who was learning about marine studies drawing upon his real-life experiences in a range of family fishing and wildlife field trips. The child used his device to link up with family members, peers and teachers as social resources in his learning, for example, asking questions for additional help, as needed. His mother was a significant figure in his learning, helping him to value the process of finding solutions to questions independently. He also captured, created and archived numerous multimodal resources ‘on the fly’ (e.g. accessing real-time information and capturing photos and videos) and framed questions for inquiry using these resources. The second case study explained a variety of mainly self-initiated m-learning activities enacted by another child. This study participant used his device to blog for self-expression, to create resources such as imaginary worlds for role-playing and to create animations to extend his knowledge on science topics.

A number of our pedagogical principles from Table 2 were evident in this illustration. For example, seamless learning was clearly present in the first case study as the child’s science activities spanned a range of informal and formal learning spaces. Elements of authentic learning (authentic environment and real-world tools) were also present, with the activities situated in real-life contexts (such as fishing) and use of tools such as the camera to enhance observation. There was also a strong sense of student agency as the child’s inquiry-based learning was self-directed, and the traditional ‘controlling’ role of the teacher was diminished. In the second case study, the principle of role-play was apparent in the activities, as was peer review (use of blogs), artefact construction (learner-generated animation) and, to a lesser degree, data sharing. Student autonomy was also a feature, with the researchers expressing amazement at some of the self-initiated, digitised materials created by the participant in the second case (p. 310). In this way, this illustration described smart mobile pedagogical practices that contained numerous elements of disruptive innovation.

5. Implications for Teacher Education

Section 5. Change to 1st level heading (same as Conclusion)

The discussion above indicates the principles that have been identified as central to innovative and effective mobile learning activities. The pedagogies underpinning these activities are ones that we identify as smart pedagogies. We noted that their deployment may disrupt current practice, and we argue for ‘feasible disruption’ as the most desirable of innovative digital pedagogies. We now turn to the implications of promoting such pedagogies for teacher education.

Teacher education faces a number of challenges in the preparation of student teachers. Teacher educators need to keep abreast of emerging technologies and ensure that the pedagogies they suggest are current and in alignment with the needs and practices of contemporary schools and societies (Royle, Stager, & Traxler, 2014). They have the dual challenge of both keeping themselves current and also inspiring their students to be competent and confident users of new technologies and new pedagogies, with the aim of improving student outcomes (Burke & Foulger, 2014). Sadly, teacher education appears to lag behind in these endeavours (McClanahan, 2017). Indeed, education in general does not seem to have kept up with the innovations in technology use that industry and society in general are enjoying (McClanahan, 2017; Papert, 2004). Often the reason given for this state of affairs is that the teachers and teacher educators (Burden & Kearney, 2017) have not received sufficient preparation in using mobile pedagogies and other emerging digital pedagogies during their teacher education courses. Whilst this reason is debatable, the fact remains that teacher educators in general do not seem to employ innovative or disruptive pedagogies in their preparation of pre-service teachers.

The question that then becomes critical is how do teacher education institutions encourage their teaching staff to embrace innovations and support their students to do likewise. Given that the pre-service teachers are likely to be teaching school students long into the future (possibly for as long as 35 years into the future), what skills and competencies do teacher educators need to support them to develop (Schuck, Aubusson, Burden, & Brindley, 2018)? It is likely that the principles identified above should underpin any pedagogies. Further it seems that there are several factors that support innovation and smart pedagogies occurring in teacher education institutions. These include support at an institutional level, the expectation that all faculty members participate in the innovation (Burke & Foulger, 2014), addressing the values and beliefs of staff (Law, 2008) and importantly that there is some driver that leads to long-term implementation of the innovation (Bereiter, 2002).

Our recommendations therefore are that teacher educators consider the principles underpinning smart pedagogies and that their institutions offer them time and opportunity to develop their own skills in implementing these pedagogies. It is anticipated that once the teacher educators are comfortable with the role of innovator, they are more likely to be able to inspire their student teachers in this regard. Mindful of the research on innovation, there needs to be some driver that will encourage sustained implementation. This driver might be policy from government or accreditation bodies or demand from student teachers (Schuck et al., 2018). It is likely that all will become critical forces for change in the future.

5. 6. Conclusion Section 6 (not 5). NB. Section 5 should be above 'Implications for Teacher Education'

Mobile pedagogies
Mobile pedagogies
have been predicted as a ‘game changer’ for some time now, potentially engendering disruptive innovation and bringing school education into an ‘Age of Mobilism’ (Norris & Soloway, 2011). Despite these predictions, the use of mobile devices in schools has so far not been disruptive, with adopted mobile pedagogies predominantly replicating traditional transmissionist approaches (Kearney et al., 2015). This phenomenon follows a familiar historical pattern over the past four decades, whereby teachers tend to use increasingly sophisticated educational technologies in culturally familiar ways (Zhang, 2010), adopting traditional digital pedagogies that often align with existing school structures and practices that were originally designed for the industrial age, similar to ‘attaching a jet engine to a stage coach’ (Papert, 2004). This chapter offers a ‘way forward’ for breaking out of this cycle and optimising the impact of smart technology use on learning by children and teenagers. In particular, it offers evidence-based principles underpinning innovative smart mobile pedagogies that have emerged from a rigorous SLR study. We argue these principles should be applied to new smart mobile practices that go beyond sustained innovation but at the same time are ‘feasibly disruptive’ for teachers and teacher educators to implement, within the realities of conservative and often bureaucratic institutions that are resistant to change.

Acknowledgement

The original research referred to in this chapter was part of the funded Erasmus+ Project (2017-1-UK01-KA201-036781): Designing and Evaluating Innovative Mobile Pedagogies (http://www.deimpeu.com/).

References

Ahn, T. Y., & Lee, S. M. (2016). User experience of a mobile speaking application with automatic speech recognition on for EFL learning. British Journal of Educational Technology, 47(4), 778–786. https://doi.org/10.1111/bjet.12354

Akom, A., Shah, A., Nakai, A., & Cruz, T. (2016). Youth participatory action research (YPAR) 2.0: How technological innovation and digital organizing sparked a food revolution in East Oakland. International Journal of Qualitative Studies in Education, 29(10), 1287–1307.

Bano, M., Zowghi, D., Kearney, M., Schuck, S., & Aubusson, P. (2018). Mobile learning for science and mathematics school education: A systematic review of empirical evidence. Computers & Education, 121, 30–58.

Barak, M., & Ziv, S. (2013). Wandering: A web-based platform for the creation of location-based interactive learning objects. Computers & Education, 62, 159–170. https://doi.org/10.1016/j.compedu.2012.10.015

Bereiter, C. (2002). Design research for sustained innovation. Cognitive Studies, 9(3), 321–327.

Bereiter, C., & Scardamalia, M. (2014). In S. C. Tan, H. J. So, & J. Yeo (Eds.)., Knowledge creation in education Knowledge building and knowledge creation: One concept, two hills to climb (pp. 35–52). Singapore: Springer.

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented Reality in education-cases, places and potentials. Educational Media International, 51(1), 1–15.

Burden, K., & Kearney, M. (2016). Future scenarios for mobile science learning. Research in Science Education, 46(2), 287–308.

Burden, K., & Kearney, M. (2017). Investigating and critiquing teacher educators' mobile learning practices. Interactive Technology and Smart Education, 14(2), 110–125.

Burke, D. M., & Foulger, T. S. (2014). Mobile learning in teacher education: Insight from four programs that embraced change. Journal of Digital Learning in Teacher Education, 30(4), 112–120. https://doi.org/10.1080/21532974.2014.927208

Caldwell, H. (2018). Mobile technologies as a catalyst for pedagogic innovation within teacher education. International Journal of Mobile and Blended Learning, 10(2), 50–65.

Christensen, C. M. (1997). The innovator's dilemma: When new technologies cause great firms to fail (Rev. ed.). Boston, MA: Harvard Business School Press.

Christensen, C. M., Horn, M. B., & Johnson, C. W. (2008). Disrupting class: How disruptive innovation will change the way the world learns. New York: McGraw-Hill.

Danaher, P., Gururajan, R., & Hafeez-Baig, A. (2009). Transforming the practice of mobile learning: promoting pedagogical innovation through educational principles and strategies that work. In H. Ryu & D. Parsons (Eds.), Innovative mobile learning: Techniques and technologies (pp. 21–46). Hershey: IGI Global.

Dede, C. (2011). Reconceptualizing technology integration to meet the challenges of educational transformation. Journal of Curriculum and Instruction, 5(1), 4–16.

Denning, P. (2004). The social life of innovation. Communications of the ACM, 4(4), 15–19.

Fenwick, T. (2016). Wanted: The innovative professional. In T. Fenwick (Ed.), Professional responsibility and professionalism: A sociomaterial examination (pp. 77–92). London: Routledge.

Ferguson, R., Barzilai, S., Ben-Zvi, D., Chinn, C. A., Herodotou, C., Hod, Y., et al. (2017). Innovating Pedagogy 2017: Open University Innovation Report 6. Milton Keynes: The Open University, UK.

Gwak, D. (2010). The meaning and predict of Smart Learning, Smart Learning Korea Proceeding, Korean e-Learning Industry Association.

Hedberg, J. G. (2006). E-learning futures? Speculations for a time yet to come. Studies in Continuing Education, 28(2), 171–183.

Huang, R., Yang, J., & Hu, Y. (2012). From digital to smart: The evolution and trends of learning environment. Open Education Research, 1, 75–84.

Hwang, G. (2014). Definition, framework and research issues of smart learning environments: A context-aware ubiquitous learning perspective. Smart Learning Environments, 1(1), 1–14.

Kearney, M., Burden, K., & Rai, T. (2015). Investigating teachers' adoption of signature pedagogies. Computers & Education, 80, 48–57.

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. Research in Learning Technology, 20, 14406. https://doi.org/10.3402/rlt.v20i0/14406

Kim, S. M., Song, Y., & Yoon, I. (2011). Smart learning services based on smart cloud computing. Sensors, 11(8), 7835–7850.

Kim, T., Cho, J. Y., & Lee, B. G. (2013). Evolution to smart learning in public education: A case study. Korean public education. Open and Social Technologies for Networked Learning, 395, 170–178.

Law, N. (2003). In C. Dowling & K. W. Lai (Eds.)., Information and communication technology and the teacher of the future Innovative classroom practices and the teacher of the future (pp. 171–182). Dordrecht: Kluwer.

Law, N. (2008). Teacher learning beyond knowledge for pedagogical innovations with ICT). In J. Voogt & G. Knezek (Eds.), International handbook of information technology in primary and secondary education (pp. 425–435). New York: Springer.

Lee, J., Zo, H., & Lee, H. (2014). Smart learning adoption in employees and HRD managers. British Journal of Educational Technology, 45(6), 1082–1096. https://doi.org/10.1111/bjet.12210

Lias, T. E., & Elias, T. (2011). Learning analytics: The definitions, the processes, and the potential. Retrieved June 29, 2018, from http://learninganalytics.net/LearningAnalyticsDefinitionsProcessesPotential.pdf

Lindfors, E., & Hilmola, A. (2016). Innovation learning in comprehensive education? International Journal of Technology and Design Education, 26, 373–389.

Looi, C. K., Sun, D., & Xie, W. (2015). Exploring students' progression in an inquiry science curriculum enabled by mobile learning. IEEE Transactions on Learning Technologies, 8(1), 43–54.

McClanahan, B. (2017). Transforming teacher education with digital technology: An informative journey. Delta Kappa Gamma Bulletin, 83(5), 15–23.

Middleton, A. (Ed.). (2015). Smart learning: Teaching and learning with smartphones and tablets in post compulsory education. Sheffield: Media-Enhanced Learning Special Interest Group and Sheffield Hallam University Press.

Moyle, K. (2010). Building Innovation: Learning with technologies. Australian Education Review, 56. Retrieved June 29, 2018, from: http://research.acer.edu.au/aer/10/

Norris, C. A., & Soloway, E. (2011). Learning and schooling in the age of mobilism. Educational Technology, 51(6), 3–12.

OECD Report. (2018). Teaching for the future: Effective classroom practices to transform education. Published on March 20, 2018, http://www.oecd.org/education/school/teaching-for-the-future-9789264293243-en.htm

Papert, S. (2004). Technology in schools: To support the system or render it obsolete. Milken Family Foundation.
AQ3

Potgieter, B. (2004). Exploring leadership and organisation for change and innovation in higher education. Paper presented at the Proceedings of the 2004 Annual International Conference of the Higher Education Research and Development Society of Australasia (HERDSA), Miri, Sarawak.

Royle, K., Stager, S., & Traxler, J. (2014). Teacher development with mobiles: Comparative critical factors. Prospects, 44, 29–42.

Schmitz, B., Klemke, S., Walhout, J., & Specht, M. (2015). Attuning a mobile simulation game for school

children using a design-based research approach. Computers & Education, 81, 35–48. https://doi.org/10.1016/j.compedu.2014.09.001

Schuck, S., Aubusson, P., Burden, P., & Brindley, S. (2018). Uncertainty in teacher education futures: Scenarios, politics and STEM. Dordrecht: Springer.

Schuck, S., Kearney, M., & Burden, K. (2017). Exploring mobile learning in the Third Space. Technology, Pedagogy and Education, 26(2), 121–137. https://doi.org/10.1080/1475939X.2016.1230555

Scott, K., & Benlamri, R. (2010). Context-aware services for smart learning spaces. Learning Technologies, 3(3), 214–227.

Selwyn, N. (2017). Education and technology: Key issues and debates. New York: Bloomsbury Academic.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology & Distance Learning, 2(1). http://www.itdl.org/Journal/Jan_05/article01.htm

Toh, Y., So, H. J., Seow, P., & Chen, W. (2017). Transformation of participation and learning: Three case studies of young learners harnessing mobile technologies for seamless science learning. The Asia-Pacific Education Researcher, 26(5), 305–316. https://doi-org.ezproxy.lib.uts.edu.au/10.1007/s40299-017-0350-5

Tornatzky, L. G., & Fleischer, M. (1990). The processes of technological innovation. Lexington, MA: Lexington Books.

Traxler, J. (2007). Defining, discussing, and evaluating mobile learning: The moving finger writes and having write... International Review of Research in Open and Distance Learning, 8(2), 1492–3831.

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. Journal of Computer Assisted Learning, 29, 403–413.

Wong, L. H., Chai, C. S., Zhang, X., & King, R. B. (2015). Employing the TPACK framework for researcher-teacher co-design of a mobile-assisted seamless language learning environment. IEEE Transactions on Learning Technologies, 8(1), 31–42. https://doi.org/10.1109/TLT.2014.2354038

Zhang, B. H., Looi, C.-K., Seow, P., Chia, G., Wong, L. H., & Chen, W. (2010). Deconstructing and reconstructing: transforming primary science learning via a mobilized curriculum. Computers and Education, 55(4), 1504–1523.

Zhang, J. (2010). Technology supported learning innovation in cultural contexts. Educational Technology Research and Development, 58, 229–243.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. (2002). Conditions for classroom technology innovation. Teachers College Record, 104(3), 482–515.

Zhu, C., Wang, D., & Engels, N. (2013). What core competencies are related to teachers' innovative teaching? Asia-Pacific Journal of Teacher Education, 41(1), 9–27.

Zhu, Z. T., Yu, M. H., & Riezebos, P. (2016). A research framework of smart education. Smart Learning Environment, 3(4). https://doi.org/10.1186/s40561-016-0026-2