Investigating and Critiquing Teacher Educators' Mobile Learning Practices

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Abstract

This study examines the mobile pedagogical practices of teacher educators. It uses data from an online survey that elicited information about how 46 teacher educator participants were using distinctive mobile pedagogical features (Personalisation, Authenticity and Collaboration) in their mobile learning practices. Findings indicated high self-ratings of Authenticity, and positive perceptions of collaborative sharing, often involving generative tasks that required use of creative, media production mobile applications. There were weaker perceptions of Personalisation and online conversation. In light of these findings, we discuss implications for teacher education and recommend future directions for research and development.

Keywords: teacher educators; mobile learning; authenticity; personalisation; collaboration

1. Introduction

Mobile learning (or 'm-learning') considers the process of learning mediated by portable, mobile technologies such as smart phones, tablet computers and game consoles (Schuler, Winters & West, 2012). Educators are increasing their use of these mobile devices (or 'm-devices') due to growing evidence of effective learning across a range of learning spaces (Pegrum, Howitt & Striepe, 2013; Wu et al., 2012), including reports of enhanced collaboration, social interactivity, in situ learning and sharing, communication between peers, teachers and experts, and customisation of learning (e.g. Kearney, Burden & Rai, 2015; Mifsud, 2014). The increasing ubiquity of these devices, and on-going technical developments such as geospatial and motion detection, image and video capture, augmented reality, connectivity and context awareness (Johnson, Adams, Becker, Estrada & Freeman, 2014), are providing educators with new opportunities for pedagogical 'repurposing' (Koehler et al., 2011). However, teachers continue to struggle with effective mobile pedagogical approaches (Herro, Kiger & Owens, 2013) and there has been a tendency to default to traditional teacher-directed approaches (Cochrane & Antonczak, 2014; Kearney et al., 2015; Royle, Stager &Traxler, 2014; Rushby, 2012).

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Teacher educators are also engaging with mobile pedagogies, responding to the rapid adoption of m-learning in schools (Herrington, Ostashewski, Reid & Flintoff, 2014; Newhouse, Cooper & Pagram, 2015; Zhang, 2015), and the contemporary mobile digital culture in which many pre-service teachers (PSTs) are immersed in their non-academic lives (Broda, Schmidt & Wereley, 2011). M-learning practices in teacher education can be categorised into two areas: teacher 'training' about and with mobile learning (Baran, 2014). Teacher education about m-learning involves PSTs learning how to integrate m-devices into their own prospective school teaching; for example, developing their understanding of how m-devices and associated educational applications (or 'apps') can leverage opportunities for more contextualised, collaborative learning in K-12. Teacher education with m-learning involves the enhancement of PSTs' professional learning with m-devices; for example, the use of m-devices to mediate their reflections on/in practice during their professional placements, and sharing ideas and resources with colleagues through social media (see Figure 1).

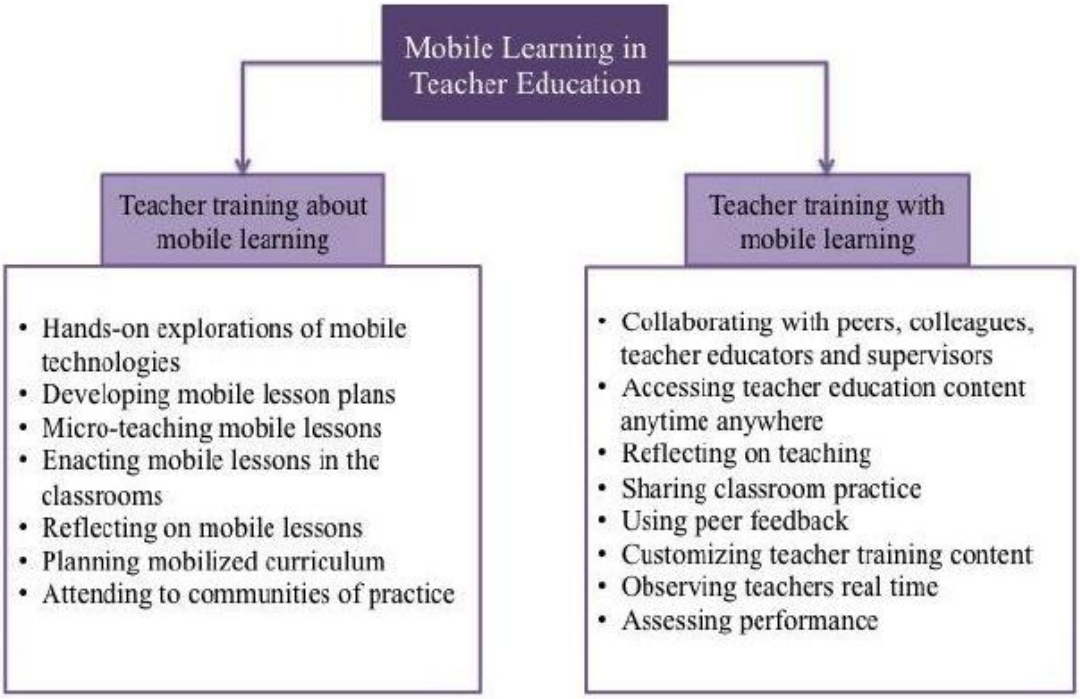

Figure 1. Two categories of m-learning practices in teacher education. From Baran (2014, p.28), with permission.

Mobile learning has been promoted as an important area in teacher education research (Albion, Jamieson-Proctor, Fasso & Redmond, 2013; Herrington et al., 2014). However, there is a scarcity of m-learning studies in teacher education exploring pedagogical insights, and the views of teacher educators themselves are often absent (Baran, 2014). This study therefore aims to investigate teacher educators' contemporary mobile learning practices in teacher education, exploring the following research question: *How are teacher educators exploiting the pedagogical features of mobile learning?*

It addresses this question by interrogating teacher educators' self-reported use of distinctive pedagogical features of mobile learning environments: Personalisation, Authenticity, and Collaboration (Kearney, Schuck, Burden & Aubusson, 2012). It draws on analysis of survey

data collected from mainly Australian and European teacher educators, with a particular focus on these featured mobile pedagogies, before discussing implications for teacher education.

2. Theoretical framework

In this paper, we use our pedagogical framework of mobile learning (Kearney et al., 2012) that draws on a sociocultural perspective. This Mobile Pedagogical Framework (or MPF) privileges three distinctive constructs of m-learning: Personalisation, Authenticity and Collaboration. From this sociocultural perspective, how learners ultimately experience these pedagogical features is influenced by their context, especially their use of 'time and space' (Ling & Donner 2009; Schuck, Kearney & Burden, 2016), comprising temporal features (scheduled/flexible, synchronous/asynchronous) and spatial features (formal/informal, physical/virtual) of the learning environment. The critical influence of this context is signalled by the central location of 'Time-Space' at the core of the framework, as depicted in Figure 2.

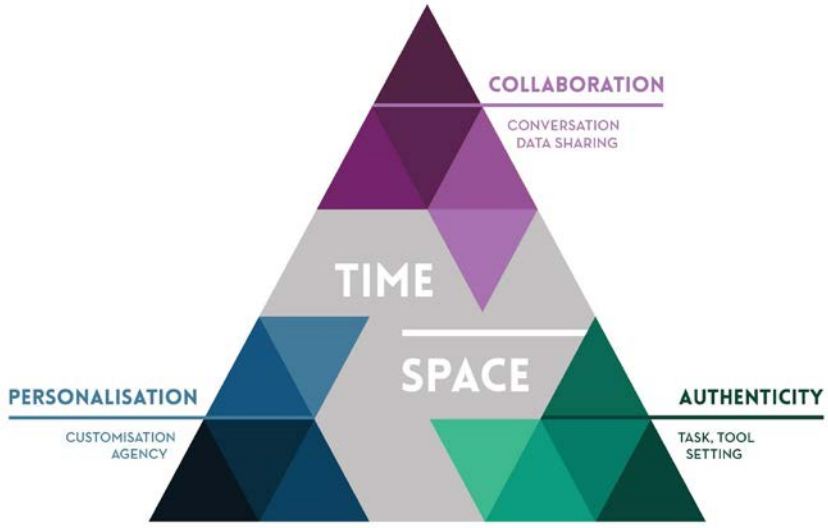

Figure 2. Our Mobile Pedagogical Framework (MPF) comprising three distinctive features of mobile learning experiences. Adapted from Kearney et al. (2012, p.8)

The Personalisation construct consists of the sub-constructs of Agency and Customisation and has strong implications for autonomous learning. High levels of Personalisation would mean the learner is able to enjoy a high degree of agency (Pachler, Bachmair & Cook, 2009) together with the ability to tailor both tools and activities, leading to a strong sense of ownership. Secondly, the Authenticity construct privileges opportunities for in-situ, participatory learning (Radinsky, Bouillion, Lento & Gomez, 2001). The sub-constructs of Task, Tool and Setting bring to bear the significance of learners' involvement in rich, contextualised tasks, making use of tools in a realistic way, and involving participation in relevant real-life practices and processes. Thirdly, the Collaboration construct captures the conversational, networked features of mobile learning. It consists of Conversation and Data Sharing sub-constructs, as learners engage in negotiating meaning, forging connections and interactions with other people and the

environment, and sharing resources through rich collaborative tasks (Wang & Shen, 2012). Figure 3 shows 'word clouds' created using frequently appearing terms associated with each of the three constructs from our previous papers (e.g. Kearney et al., 2012).

Figure 3. Word clouds relating to the three constructs of our Mobile Pedagogy Framework (MPF)

The MPF has recently been used to inform research on m-learning in school education (Kearney et al., 2015), teacher education (Kearney & Maher, 2013) and other areas of higher education (Kinash, Brand & Mathew, 2012). For example, Green, Hechter, Tysinger and Chassereau (2014) used the framework to inform the development of their own instrument – the 'Mobile App Selection for Science' (MASS) rubric – to aid teachers' rigorous selection and evaluation of K-12 science apps.

3. Mobile learning in teacher education

Part of the 'wicked problem' (Borko, Whitcomb & Liston, 2009) with integrating technology in teacher education is that teacher educators (and often PSTs) are navigating 'unchartered territory', in terms of adopting appropriate pedagogies that they did not experience in their own education (Foulger et al., 2013; Zhang, 2015). Most educators have had limited opportunities to observe and experience mobile pedagogies as part of what Lortie (1975) calls their 'apprenticeship of observation'.

Adding to these these concerns is the changing context within which teacher education is situated and the fractures that disruptive mobiles technologies generate. Technology is not value free but rather it embodies a set of unspoken assumptions or ideologies that influence how it is used and with what effect (Royle et al., 2014; Selwyn, 2013). In this respect, as noted by Selwyn, educational technology is a highly political enterprise and "…it is clear that educational technology is a value-laden site of profound struggle that some people benefit more from than

others – most notably in terms of power and profit" (p. 175). In the pre-mobile era, educational technology was essentially institutional, monolithic and stable in its orientation and form which in turn embodied a set of pedagogical values that was teacher-centered and focused on content transmission (Royle et al., 2014). In the post PC era, many of these certainties no longer exist as learners have access to their own, personalized technologies that are not regulated or controlled by their institutions. This shift could support an alternative ideology that is more democratic and student-centred, focused on digital capabilities and social networking rather than content transmission. However, education is notoriously conservative and risk-averse and history suggests mobiles will be appropriated as 'post-Fordist technologies':

> If teachers are merely the overseers of these factories of educational capital, then teacher development must be seen in the same light and mobiles in education become merely post-Fordist technologies, part of flexible manufacturing systems (FMS), in which the overseers—the teacher trainers—build educational capital into the trainee teachers, who need a different skill set." (Royle, Stager & Traxler, 2014, p.32)

Compounding this complex situation, there is a paucity of research examining teacher educators' practices with m-learning (Baran, 2014). However, there are some pioneering mobile learning studies in teacher education and they are discussed in this section.

3.1. M-learning practices in teacher education

Foulger et al. (2013) established a snapshot of how teacher educators are preparing PSTs to use m-devices in their K-12 teaching. They used a survey tool to explore the m-learning adoption practices of 79 teacher educators in US institutions, finding that most institutions were still in the early stages of exploration and adoption of m-learning approaches. In terms of Rogers' (2003) diffusion of innovation theory, most teacher educators surveyed in this study were still in the initial stage of 'defining the innovation' (mobile learning) and were "taking a certain level of risk by exploring its possibilities" (p.27). Pedagogical approaches varied amongst the teacher educator participants in this study, ranging from direct instruction of PSTs to modelling of sound pedagogical practices for the PSTs' prospective K-12 teaching. Pegrum et al. (2013) investigated how iPads contributed to PSTs' learning, including their learning about teaching. Case studies of eight PSTs were developed alongside focus group interviews of a larger cohort. They found that iPads supported PSTs' learning by helping them to develop their understanding of content and pedagogy, stay connected and organised. Their use of the iPads also helped PSTs develop a broader understanding of learning spaces and learning networks.

Innovative ways of enhancing teaching and learning using mobile technologies were explored by Herrington et al. (2009) in a project titled 'New Technologies – New Pedagogies'. In conjunction with an action learning framework involving sharing and reflection, the project's aim was to explore appropriate mobile pedagogies in a range of different subject areas. For example, primary PSTs "investigated the use of smartphones to facilitate interactions and reflections about K-6 mathematics concepts and the teaching of these concepts in the classroom" (p.11). Mobile devices in this project were used as 'cognitive tools' in authentic learning environments involving real-world problems and relevant projects. Herrington et al.

(2014) further considered mobile pedagogies informed by their authentic learning principles, advocating less prescriptive, more open implementation of m-devices and a move away from a focus on the affordances of m-devices. They advocated a design-based pedagogy, consistent with their views on authentic learning, whereby "m-devices can be used to create polished and worthwhile products that can be shared, published and appreciated widely" (p.148), in contrast to the traditional use of m-devices to deliver content.

Modelling of authentic m-learning practices is critical in teacher education (Herrington et al., 2014) to help PSTs learn how to use m-devices in a pedagogically appropriate manner and with the hope that they will in turn provide effective mobile learning experiences for their own students. There is a need for teacher educators to model exemplary mobile pedagogies "through collaborative practices, problem solving, creative thinking, interpersonal communication, and digital technology competencies" (Newhouse et al., 2015, p.71). For example, Broda et al. (2011) explored meaningful strategies for using iPads both in pre-service teacher education and within K-12 contexts. To help PSTs become comfortable in using the m-devices in their own teaching, they highlighted the importance of the modelling of iPad use (by teacher educators) to provide "progressive, authentic socially mediated experiences" (Broda et al., 2011, p.3151). They emphasised the need for all educators to adopt a "progressive ethic for teaching and learning, supporting efforts to think differently and use the technology tools to explore and embody the fluid nature of learning and teaching" (p.3150). This 'ethic' allows PSTs to realize the potential of mobile technologies in ways that are 'intrepid and creative' beyond what was possible when they (or their own teachers) were educated. Research undertaken recently, however, suggests teacher educators are not confident in modelling the use of mobile technologies with their PSTs (Burden & Hopkins, 2016), which echoes previous findings about their failure to model the pedagogical practices they expect of their trainees (Lunenberg, Korthagen & Swennen, 2007).

Other studies have looked at the development of teachers' 'technological, pedagogical and content knowledge' (or TPACK – see Mishra & Koehler, 2006) through the lens of mobile learning. For example, Kearney and Maher (2013) investigated the use of iPads to support PSTs' TPACK development in maths education. Findings suggested that the PSTs used the mobile devices to facilitate their own awareness of maths in everyday contexts, and then applied this knowledge to develop rich, more authentic and contextualized ideas for their own K-6 math tasks during professional experience. They also exploited the iPad's potential to conveniently and spontaneously take notes, observe lessons and make multimodal reflections. Hodges et al. (2012) also explored possibilities for PSTs to develop their TPACK through the use of iPads in teacher education, including the transfer of relevant skills and techniques to K-12 settings.

A promising area of focus in teacher education has been the use of mobile devices to support PSTs' learning during their school-based professional experience. For example, Maxfield and Romano (2013) explored PSTs' use of m-devices to video-record their observations on the first day of their school-based professional experience, and examined the impact that peer review of these videos had on their professional learning. The m-devices enhanced observation, and PSTs were able to connect to a diverse group of peers and other educators, enabling reflection on both their own first day experiences and their peers' experiences. Videos were later used on

campus to enhance collaboration and reflection on campus-based classes. More recently, Dann and Allen (2015) investigated how m-devices (especially iPhones) can be used by PSTs, supervising teachers and teacher educators to provide feedback to PSTs. Improvement of professional learning experiences was recorded for mentors and PSTs. For example, they received powerful visual feedback as part of a formative assessment process. Other studies have investigated the use of m-devices to access social media on professional experience. Zagami (2010) investigated PSTs' use of Twitter on their school placement (or 'iPrac') to share activities, achievements, attitudes, resources and events. He found that this process reduced the anxiety, isolation and uncertainty commonly experienced by inexperienced PSTs on professional experience. Similarly, Wright (2011) found that PSTs' use of Twitter on their mobile devices during school placements enhanced a sense of community, reducing isolation and helping them to focus their thinking and make more clear, purposeful reflections on their teaching.

3.2. Teacher educators' views

Many academic staff are unfamiliar with the use of mobile devices in education and are not effectively prepared to investigate the advantages or make informed decisions (Kukulska-Hume et al., 2009; Schuck, Aubusson, Kearney & Burden, 2013). Some feel that these technologies are changing so rapidly that they lack confidence and feel incompetent in using them for teaching (Herrington et al., 2014), fearing change from more familiar teaching methods. An unfortunate consequence is that PSTs who bring a device to university can become critical of their lack of use (Russell, Malfroy, Gosper & McKenzie, 2014) or may indeed decide not to bring their device to campus (Newhouse et al., 2015).

A number of first- and second-order barriers (Ertmer, 1999) to adoption of m-learning practices have been identified in teacher education contexts. First-order factors include a lack of teacher support and training (Baran, 2014), as well as issues of classroom management, concerns over equity (especially in relation to BYOD policies), restricted screen size and availability of devices, access to wifi and 3G/4G, and technical support (Albion et al., 2013; Herro et al., 2013; Pegrum et al., 2013). A challenging second-order barrier for teacher educators (and more widely in school and tertiary education) is their strongly held pedagogical beliefs. A common concern is that 'true m-learning' – learning untethered from the classroom – might challenge some teachers' beliefs about instruction and the role of the teacher (Sølvberg & Rismark, 2012). In this way, m-learning can be viewed as conflicting with more traditional views of teaching and learning (Burden, 2016). Consequently, some teacher education staff believe PSTs' 'work with technologies' should be confined to specialist education technology subjects, and this reluctance "can create a chasm between student teachers and other academic staff who have not realized the potential of m-learning across the curriculum" (Herro et al., 2013, p.36). Furthermore, some educators are concerned about a lack of evidence for the educational value of mobile devices to support learning and this may drive some techno-cynicism (Pegrum et al., 2013).

Another issue is the reductionist view of 'm-Learning' as a way to simply 'deliver information' (El-Hussein & Cronje, 2010), whereby students make use of m-devices to access content and

resources. This view is unsurprising given the rhetoric around ‘m-learning’ as a new way to ‘deliver instruction’, albeit more flexibly (Sharples, Taylor & Vavoula, 2007). The dominance of ‘drill and practice’ and ‘information provision’ apps in the Education category of providers such as iTunes (Murray & Olcese, 2011) potentially makes it easier to enact this transmissionist view. Indeed, in their m-learning study in higher education, Churchill and Wang (2014) found a strong focus on the use of ‘content accessing’ apps and resources by academic staff. Their study also provided valuable insights into both the educational affordances of iPad technology and the ways in which teachers’ personal or private theories mediate these perceived affordances. These theories covered a vast ‘territory’ ranging from teachers’ own theories of learning to epistemological and societal views. To address this important area of teacher beliefs, research is needed to explore other possibilities with mobile technologies, where emphasis is placed on collaboration, connectivity, representational possibilities, and analytical uses (Churchill & Wang, 2014).

4. Methodology

The aim of this research project was to gain an understanding of contemporary mobile learning pedagogies in teacher education, exploring the key research question: *How are teacher educators exploiting the pedagogical features of mobile learning?*

An online survey instrument was developed specifically for this purpose, with a focus on the three distinctive mobile pedagogies from the MPF (Kearney et al., 2012): Personalisation, Authenticity and Collaboration (see Figure 2). The survey was developed over several iterations prior to the commencement of the study. Intra-researcher validation was achieved through regular discussions amongst the authors of this paper and with regular feedback from two other academics who contributed to the original pedagogical framework (Kearney et al., 2012). These discussions critiqued each iteration and how well items aligned with the three framework constructs and the underlying socio-cultural theory. A penultimate version of the survey instrument was trialled as part of a pilot study with 20 external academics and school teachers at the beginning of 2013. Evaluative discussions focused on how well items elicited data relevant to the three mobile pedagogical constructs and also the consistency of these results. Feedback from pilot survey participants, including four specialist m-learning researchers, helped us to make final adjustments. For example, a distinction was made between *face-to-face* and *online* conversations in the Collaboration category. Also, the items relating to ‘Data Sharing’ (in the same Collaboration construct) were divided up into items relating to *generativity* (the extent to which learners shared learner-generated content) and *networking* (the extent to which learners shared data in online networked collaborations).

The final version of the online survey comprised 6 survey sections, consisting of 24 multiple choice questions yielding quantitative data and 6 open-ended questions producing qualitative data. The survey required participants to choose a mobile learning task that they had recently implemented, as the focus for their responses. In order to avoid response bias, ‘m-learning tasks’ were broadly defined in the survey as ‘specific learning tasks or activities in which mobile technologies were used’.

The first 2 sections were designed to ascertain background data on survey participants and their chosen m-learning task (e.g. task location, device ownership and applications used). The culminating Section 6 of the survey was optional to complete and gathered further information about participants' chosen tasks (e.g. teacher roles, intended learning outcomes). Data from open-ended questions in these sections of the survey were condensed, categorised, and connected over time (Huberman & Miles, 1998) according to emerging themes relating to the three constructs of Personalisation, Collaboration and Authenticity. An interpretive approach was employed for this analysis, providing insights into the teacher educators' perceptions (Mason, 1996).

Sections 3 to 5 comprised the core items in the survey, containing multiple choice questions relevant to the three constructs in the framework: six items relating to Collaboration; five items for Personalisation and three items for Authenticity. Each item in these sections contained three response options corresponding to 'low' (rank of 1), 'medium' (rank of 2) and 'high' (rank of 3), so a mean score for each sub-construct could be calculated. A reliability analysis of these items was carried out using Cronbach's alpha. Internal consistency (with all three constructs combined) was excellent ($\alpha = 0.828$). When considered separately, the internal consistency was in the acceptable range for each of the three constructs: Personalisation ($\alpha = 0.711$), Authenticity ($\alpha = 0.775$) and Collaboration ($\alpha = 0.715$).

4.1. Participants

There were 195 school and university educator participants who completed the survey. This paper focuses on the 46 teacher educator participants from the teacher education sector. All 46 teacher educators completed Sections One to Five of the survey, and 33 teacher educators completed the final optional Section 6. The teacher educator participants were mainly from Australia (14) and Europe (15), where the researchers' institutions were located. The purposefully sampled participants were generally very experienced educators, with 85% of them having taught in universities for more than 10 years (51% for more than 20 years). Also, 75% of participants perceived themselves as experienced users of mobile devices in their teaching – defined as having more than 2 years' experience. Despite this high level of expertise and experience amongst these teacher educators, the relatively low number of participants (essentially from two geographical regions of the world) was a limitation of the study.

4.2. Use of apps

All 46 teacher educators answered the following compulsory open-ended question: "What were the main apps and/or built-in tools (e.g. camera) used in the task?" Most participants listed several apps that were used in their nominated m-learning task, and we were also able to contextualize their use of these apps using other open-ended questions from the survey. We also used Goodwin and Highfield's (2012) classification of educational apps to categorise the teacher educators' responses (see Table 1). Their system uses three main categories, essentially arranged along a continuum from Instructive apps that are used for lower level cognitive, drill-and-practice style tasks, to higher level Constructive apps, used for more creative or communicative purposes, allowing learners "to create their own content or digital artefact using

the app" (p.12). In the middle of this spectrum is the use of Manipulative apps, demanding more rigorous thinking than Instructive apps, and leveraging "guided discovery and experimentation but within a predetermined context or framework" (p.13).

Table 1. Breakdown of apps used in the teacher educators' m-learning tasks (n=46)

	Instructive 11%	**Manipulative** 11%	**Constructive** 78% (43% media production)
Examples from participants	i) Multimedia viewing and 'content access' apps such as YouTube, iTunes U, TED and iBooks Reader; ii) Other apps used to access content such as QR Code scanners/readers.	i) Simulations, games and augmented reality apps; ii) Interactive discipline-specific/curriculum apps such as Matlab and WolframAlpha (maths).	i) Media production apps for video (e.g. iMovie), images (e.g. Skitch), audio (e.g. Sound Recorder), presentations (e.g. Keynote, Explain Everything, ShowMe), location-based learning (e.g. 7scenes); ii) 'Cognitive tools' such as note-taking apps (e.g. Evernote), mindmapping apps (e.g. Mindomo) and communication/social media apps (e.g. Twitter).

5. Findings

Participants chose a range of task contexts as a focus for their survey responses, with 86% describing a formal m-learning task that was campus-based. Only 14% of teacher educators reported on a m-learning task they had implemented that was situated in an 'extramural' context (school playground, excursion site, museum, home) and no tasks were set in a totally informal location such as a café or public transport. Surprisingly, not one task involved a 'change in context' (or 'boundary crossing' between learning spaces), an increasingly important characteristic of mobile learning in the literature (Burden & Kearney, 2016b; Schuck et al., 2016). The most common discipline areas were STEM education (40%), languages and literacy education (14%), and social sciences education (12%). Most tasks involved use of an iPad (28%), laptop (19%), or mobile phone (12%), while 30% of tasks integrated a mixture of devices. Thirty-five percent of tasks involved use of institution-owned devices (23% for on-campus use only), while a surprisingly low 33% involved student-owned devices in a Bring Your Own Device (BYOD) approach. The large majority of tasks reported in the open-ended questions in the survey fitted into Baran's (2014) category of PSTs learning 'about' m-learning, with only 3 participants reporting on a task that would fall into the category of PSTs learning 'with' m-learning (see Figure 1).

In this section, we discuss the teacher educators' self-ratings of their use of mobile pedagogies, as shown in the third column of Table 2. When relevant, the quantitative results are discussed in light of results from the school teacher data set (Kearney et al., 2015)—see right hand column of Table 2. In general, teacher educators' perceptions of conversational strategies in their m-learning tasks, and to a lesser extent those around Personalisation, were noticeably low. In contrast, their perceptions of authenticity were more positive.

Table 2
Mean rankings for components of the Collaboration, Authenticity and Personalisation constructs

Construct	Component	Mean rank Teacher educators n=46	Mean rank School teachers n=107
PERSONALISATION	Agency	2.1	1.9
	Customisation	2.1	2.0
AUTHENTICITY	Setting	2.4	2.3
	Tool	2.6	2.3
	Task	2.6	2.4
COLLABORATION	Conversation (face-to-face)	1.9	2.4
	Conversation (online)	1.6	1.4
	Data sharing (generativity)	2.5	2.4
	Data sharing (networking)	2.2	1.9

5.1. Personalisation

The Personalisation construct, which includes the sub-constructs of Agency and Customisation, was scored modestly by the teacher educators with a mean score of 2.1 each. The use of mobile devices to customise the learning experience for PSTs was evidently not widespread and indeed this has been a consistent finding across all of the different education sectors we have surveyed, not just teacher educators. For example, the school teachers made similarly low self ratings for Agency and Customisation (1.9 and 2.0, respectively—see right-hand column of Table 2) in their tasks. Few of the open text exemplars that teacher educators cited in the survey featured Customisation in any great depth, indicating this is an area where more professional development is needed.

Given the much heralded benefits of 'student control' in the mobile learning literature (e.g. Pachler et al., 2009), it was surprising that the other sub-construct of Personalisation – Agency – scored 'low' amongst teacher educators. Similarly low scores amongst school teachers (see Table 2) might be attributed to the age of the students and concerns about privacy and online safety that are more common in the school sector than in the post-school sector. Hence, it was more surprising to find broadly similar low scores for the Agency sub-construct amongst teacher educators, which suggests they are also reluctant to grant PSTs more control and choice when using mobile technologies. Also, this lower rating may have been affected by the unexpectedly low use of student-owned devices (33%).

5.2. Authenticity

Authenticity was the highest-scoring construct in the survey and was a major priority for the teacher educators. The MPF that informed the construction of this mobile learning survey instrument identifies Setting, Tool and Task as three sub-constructs for Authenticity. Although all three of these sub-constructs were scored very highly by participants (2.4, 2.6 and 2.6

respectively—see Table 2), some of them were more prominent in their scenarios than others. Teacher educators often reported on giving their PSTs opportunities to participate in authentic networks or to work in an authentic location.

For example, one teacher educator asked her PSTs to use their m-devices to develop and use a professional learning network (PLN) to enhance their digital footprint and discuss digital citizenship issues. They later used their PLNs to find resources, answer questions and forge authentic relationships with other pre-service and practising teachers beyond their immediate setting. Another teacher educator created and modelled a place-based m-learning task suitable for a field trip to a river as part of geography education studies. The PSTs used their m-devices' geo-location facilities to pick up their locations at the three main stages of a river's path. At strategic points, their devices presented them with teaching materials corresponding to their positions along the river. The aim of this in-situ, contextualised task was for students to identify river features (e.g. waterfalls, meanders) and processes (e.g. erosion, deposition) associated with each stage of the river, and the impact on the surrounding landscape. As well as creating and testing this authentic task, the teacher educator asked the PSTs to create their own location-based m-learning task for a different topic in geography (for their peers), in light of their immersion experience. In this way, the task had another layer of authenticity in that the PSTs were producing real-life teaching resources for their teaching peers and prospective school students.

5.3. Collaboration

Data sharing was a strong feature of the teacher educators' perceptions of Collaboration in their m-learning tasks. In particular, the generativity element of the Data Sharing sub-construct—such as the use of apps to create videos, animations, digital stories, e-books and other multimedia artefacts—was prominent in the exemplars quoted by the teacher educators and also in the survey items, with a mean score of 2.5. This result mirrors the similarly high mean score awarded by school teachers (2.4—see Table 2) for this element and indicates these constructionist digital practices are well understood and widely practised and modelled in teacher education. As shown in Table 1, over three-quarters (78%) of the apps mentioned by survey participants were used in a way that would be classified under Goodwin's (2012) Constructive category: leveraging students' communication and creation of their own digital content. Almost half (43%) of the apps mentioned were media production apps. Frequently mentioned apps were social media apps such as *Twitter*, video production apps such as *iMovie*, as well as note-taking apps such as *Evernote*. These results suggest teacher educators are more inclined to use open-ended, content-free apps apps to support more design-based pedagogies (Koehler et al., 2011), in line with the growing popularity of knowledge-building activities in teacher education (cf. Burden, 2016), and recent initiatives such as the digital maker 'movement' (Niemeyer & Gerber, 2015).

However, the conversational aspects of m-learning that constitute the Collaborative construct—both face-to-face (1.9) and online (1.6)—were not scored as prominently. This low online conversation score also mirrors the low scores awarded to this item by school teachers (1.4), although curiously, face-to-face conversations were rated far more favourably (2.4) by the

school teacher cohort, possibly influenced by the tendency for school teachers (especially K-6 teachers) to issue m-devices for groupwork. Like their colleagues in schools, teacher educators did not yet appear to be fully exploiting the affordances of mobile devices that support the elements of dialogue and conversation that might be described as virtual and distant. One exception was a maths teacher educator who challenged his first year PSTs to take photos to demonstrate maths concepts and create a collage to share with others online on their course *Facebook* page. PSTs were then encouraged to report on their maths experiences and learning via *Twitter*. The aim of the task was to "think mathematically and discover the concept and demonstrate it authentically" (survey response). The use of social media was emphasised by the teacher educator as a way to "talk, discuss, experiment and play".

6. Discussion and Conclusion

We acknowledge that the teacher educator participants may well have designed and implemented other m-learning tasks that have different pedagogical emphases to the one they reported on in this survey. Nevertheless, this study has effectively examined 46 different tasks from teacher education contexts of varying characteristics and purposes. In this way, it has provided an in-depth snapshot of current m-learning practices in teacher education, scrutinising pedagogies privileging authentic, collaborative and personalised learning. Teacher educators in this study perceived their own m-learning practices to be strongly authentic in nature, with less positive perceptions of autonomous, personalised learning and online learning conversations. These results are quite similar to the school teacher cohort (Kearney et al., 2015), though there was more emphasis amongst teacher educators on design-based approaches, typically through the PSTs' use of generative media production apps.

The results from this study, combined with research referred to already in the Literature Review, underline our earlier contention that teacher educators may struggle to exploit the full range of effective mobile pedagogical approaches. The findings suggest that teacher educators are cautiously exploring the potential for online collaboration mediated through mobile devices, but have not yet fully grasped the opportunities to design tasks which fully exploit (and model) the personalised nature of m-learning, or indeed its virtual, networked-based characteristics. There is evidently a need to encourage teacher educators to consider modelling a wider range of approaches to their PSTs, especially those inclusive of in-situ learning contexts, and supporting a greater level of learner agency, customisation and virtual conversations to share practices beyond the immediate vicinity and access external expertise. There is also a need to consider m-learning task designs that support more seamless 'boundary crossing' across these contexts (Burden & Kearney, 2016b)—a feature of mobile learning that was not evident in the participants' responses. For example, m-learning activities that span an informal learning space such as a café or public transport; a semi-formal space such as a field trip setting (real or physical); to more formal, scheduled, campus and school-based learning spaces. Such approaches need to exploit an extended range of physical and virtual contexts in and beyond traditional formal learning environments, or what Schuck et al. (2016) call 'Third Space learning'.

Like the school teacher cohort, teacher educators point to perceptions of highly authentic and realistic uses of mobile technologies, despite their setting in predominantly formal institutional contexts and use in somewhat contrived processes. Such results suggests a need for additional perspectives from other stakeholders, especially learners themselves, to provide greater triangulation. Perceptions of 'authenticity' may well be very different from the students' perspectives (Barab, Squire & Dueber, 2000; Burden & Kearney, 2016a), and hence, a student version of the survey used in this study is currently being trialled (Burden & Kearney, 2016a) to provide additional perspectives based on student voice (Groundwater-Smith, 2007). These survey instruments may have applications beyond research purposes. In teacher education contexts, PSTs and their supervisors could separately complete the survey used in this study as stimulus for post-lesson professional learning conversations and analysis. The previously mentioned student version of the survey could also be completed by school students to help PSTs evaluate their own m-learning tasks implemented during their school practicum.

Although some of the literature reviewed indicates educators are looking for advice and guidance on how to select and use discipline-specific apps (Churchill & Wang, 2014; Green, et al., 2014), the findings from this study suggest teacher educators are inclined to use more generic, content-free, creative apps that can be used in a wide variety of ways across all disciplines. This approach appears more sustainable and scalable in the longer term, and research and development is needed to explore new principles and instruments to evaluate the mobile pedagogical affordances of these resources, with emphasis on the sociocultural underpinnings of the MPF. To supplement currently popular rubrics (e.g. Walker, 2011), new instruments need to be developed to guide teacher educators and PSTs in their examination and evaluation of various characteristics and features of apps that potentially leverage aspects of collaborative, personalised and authentic m-learning.

Mobile learning has been raised as a critical aspect of contemporary teacher education (Albion et al., 2013) and this has prompted calls to update pedagogical approaches in teacher education programs (Herrington et al., 2014). This study has placed a much needed 'spotlight' on contemporary m-learning practices in this context but further research is needed to address salient questions raised from our findings. For example, to what extent are teacher educators cognisant of the theoretical foundations and pedagogical affordances of m-learning? And how can expertise and understanding about the use of m-learning in teacher education be developed at scale to have an impact beyond 'early adopters' and 'innovators'? Modelling of best practices with mobile pedagogies is an imperative in teacher education (Herrington et al., 2014; Pegrum et al., 2013) but what constitutes 'best practice' in the use of m-learning and how can teacher educators be supported in challenging their own teaching beliefs and exploring new teaching approaches? Further research in this area will assist present and future teachers in fully grasping the growing range of potentially disruptive mobile pedagogical opportunities available to them.

Footnote. In response to some issues raised in this paper, the authors are currently designing and developing a mobile learning toolkit (www.mobilelearningtoolkit.com) for teacher educators undertaken as part of a transnational Erasmus+ initiative, led by Prof. Burden and funded through the European Union (see www.mttep.eu).

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