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Exploring Mobile Affordances in the Digital Classroom

Abstract

This article reports on a survey of teachers undertaking a postgraduate applied practice certificate in digital and collaborative learning. The survey was intended to capture how mobile learning was currently being used by the teachers both on the course and in their own classrooms. The objective was to investigate to what extent mobile learning was being used by our students, and which particular mobile learning activities were, or were not, being integrated into teaching and learning in their own classrooms. We also wanted to explore how interested the teachers might be in seeing new mobile learning activities embedded within the course. Our results suggested that teachers and their students are frequently engaged in activities that utilise mobile learning affordances, but that these activities focus on simple, supplementary activities such as taking photographs and making videos. However, our results also indicate that there was significant interest among our teachers to explore more sophisticated mobile learning activities such as outdoor discovery activities. One conclusion we might draw from this study is that, despite many years of research into mobile learning and how it can be used both inside and outside the classroom, teachers need to be explicitly guided and supported to adopt these approaches in their schools. The feedback from this survey will be used to help to develop the course curriculum to integrate new elements of mobile learning.

Introduction

In the early years of mobile learning, the distinction between mobile devices and other types of digital tool was quite clear. The physical differences in size, weight and features between mobile phones and PDAs on the one hand, and desktop and laptop computers on the other, were significant. Both Quinn (2000) and Traxler (2005) provided early definitions of mobile learning that explicitly focused on mobile devices as core components of such a definition. However, we now inhabit a world where digital devices of all sizes and intents present a ubiquitous environment of potential learning tools. As Wu et al. (2012) note, while past research tended to focus on mobile phones and PDAs, there is an increasing range of devices being utilised for mobile learning. The huge uptake of touch screen tablet-sized devices in the 2010s (Pope & Neumayr, 2010) has blurred the boundary between the mobile and the static device. A tablet on the desktop with an attached keyboard mimics the traditional style of static computer, while the same device can immediately switch to a tool for mobility, with GPS, camera, sensors and so on. The potential for mobility continues to increase, for example a GoPro proves new perspectives for creativity (Stodd, 2013) while drones are already being used for teaching and learning (Briggs & Patterson, 2015.)

In addition to the expanding notion of what might be viewed as a mobile device, current definitions of mobile learning incorporate notions of mobility that include: a realisation of the illusory nature of traditional classroom-bounded practices that are based on an assumption of the stability of the learning context (Kukulsa-Hulme et al., 2009); the view that learners are always on the move and that learning is both informal and, at times, vicarious (Brown et al., 2010); and, that mobile learning has unique features that enable place-sensitive information, amongst other things (Raudaskoski, 2003.)

Mobile Learning Affordances

Gibson (as cited in Bruce, Green & Georgeson, 2003) developed the theory of affordances, which says that the affordances of the environment are potential actions and interactions that the environment offers. The concept of affordance therefore emphasises usage over form factor. Naismith, Vavoula, Lonsdale and Sharples (2004) noted that mobile technologies can be broadly categorised on the two dimensions of personal vs shared (with an implicit impact of collaborative activity) and portable vs static (whether a device that can be used in a mobile context is, in fact being used in a static context.) The importance of these distinctions is that they have more to do with the way a device is used than the features of the device itself.

Orr (2010) outlines the main affordances of mobile learning. Using a device that is small enough to be easily carried means that not only can learning material be downloaded to the device in a ubiquitous fashion, but data can be gathered in a similar manner. Further, data may be gathered much faster than using more traditional methods such as pen and paper (though hand drawing does have some of its own affordances.) Communication facilities allow material to be posted / broadcast immediately and, overall, the unique value proposition of the mobile device is that it can be used in situations where there is no digital alternative. Liang et al. (2005) focus specifically on communication affordances, listing six different types of communication affordance that may be relevant to mobile learning; response collecting, posting, pushing, controlling, file-exchanging and instant-messaging. Lai et al. (2007) remind us that a learning affordance is the relationship between the properties of an object and the characteristics of its user. They also point out that mobile devices use new forms of user interface. Thus a mobile user affordance is based on the way that the user chooses to interact with the tool. So, Kim & Looi (2008) emphasise the mobile affordances of portability, connectivity and context-sensitivity, while also highlighting the ability of mobile devices to enable seamless, active learning. Tan and So (2015) emphasise not the affordances of the device but that of the physical environment within which mobile learning takes place. They suggest that the 'rich' (i.e. complex) real world environment of an outdoor mobile learning activity leads to greater learning challenges and opportunities than the controlled environment of the classroom. Interestingly, their study was based on the use of laptops in a learning activity based on gathering and analysing data from the outdoor environment, stressing that the affordance is embedded in the nature of the activity, not the device itself. From these various perspectives we can see that mobile learning affordances are based on a three way relationship between the device features, the environment, and the way that the learner interacts with both of these. Thus in a study of

affordance we need to gather data on the physical features of the device being exploited, the physical context in which it is used and the activities of the individual learner in relation to these two factors.

Table 1 shows a set of mobile affordances taken from the literature, with detail provided under the three general concepts of affordance identified from that literature; the physical features of the device, the context of use and the activities of the learner.

Table 1: Mobile affordances, features, contexts and activities

Mobile Affordances	Physical features of the device	Context of use	Activities of the Learner (examples)
Portability (Naismith, Vavoula, Lonsdale & Sharples, 2004)	Physical form factor	For movement during learning activities	Any of those below
Data gathering (Orr, 2010)	Data recording / retrieval	To gather, manage or store information	Taking Photos Recording Videos Recording Sound Reading environmental values
Communication (Liang et al., 2005)	Connected to data networks	For communication and/or collaboration	Coordinating distributed, purposeful messaging
Interaction with the interface (Lai et al., 2007)	Applications, tools and presentation	To visualise and present digital content	Reading QR codes Triggering augmented reality overlays Hosting virtual reality
Contextual, active learning (So, Kim & Looi, 2008)	Context awareness	For active learning interacting with a context	Using sensors (e.g. temperature, light, orientation, acceleration)
Outdoor environment (Tan and So, 2015)	Pervasive in the environment	To support learning outside the classroom	Using GPS location Mapping outdoor learning activities

Research Context

This paper takes as its context a post graduate certificate course in digital and collaborative learning, offered to qualified teachers with at least three years of teaching experience. The course is broad ranging, covering multiple aspects of pedagogy, leadership and innovation, but an essential thread of the course is that it supports applied practice in the use of digital tools for teaching and learning. Many of these tools are cloud-based, Web 2.0 systems best used through desktop or laptop computers. We find that in many cases the larger form factor of the laptop screen and the fine control of the mouse rather than the touch screen is better for activities such as movie editing, creating cartoons, building infographics, designing for 3D printing etc. than smaller tablets or mobile device screens. Further, some of the software we use does not support mobile versions on all platforms, or we find that the mobile versions of these applications lack some features. As one indicative example, we found that the iPad app version of the cloud-based mind mapping tool we were using did not support all the tools necessary to enable the user to work on collaborative mind maps.

No-one can deny the relevance or the utility, of web 2.0 tools in social constructivist learning (Cochrane & Bateman, 2010). Yet, the mobile component of digital teaching and learning is one that we would be remiss to ignore or undervalue. We know that mobile learning provides opportunities for contextualised, interactive, collaborative, pervasive learning that cannot be fully addressed by static computer based activities. Many researchers have previously demonstrated the breadth of imagination and discovery that can be embedded into learning activities supported by mobile devices, include mixed reality (Winter & Pemberton, 2011,) historical narrative (Dugstad Wake & Baggetun, 2009), science fiction (Dunleavy, Dede & Mitchell, 2009,) geolocated augmented reality (FitzGerald et al., 2013) simulation (Colella, 2000) environmental exploration (Klopfer & Squire, 2008), applied mathematics (Tangney et al., 2010) and situated enquiry (Sharples et al., 2011.)

Mobile Affordances in our Course Curriculum

We were conscious of the fact that the current digital component of our course curriculum was not directly addressing any aspects of mobile learning, so undertook a study to help us to redesign the curriculum to integrate the use and awareness of mobile learning features and benefits. Given the blurring of boundaries between devices used for static and mobile learning activities, we focus here not on device type but on affordances, i.e. we were interested in devices being used for what may be categorised as mobile learning activities rather than worrying about whether a particular device is or is not 'mobile'.

It should be noted that current classroom activities are not actually devoid of mobile affordances, indeed some are used very regularly, albeit informally (there are no formal mobile learning activities.) Using mobile devices to take photos or videos is a typical classroom activity. These devices are also occasionally used for reading QR codes and Aurasma triggers. These are, however, just support activities for other learning experiences. The photos and videos are

uploaded to social media, the QR codes and Aurasma triggers used to access other media, but there is a lack of integrated mobile learning activity or creativity. Further, we do not provide specific classroom content on the pedagogy of mobility.

Methodology

Previously, we explored some mobile affordances that may be relevant to our course curriculum. Given the potential benefits of mobile learning, we wanted to consider the introduction of further mobile learning coverage into the course. The chosen research participants for this study were both the alumni of the course and those currently enrolled. From the alumni, we hoped to gain insights from their retrospective reflections on their experience of the course, and perhaps also the new experience gained after graduation. From the currently enrolled teachers, we hoped to gain some insights into what their hopes and expectations of the course might be, since we would be in a position to perhaps modify the course content accordingly to enhance their experience. In order to do this, our first step was to explore to what extent teachers in the course (1) were already using mobile affordances in teaching and learning and (2) what ideas and interests they might have regarding the introduction of new mobile learning course components. Our research questions for this study were therefore the following (note that the 'teachers' referred to here are those attending the postgraduate course, and alumni of the course):

- RQ1: To what extent do teachers currently utilise mobile affordances in the postgraduate course?
- RQ2: To what extent do students currently utilise mobile affordances in the classroom?
- RQ3: How can mobile affordances be better integrated into the postgraduate course?

To address these questions, we developed an online survey which we distributed through our learning management system and also through the Google+ communities of our students. This was the best channel available to us to reach not only the currently enrolled students but also the alumni, who were no longer engaged with our learning management system. There are several of these online communities; one for each current cohort, plus another for alumni. Responses were entirely voluntary and anonymous. In addition, the first question in the survey asked the respondents to confirm that they were happy for their anonymous data to be used for our research purposes and possible publication.

Results

We had 72 valid responses to the survey. Unsurprisingly, these were primarily from those students currently enrolled on the course (the July and November 2015 intakes), since these are regular users of the Google+ communities where the survey was posted. Only around 21% of the responses were from our alumni (Figure 1.)

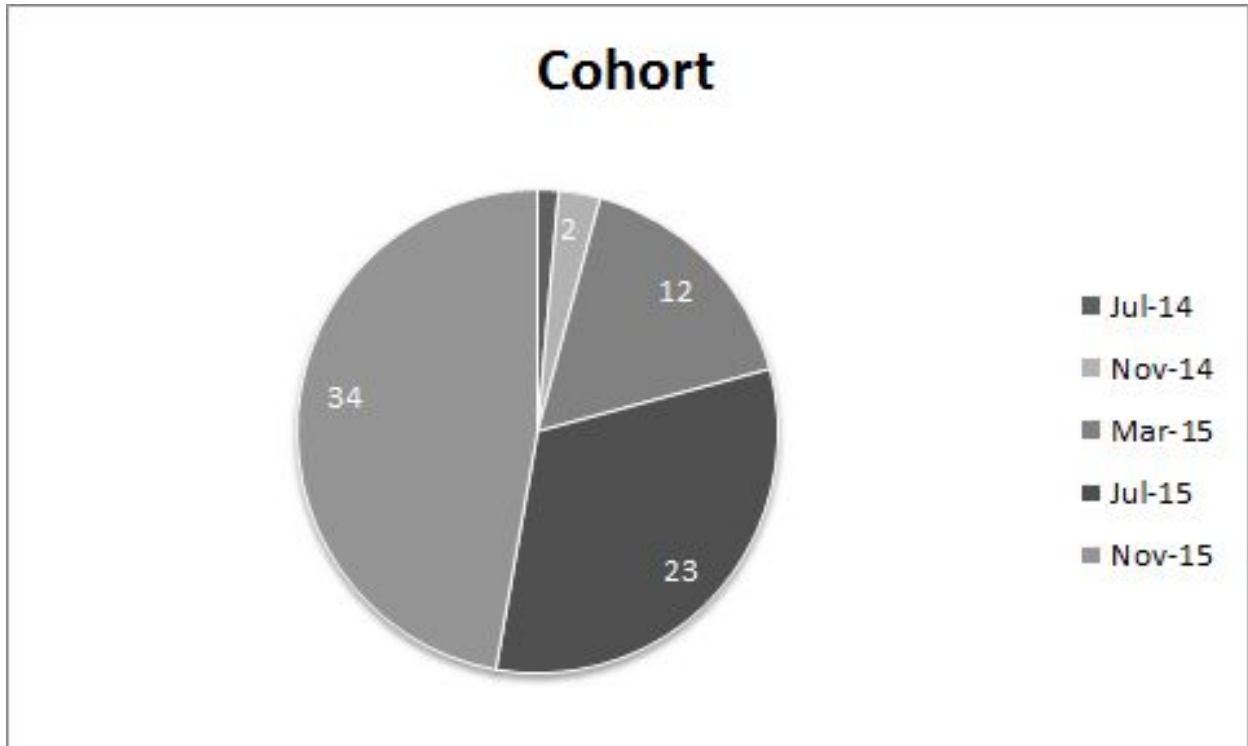


Figure 1: Survey responses by cohort

In order to gain some idea of the range of devices being used in the classrooms of our respondents, we asked them what proportion of their total digital activity they spent working with students using each of four types of device; desktop, laptop, tablet and smartphone. The results indicated that the use of different types of device; desktop, laptop, tablet and smartphone, showed that all of these tools were being regularly used for various tasks in the classroom (Figure 2). This would suggest that teachers and students are regularly shifting between devices depending on the affordances of those devices for different teaching and learning tasks. However we noted that those devices that more easily support mobile affordances (tablets and smartphones) were being used slightly less often than those tools that do not easily support mobile affordances (desktops and laptops).

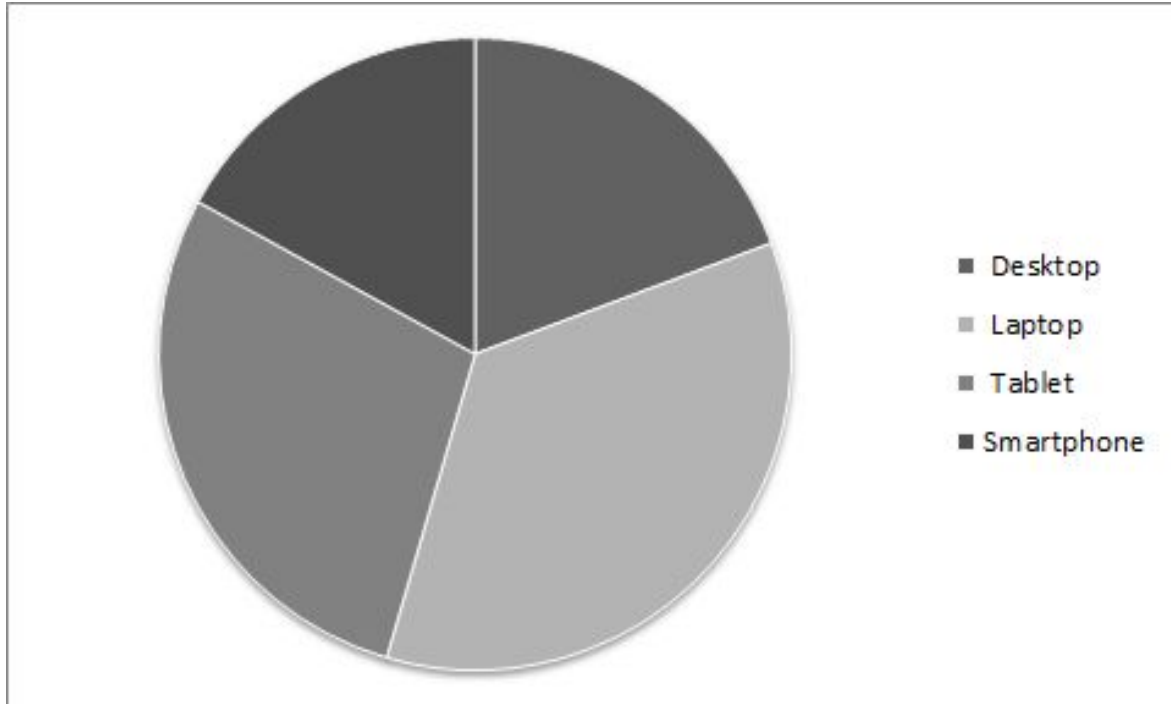


Figure 2: Relative usage of different types of digital device when working with students

Mobile Affordances and activities

To address research questions 1 and 2, asking to what extent both teachers and their students currently utilise mobile affordances in their respective learning spaces, we developed a series of survey questions based on the activities of the learner identified in Table 1. These activities were; taking photos, making videos, sound recording, using QR codes, using augmented reality, using virtual reality, using sensors, using location sensing and collaborative messaging. The results are shown in Figure 2. The activities of taking photos and making videos were extensively used by both teachers and students (more than 50 in all cases.) Sound recording was the only activity that was used more by the students (40) than their teachers (34). Collaborative messaging was well used by the teachers (47), less so by their students (32). The other categories show relatively small uptake by both teachers and student, though it is notable that in all the other cases the teachers were currently using the other affordances more than the students. The use of QR codes is an exception, where there was an equal level of usage (18). Overall, portability (Naismith, Vavoula, Lonsdale & Sharples, 2004), data gathering (Orr, 2010) and communication (Liang et al., 2005) provided most usage of mobile affordances in the survey. In contrast, the affordances of interaction with the interface (Lai et al., 2007), contextual, active learning (So, Kim & Looi, 2008) and learning in an outdoor environment (Tan and So, 2015) were rarely used by either the teachers or their students.

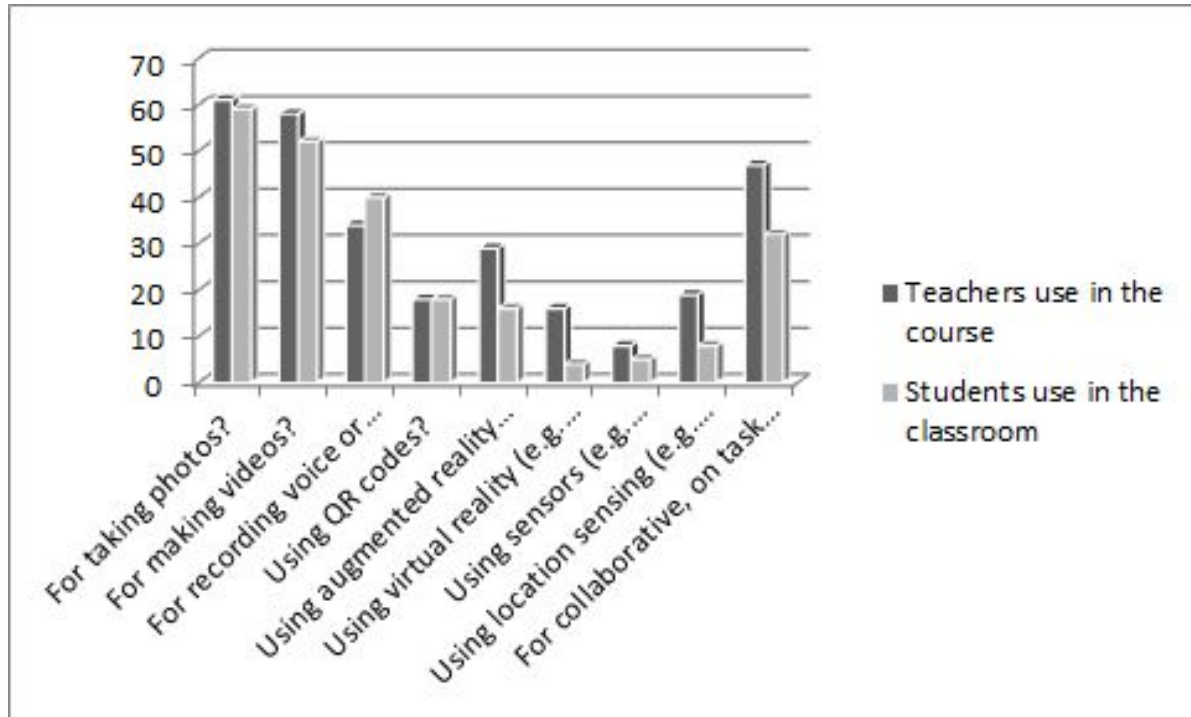


Figure 3: Use of mobile affordances in the learning spaces of the teachers and their students

Given that the set of learner activities in the survey was taken from a review of the relevant literature, we hoped that it was comprehensive. However, in case we had excluded any important activities that the respondents had engaged in, we asked them if there were any mobile learning activities from their own practice that we had missed. If so, we asked what they was, and where they were used. We only received seven responses to this question, suggesting that our list of activities was largely complete. Most of the responses we got could in fact be seen as refinements of the suggested categories. For example, texting and Skyping were mentioned, both of which would come under the heading of collaborative messaging. Stop motion movie making as also mentioned, which to some extent relates to taking photos, recording sound and video, so crosses several activity boundaries but sits within the affordance of data gathering. It does raise the question, however, of whether data gathering is a sufficiently broad category to encapsulate the creative activity of stop motion movie making (or indeed other creative activities that include the capture of digital data.)

Quite a few examples were given of mobile devices being used to access online applications and social media; Google+, iTunesU, Pinterest etc. Perhaps this suggests that the most obvious affordance of mobility, being able to access online resources anytime anywhere, might usefully have been included in the list of activities. Robotics was also mentioned by two respondents, though unfortunately no other detail was provided. However it is clear that mobile devices can be used with robots, for example Lego Mindstorms includes a mobile app that can be downloaded to control Mindstorms robots. 3D printing was also mentioned, again without further

details. but it is certainly the case that there are now several mobile apps available for controlling 3D printers. These responses suggest that an additional affordance, that of the mobile control of other devices, should be considered. This type of affordance is likely to become increasingly important as the Internet of Things continues to develop and expand.

Mobile App Usage

In order to capture practice in more detail, we also asked the teachers to list any mobile apps that they used in the classroom. There was a wide range of tools mentioned, many of which had niche application, such as Maori language learning, playing the guitar and sketching, and were only mentioned by one or two respondents. More generic tools, which were used more widely, included various Google apps (15), several social media apps (15), photo/video/movie apps (12), synchronous communication tools (5) and quiz apps (7).

We also asked the teachers to list any mobile apps that their students used in the classroom. Whilst there was some overlap with the teachers' own usage, for example Google apps and movie editing, there was a broader range of apps being used by the students. Many of these were used for creating work for sharing or assessments. Specialist mobile apps included Hopscotch (for coding) Gamefroot (for game creation), maths apps such as Mathletics, Explain Everything for presentations, reading and writing apps such as Chatterpix, among a range of others.

Indoor / Outdoor uses of mobile activities and affordances

The use of mobile apps amongst teachers compared to the use of mobile apps amongst students provides some initial insight into differences. Equally intriguing are differences between teacher and student uses of mobile activities indoors and outdoors. These differences, captured in Figure 4 below, are apparent in a comparison, firstly, of both groups' indoor versus outdoor uses and, secondly, a comparison of teacher versus student uses in both environments.

The most striking difference, overall, relates to indoor versus outdoor use of mobile activities and affordances. On all of the identified activities, from taking photographs to on-task, collaborative messaging, indoor activities enjoy roughly 10% to 50% more engagement than outdoor activities. Furthermore, elicited responses from teachers (a summary of which is provided below in Figure 5) regarding the improvement of the mobile curriculum foreground the desire for curriculum content specifically targeting the design and implementation of outdoor mobile learning activities. If teachers are keen to implement these activities, the question that begs further research is whether there are other systemic or context-specific influences that significantly impede engagement in outdoor mobile learning activities and, if this is the case, what these impediments might be?

The second noticeable difference, though less striking, is the fact that student use of mobile activities and affordances outstrips teacher use of mobile activities and affordances on the

course in a number of identified fields, such as recording sounds and making use of sensors. Once again, this raises some questions: bearing in mind the fact that virtually 79% of respondents belong to the July 2015 and November 2015 cohorts, did participation in the course meaningfully influence student activity in their classes (over a very short period of time), or, were these practices embedded before the teachers enrolled in this programme? Furthermore, should this

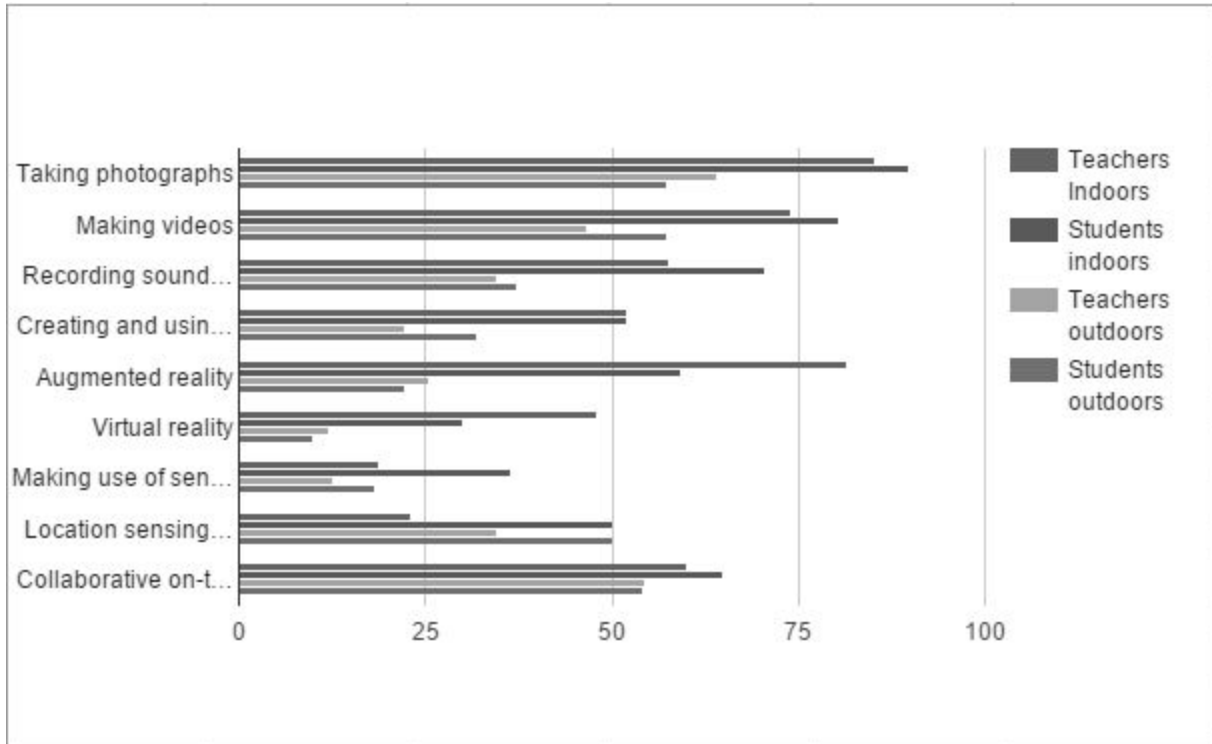


Figure 4: Indoor and outdoor use of mobile activities and affordances

disparity in usage encourage us to reflect on ways in which specific app-related hands-on skills are acquired during the course of the program?

Improving the mobile curriculum

Since one of the main motivations for this research (research question 3) was to seek to improve our curriculum coverage of mobile learning, we asked the teachers which suggested mobile activities they would like to see covered in the course. All of the suggestions gained some interest but the outdoor learning activities were the most popular option (Figure 5). If combined with GPS, which is used for many outdoor mobile learning activities, this would prove to be a popular addition to the course, and is therefore the most likely innovation that we will pilot at the next available opportunity. However, given that the other options also revealed interest, we will also consider whether some of these other activities might also be covered.

These results suggest that there is genuine interest in mobile learning activities in the teacher community that we are not currently addressing.

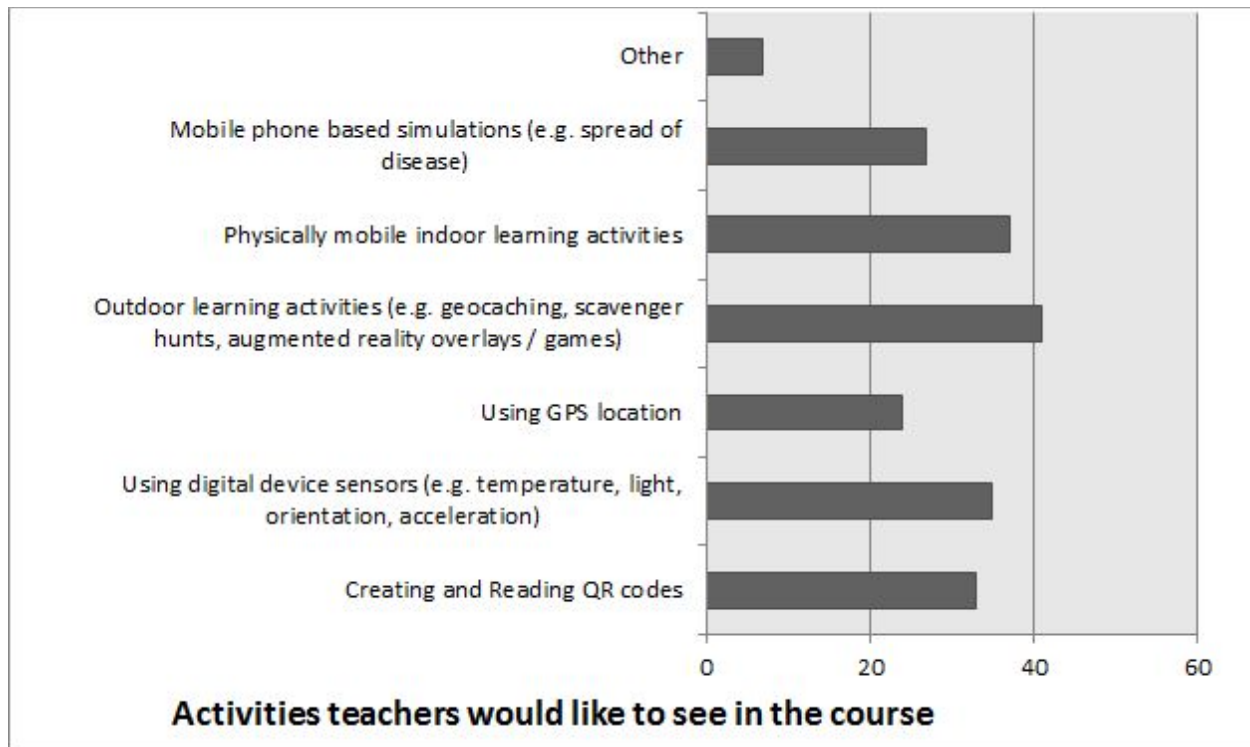


Figure 5: Mobile learning activities suggested for inclusion on the course

Summary / conclusions / limitations / future work

This investigation has provided some evidence in support of both teacher and student use of mobile activities and affordances in the classroom and beyond. One of the most important limitations of this investigation, however, is its inability to shed light on the extent to which the existing curriculum, whether experienced or anticipated, has influenced teacher responses to survey questions. In the process, the following questions for further research have been raised:

- (1) If teachers are keen to engage in outdoor mobile learning activities, are there other systemic or context-specific influences that significantly impede engagement in outdoor mobile learning activities and, if this is the case, what might these impediments be?
- (2) Bearing in mind the fact that virtually 79% of respondents belong to the July 2015 and November 2015 cohorts, did participation in the course meaningfully influence student activity in their classes (over a very short period of time), or, were these practices embedded before the teachers enrolled in this programme?
- (3) Furthermore, should this disparity in usage encourage us to reflect on ways in which specific app-related hands-on skills are acquired during the course of the program?

The investigation does provide sufficient impetus for redevelopment of the mobile curriculum to include, most importantly, a focus on the design and implementation of outdoor mobile learning activities, and, possibly, selected additional activities identified by teachers as being desirable, such as physical mobile indoor learning activities and the use of digital device sensors.

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