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P. Anand

University of Wollongong, pranit@uow.edu.au

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Abstract

Mobile wireless technologies have the potential to exploit locationawareness capabilities to engage learners in constructivist collaborative learning activities yet there is little research that explores this capability. This paper describes the design-based research approach that has been adopted for an ongoing exploratory study that seeks to identify ways in which the location-awareness feature of mobile wireless devices could be used to create constructivist-based learning activities. A literature review of existing research in technology enhanced learning applications suggests the suitability of using the designbased research approach to develop complex and innovative learning applications. This study will make contributions for the future research and development of mobile learning applications.

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Pranit Anand
University of Wollongong

Abstract:

Mobile wireless technologies have the potential to exploit location-awareness capabilities to engage learners in constructivist collaborative learning activities yet there is little research that explores this capability. This paper describes the design-based research approach that has been adopted for an ongoing exploratory study that seeks to identify ways in which the location-awareness feature of mobile wireless devices could be used to create constructivist-based learning activities. A literature review of existing research in technology enhanced learning applications suggests the suitability of using the design-based research approach to develop complex and innovative learning applications. This study will make contributions for the future research and development of mobile learning applications.

Introduction

Mobile learning has been defined by a number of authors as the practice of learning when the learner is mobile or not at his/her normal location (Vavoula and McAndrew 2005). It can be argued that mobile learning can occur with the use of conventional learning tools such as pen and paper, text books, printed lecture notes and the like. Yet there are other authors who suggest that mobile learning also includes learning activities that utilise mobile devices (McManus 2002; Herrington, McKenney, Reeves and Oliver 2007). For this study I will adopt the definition that mobile learning includes learning when the learner is mobile while using mobile wireless devices such as smart phones, and laptops, to support their learning activities.

Most countries around the world, like Australia, are experiencing an increase in the overall usage of mobile devices (www.dcita.gov.au 2006). There is a proliferation of mobile devices on Australian higher education campuses, with devices such as wireless laptops, mobile phones, smart phones, entertainment units, and iPods, being carried by a number of students. Some institutions have already adopted wireless technologies and attempted to implement wireless infrastructure within their campuses (Wagner 2005; Kim, Mims and Holmes 2006). Libraries for example encourage the use of personal wireless laptops and other wireless devices to access their resources by providing wireless network access.

Mobile wireless devices generally do not require any more infrastructure implementation than that has already been implemented, and since most students already own some form of a mobile device, they would not necessarily be burdened with the requirement to purchase hardware if these devices were used for learning activities. Although there exists many different types of mobile devices from different manufacturers, there has been a gradual move towards a standards based technology incorporating a number of features that would only have been available in separate devices not too long ago.

Some of the technical aspects of modern mobile wireless devices include:

1. Mobile communications capabilities: using cellular networks for voice and data communications.

2. PDA capabilities built-in: with fully functional mobile operating systems providing capability to install productivity software, and allowing these devices to be customised for unique applications, i.e. programs can be written especially for certain applications.
3. Wireless connectivity: through infrared, WiFi and Bluetooth standards.
4. Location-awareness: through Global Position Systems (GPS) and cellular technologies outdoors and configurable WiFi and Bluetooth location-awareness indoors.
5. A number of expansion options. (Wagner, 2005)

Apart from the novelty of owning and using these highly technological devices, using these devices for teaching and learning has significant benefits for the learners. Some research indicates that mobile devices for learning have the potential to increase learners' motivation, enthusiasm and overall participation in learning activities. For example, in their research, Swan et al. (2005) found that when mobile computing devices were used in an elementary class in America, students' motivation, their engagement and the overall support for their learning activities increased. In this research, it was found that the students' felt more connected to the learning that was supported using mobile devices due to the personal nature of the devices. Students did not have to share the devices with other students unlike laboratory computers. Similar findings have been reported in Australia by Kervin (2005), who used mobile phones within a class of primary school students to facilitate better, more immediate communication between the students and their parents. Other studies (Osawa et al. 2005; Yee and Park 2005; Mejia, Morán and Favela 2007) have also reported increased motivation and engagement in learning activities using mobile devices.

The vast majority of initial research and use of these highly technological pervasive devices has focussed on providing access to existing learning materials, which although convenient, is not particularly unique for the affordances that these devices provide. Effective mobile learning pedagogies must engage the peculiar qualities of mobile devices, which include ubiquity, convenience, location-awareness and personalisation (Stead 2006).

Research Question

How can mobile wireless technologies, particularly the feature of location-awareness, be used to support constructivist based learning activities in higher education?

Methodology

This is an exploratory study that will investigate the possibilities of using location-aware mobile wireless technologies to create constructivist based learning activities. Design-based research provides the overall structure and phases for the research.

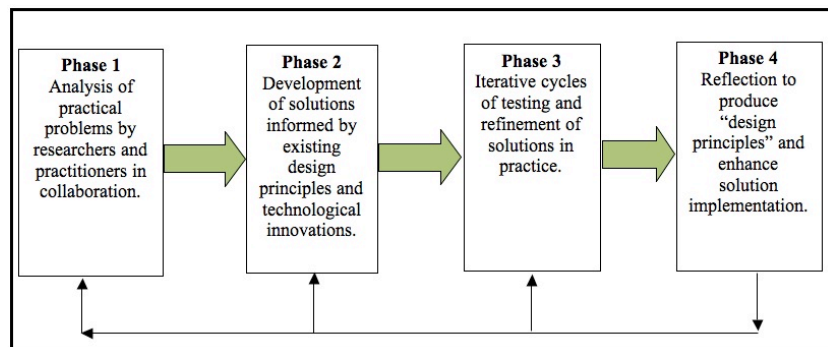
Educational technology research and particularly research into the use of innovative new technology like mobile devices is a complex process (Wang and Hannafin 2005; Chan et al. 2006). Although research in educational technology has started to address mobile

learning, there are currently very few applications of these devices to support teaching and learning activities. Mobile technologies itself is still evolving with most devices supporting numerous communications and technology standards. As such, a great deal of research activity in mobile learning would involve identifying appropriate technology and its affordances, as well as the relevant pedagogical applications of the technologies. In most cases, these types of research involve identifying a problem and through rigorous research provide solutions, which are then improved upon over a number of iterations of testing and implementations (Herrington, McKenney, Reeves and Oliver 2007).

Design-based research has been used by a number of studies involving the use of technology to solve learning and teaching problems, for example, Zydney, Todd and Hasselbring (2007) used this approach to develop a software that allowed primary school students in America to participate in the development process of a computer game for learning mathematics, as well as an evaluation of the system to identify the motivating factors that influenced how students used the computer based game. The results were used to create more engaging computer based games to help students learn mathematics, as well as inform the theories of motivation.

The following diagram describes the various phases of design-based research:

Figure 1: Refinement of problems, solutions, methods and design principles [Reeves, 2006]



Phase 1: Analysis of practical problems by researchers and practitioners in collaboration.

The purpose of phase one is to identify an opportunity for research, “explore its history and background and provide a convincing and persuasive argument that this problem is significant and worth researching” (Herrington, McKenney, Reeves and Oliver 2007 p4).

A literature review was conducted to identify existing applications and how mobile wireless devices have been used for teaching and learning. As mentioned earlier, currently there are very few applications that utilise the unique features of mobile wireless devices, which include location-awareness. However, there is enough discussion in the literature (Chan et al. 2006) about the potential for utilising location-awareness for educational applications that a lot more work needs to be done to identify suitable learning activities that could enhance learning using this feature.

This phase of the research encourages extensive consultation with other researchers and practitioners. Opportunities such as conferences and other academic gatherings need to be identified to allow discussion of mobile learning ideas with others that have significant

experience in the research, design and deployment of mobile learning applications. Papers are being presented at various conferences for various stages of this research and feedback from these presentations will be used to further inform the design of the research and the learning activity.

An initial implementation of a location-aware mobile learning activity has been identified which may be expanded further through the initial phases is the study. Initial ideas about this learning activity involves developing a software that can be loaded onto mobile devices which can recognise similar and different knowledge domains of other devices. A potential implementation may involve a classroom where, say towards the end of a class the teacher may instruct students to identify three things that they feel confident about and three things that they think they need more help with about the topics covered in that class. The devices should be able to identify and inform its owners the other students who may need help with the topics that they themselves are confident about. It is expected that students would use this information to discuss their 'know well/not know well' areas with others, and eventually be able to construct knowledge about the topics. It will be aimed at allowing students to construct knowledge through collaborative activities. This activity would encourage collaboration through peer teaching and learning. In addition to that, the ability of these mobile devices to connect to other networks would enable students to seek knowledge from other sources.

Phase 2: Development of solutions informed by existing design principles and technological innovations.

Phase two of the research uses existing theoretical frameworks to guide the design and development of the learning activity including the location-aware mobile learning software. Learning activities must be anchored within acceptable theories of learning.

Constructivism has gained a great deal of prominence within the higher education environments in recent times. It includes learning activities where students are able to construct their own knowledge and are provided with an opportunity for their own learning (Honebein 1996). Another significant idea that has only very recently started to be discussed and used to influence learning activities is that of connectivism. Connectivist ideas suggest that new ways of learning and knowledge creation is needed in an environment where computers and digital technology play a significant role (Siemens 2006).

Informed by constructivist and connectivist learning theories, the proposed location-aware mobile learning application should be able to identify other learners with similar interests within a more tightly structured formal learning situation, deployed using convenient wireless mobile devices.

Location-awareness will be used to support face-to-face collaborative knowledge creation amongst co-located learners. Built within the learning activity and supported by the system will be the opportunity to contribute towards a community knowledge base using Web 2.0 principles.

Phase 3: Iterative cycles of testing and refinement of solutions in practice.

An initial pilot study will be conducted to test out the activity. This would consist of about 4 or 5 volunteer students. These students would be provided with mobile devices provisioned with the mobile learning application. An introduction to the software and the various activities will be explained. The students will be required to use the system to identify other students with whom they could potentially collaborate. Feedback in relation to the effectiveness of the technology, including any user interface issues will be collected from these students. They would also be required to provide their personal reflections about their experiences using an online blog. This feedback and the reflections will be used to identify any improvements to the system.

The second implementation will involve a classroom size group of about 10 to 20 students in an existing class. The activity should be incorporated within the overall learning activities of that class, and once again feedback from students relating to the effectiveness of the technology and the activity to support their learning will be collected.

Phase 4: Reflection to produce “design principles” and enhance solution implementation.

Use the activities and data from previous phases to create a set of design principles that can be used to design constructivist based learning activities for mobile wireless devices.

Data analysis

Data analysis will be a continuous process in this research. The analysis will begin during the first phase of the study. The following table demonstrates the focus of that various phases, the types of data, the data gathering techniques and the data analysis procedures that will be adopted.

Table 1: Data collection and analysis

Phases	Focus	Data Gathering Technique	Data Analysis
<p>Phase 1:</p> <p>Information about existing research, practice and technology.</p> <p>Suitable implementation of location-aware learning activity.</p>	<p>What is mobile learning?</p> <p>Existing mobile learning applications.</p> <p>Current mobile technologies.</p> <p>Current learning theories and principles.</p>	<p>Literature review.</p> <p>Online discussion forums that provide opportunity for practitioners and researchers of collaborate and share their experiences.</p> <p>Participate in discussions with other researchers and practitioners who have attempted to use location-aware mobile learning in various ways.</p> <p>Attend presentations and conferences and seek opportunities to discuss ideas with other researchers.</p>	<p>Initial literature used to identify themes that are relevant for mobile learning including the learning theories and mobile technologies.</p> <p>These readings are coded with researchers reflections about the relevance to the study and providing overall idea about the position of the previous studies.</p> <p>Discussions with other experts in the field and conference presentations feedback will be analysed as a reflective process.</p>
<p>Phase 2:</p> <p>Using the data and information gained from previous phase, design and develop the first prototype of the learning activity using appropriate technology solutions for mobile wireless devices. This would require the development of customised software that can support the learning activity and provide the facilitator with the tools to monitor the students' progress.</p>			
<p>Phase 3:</p> <p>Student interactions.</p> <p>Students' perceptions.</p> <p>Teacher perceptions.</p>	<p>How is the activity influenced by the technology?</p> <p>What do the students and the teachers think about the technology and the learning activity?</p>	<p>Observations about how the technology is being used to support collaborative learning practices will be recorded to describe the activities in the class and will also report on unusual events observed.</p> <p>Focus group interviews with students and teachers will be used to explore the perspectives of the students and teachers using this activity. It will be used to seek feedback about the observations.</p>	<p>Personal reflection notes about the observations will be added to the observation notes and these will help organise the observations into themes to seek evidence of collaborative learning.</p> <p>Interviews will be recorded and coded according to themes. Students and teachers will be allowed to provide their own reflection about the activity.</p>
<p>Student approaches to learning.</p> <p>Student reflections.</p>	<p>Did the technology-enabled learning activity help or hinder students' learning?</p> <p>Did the learning activity motivate collaborative learning practices?</p> <p>How did the learning activity influence developing understandings?</p>	<p>Record of students' learning activities.</p> <p>A questionnaire would be aimed at all the students in the class, and it will be used to collect feedback about the influence of the activity on their motivation and knowledge creation.</p>	<p>Record of students' learning activities will be used to verify if the collaborative activities contributed towards knowledge creation.</p> <p>The data will be coded and emergent themes identified.</p>
<p>Phase 4:</p> <p>Development of a set of draft principles for the use of mobile wireless devices for constructivist based learning activities. Reflection about the use of deign-based research approach for this study.</p>			

Conclusion

Location-awareness feature of mobile wireless technologies can provide opportunities for constructive collaborative learning. Design-based research approach is well suited for complex, innovative research and development where there are little existing applications. It allows the researcher to collaborate with others in the field and contribute towards existing knowledge about mobile learning practices.

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Contact: pranit@uow.edu.au

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