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Constructivist-based learning using location-aware mobile technology: an exploratory study

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Abstract: Mobile wireless technologies have the potential to exploit its location-awareness capabilities to engage learners in constructivist collaborative learning activities yet there is little research that explores this capability. This paper is a report of work-in-progress on an 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 mobile learning applications suggests the potential of using location-awareness feature of mobile wireless devices for learning and teaching applications, however, little research has been done to implement such as system so far. This study will make contributions for future development of location-aware mobile learning experiences.

Introduction

Higher education institutions in Australia and elsewhere are experiencing a growth in the use of wireless mobile devices amongst their student populations. Research in the use of wireless mobile devices for education and learning has also increased; with numerous studies indicating the possibility of using these wireless mobile devices for teaching and learning to allow institutions to better engage learners. Although some studies discuss the educational potential of the unique affordances of mobile wireless devices that include location-awareness, ubiquity, personalisation and mobility, most existing mobile learning practices do not consider location-awareness activities within a constructivist framework of learning.

The purpose of this paper is to report on a work-in-progress study that explores the educational applications of location-aware mobile wireless devices in higher education environments. It provides a discussion about the relevance of mobile learning and suitability of these devices for constructivist-based learning activities. The paper also outlines the proposed research approach for this study. The findings of this study will provide useful information for the future development of constructivist-based learning environments using the location-awareness feature of mobile wireless devices.

Background

Mobile learning has been recently 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 includes learning activities that are mediated by mobile devices (McManus 2002). For this study we will adopt the definition that mobile learning includes learning when the learner is mobile while using mobile wireless devices such as smart phones, personal digital assistants, mobile phones, laptops, etc. to support their learning activities.

Higher educational institutions in Australia, like most other countries, are experiencing a steady increase in student numbers. At the same time the overall use of mobile devices is also increasing. Over 82% of the entire Australian population own a mobile device and over 94% of all 19 to 24 year olds, who form the majority of students at Australian universities, own a mobile device (www.dcita.gov.au). There is a proliferation of mobile devices on Australian higher education campuses, with devices such as wireless laptops, mobile phones, smart phones, entertainment units, iPods, etc. being carried by many students. Most tertiary 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. It is clear that educational institutions are encouraging the use of personal wireless devices, particularly since it eases up some of the load on other computers in laboratories and classrooms.

Mobile devices generally do not require any more infrastructure implementation than 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 and the devices themselves converging to incorporate a number of features that would previously only have been available in separate devices.

Some of the technical aspects of modern mobile wireless devices include (Groten and Schmidt 2001; Rogers et al. 2002; Bernd, Hampel and Sprotte 2004; Wagner 2005):

1. Mobile communications capabilities: using cellular networks for voice and data communications. Current cellular network standards like 3G are able to support extremely fast wireless data transfer rates.
2. PDA capabilities built-in: with fully functional mobile operating systems providing capability to customise these devices.
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: providing unlimited possibilities to add components and enhance its functionality.

A number of recent studies have been done to explore the potential of using mobile devices for teaching and learning. Apart from the novelty of using these highly pervasive technical devices, studies have reported that the use of mobile devices for learning has a positive influence on learners, observing that mobile learning generally increased learners' motivation, enthusiasm and overall participation in learning activities (Demana, Meagher, Abrahamson, Owens and Herman 2003; Swan, Hooft, Kratoski and Unger 2005; Zydney, Todd and Hasselbring 2007). The vast majority of initial research and use of these highly technological pervasive devices has focused 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).

A number of recent studies have started to utilise location-awareness capabilities of mobile wireless devices for teaching and learning applications, and a lot more papers are also suggesting that this particular capability can be extremely useful for contextualised learning activities. Some studies that have used location-awareness for teaching

and learning applications include:

The Ambient Wood Project: Location-awareness was used in this study primarily to transmit information to the students (primary school context) and provide opportunity for students to collaborate. The learning experience involved augmenting a physical woodland environment with digital technology like the radio frequency identification tags and movement sensors. The mobile devices were used to look up more information about these points of interest, as well as to take environmental readings like temperature and humidity (Rogers et al. 2002),

periLearn: Location awareness was used in this study to support situated learning, supported by collaborative sharing and knowledge creation. Students in a higher education setting used Global Positioning System enabled smart phones to identify physical locations that were of interest to them, taking pictures of these locations, adding their own unstructured text descriptions to these pictures and uploading them to a server online. This technology allowed students to create 'views' of their community and to share it on a collaborative website (Winters 2007). Students shared their pictures through a collaborative website, where the location-awareness feature of the mobile devices appropriately embedded the pictures on existing mapping software.

Thinking Tags: This study was designed to allow students to construct knowledge in a collaborative, simulated setting. 'Thinking tags' are small wearable devices that can be programmed to simulate different types of behaviour. In one study these devices were programmed to simulate the propagation of a virus from one device to another in a classroom setting (Colella, Borovoy and Resnick 1998).

These are just some examples of innovative uses of location aware mobile wireless technologies for education and learning applications. "To be widely adopted, location-aware computing must be as effortless, familiar and rewarding as web search tools like Google" (Schilit et al. 2003 p29). Existing wireless infrastructure and built-in Bluetooth standards can provide this sort of convenience, as these technologies do not require any significant set-up of the learning environment.

Proposed Research Study

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

Educational technology research and particularly research into the use of innovative new technology like mobile devices is a complex process (Wang and Hannafin 2005). Especially in regard to mobile learning, there are not a lot of applications, and as such a great deal of planning is required to determine the appropriate technology and the relevant pedagogical applications of the technologies. In most cases, these types of research involve identifying a problem and through rigorous research; providing solutions, which are then improved upon over a number of iterations of testing and implementations (Herrington, McKenney, Reeves and Oliver 2007).

Design-based research approach is well suited for these complex research attempts (Herrington, McKenney, Reeves and Oliver 2007). It consists of four phases, which are described as follows:

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

The purpose of Phase 1 is to conduct literature review to identify existing applications and how mobile wireless devices have been used for teaching and learning. Although some studies have utilised the location-aware features of mobile wireless devices for teaching and learning, they have not been used to facilitate constructive learning practices through co-present collaboration.

An initial implementation of a location-aware mobile learning activity has been identified which will be expanded further through the initial phases in the study. It involves learners collaborating with each other to construct and share knowledge. Initial ideas about this potential learning activity involves developing 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 of the other students who may need help with the topics that they themselves are confident about. It is expected that students would use that to discuss their 'know well/not know well' areas with others, and eventually be able to construct increased understanding about the topics. 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. More work needs to be done to detail this activity and some of this process will involve discussing the initial ideas with other experts in the field of mobile learning. Currently we are in the process of discussing potentialities with other researchers who work with mobile learning in Australia and overseas.

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

A set of draft principles will be created that will be used to guide the development of the location-aware learning activity, informed by appropriate learning theories.

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

It is envisaged that the learning activity will be implemented with a group of students, with the expectation that these students will realise the benefit in such research as it would help them advance their own understanding of applications of educational technology. An initial pilot of the study will be conducted using about 4 to 6 students. Feedback in relation to the technology and personal reflection of students will be used to design further implementations, which 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.

Conclusion

Location-awareness feature of mobile wireless technologies can provide opportunities for constructive collaborative learning. The study described in this paper is the result of exploring existing literature on mobile learning and identifying aspects of mobile wireless devices that can influence modern teaching and learning practices. It will involve extensive collaboration between researchers in the field of mobile learning and the results of this study will add to the existing knowledge about mobile learning practices.

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