LOCATION-BASED MOBILE LEARNING FOR HIGHER EDUCATION STUDENTS – DEVELOPING AN APPLICATION TO SUPPORT CRITICAL THINKING

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ABSTRACT
The increasing adoption of smart phones and tablets has opened up many opportunities for the use of new technologies in ways that can benefit. The challenge is to try and match the technology to educational activities that can be adapted to students' current practices and levels of ability, thus enriching their learning experience. Many higher education students' assignments require critical thinking and analysis and students with rudimentary skills need a high level of guidance and support. This paper presents the background to an intervention, which is currently in the early stages of design, to develop students' critical thinking skills using location-based mobile learning. It is hoped that this intervention, which will involve the use of a mobile application, will enrich students' independent learning experiences by providing contextually relevant knowledge to enhance their analysis in various situations.

Author Keywords
Location-based, critical thinking, mobile application.

INTRODUCTION

Mobile learning has become a burgeoning area of research in recent years. It is gaining increasing attention with the advancement of mobile technologies and the widespread use of smartphones and tablet PCs. It has been applied within many disciplines such as Science (Hwang et al., 2009; de-Marcos et al., 2010), Computing (Hwang et al., 2010; Yau and Joy, 2008), and Languages (Chen and Hsu, 2008; Guerrero et al., 2010) to name but a few. Research has been conducted both in schools and higher education. However, in comparison with secondary education, there is relatively little research regarding mobile learning in higher education (Yatani et al., 2004; Costabile et al., 2008; Shih et al., 2010; Hwang and Chang, 2011).

This paper presents an intervention currently being designed to develop students' critical thinking skills using location-based mobile learning, which showcases personalisation as one of the strengths of mobile learning (Kinshuk et al., 2009). The next section of this paper briefly explains the relevance of critical thinking to this study. This is followed by a summary of the related work in the area. Next, the initial concept is introduced, together with the aim and objectives of the proposed system. Finally, the research methodology and the rationale for the adopted approach are discussed.

CRITICAL THINKING

As this research aims to encourage and develop students' critical thinking and analysis, it is important to define what this means. There are several relevant definitions of critical thinking, some as early as Dewey (1933). However, for the purposes of this study one definition has been identified, Scriven and Paul's (1987) who defined it as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action". Their definition shows a clear relation to Bloom's taxonomy, linking critical thinking to the three higher levels of the taxonomy (analysis, synthesis, and evaluation) (Duron et al., 2006). This definition emphasizes the multifaceted nature of critical thinking, expressed through a number of activities. These activities correspond to the assessed work carried by students in this study.

RELATED WORK

This section provides a brief overview of a few selected research studies in the area of location-based mobile learning which best exemplify use in a learning environment. Chu et al. (2010) developed a location-aware mobile learning system for a natural science course for primary students. The system uses RFID tags on plants as the sensing technology. The system guides students to a particular plant encouraging them to ask questions and compare similar plants. They argue that the system promotes students' interest in natural science and improve their learning.

Shih et al. (2010) developed a mobile learning activity to guide primary students' learning in a historic site for a social science course. They claim that students' achievements have risen by 10%, with 90.6% of the students strongly agreeing that using the PDA, as a guide was more interesting.

Yau and Joy (2008) developed a framework for a mobile context-aware and adaptive learning schedule (mCALS) tool. The framework is designed to help students plan their studies. It retrieves their context to suggest which learning material is appropriate for the student, given their preferences, and the location.

A LOCATION-BASED SITUATED LEARNING FRAMEWORK

This section describes the initial concept behind this research and the motivation for applying such a system in higher education courses.

Motivation and Initial Concept

The idea for the research emerged from seeking to identify ways of exposing interaction design students to real world environments, similar to those in which they will eventually be designing, in order to maximise their ability to identify opportunities for innovation. However, sending students out into real-world environments with a brief to be evaluative and analytical, without the presence of a teacher, can lead to a superficial and frustrating experience, especially for students with beginning levels of analysis and limited critical thinking skills. It is not always possible for teachers to accompany students, and moreover, it might not be beneficial for developing students to have immediate input from teachers, but rather prompts to provoke the development of their own thinking.

Hence, a system that provides location-based hints and formative feedback to students could aid students' understanding of the context they are in. Without guidance, students might miss out on key areas that may help them with analysing the situation properly. The hints could give them the beginning of a thread that leads to the development of innovative ideas.

This proposed system will be designed for smart phones, providing students with structured support as they learn about their subjects in a real-world context. When students reach a pre-specified location, the application will display a detailed map identifying the various sub-locations which contains either text and/or images provided by their lecturer. These hints will be designed to aid them in widening their perspectives, developing their own ideas and in critical evaluation. The text notes will vary from simple words to questions, and in some cases to links that will open a quiz webpage; the particular content will depend on the specific aspect that the lecturer would want the students to focus on. Furthermore, to add a collaborative learning aspect to the activity, students will be able to post their comments for their lecturers and fellow students to take note of.

The motivation for developing the mobile application is as follows:

- We have chosen a situated learning pedagogical approach, a research topic that has been lagging behind a location-based and context-based for mobile learning paradigm in higher education.
- The application could help students stay focussed on the purpose and outcome of the activity, rather than be distracted by the process. Thus, maximising their benefit from the real world experience while still implicitly developing an understanding of the process.
- Students struggling to analyse the situation and develop new ideas have the appropriate guidance from the application.
- Sharing comments, ideas and maybe stories if desired, may enable students to benefit from their peers' knowledge and different perspectives.

The initial situated learning activity will be developed for a level 2 Human-Computer Interaction (HCI) module in the Department of Computer Science and Creative Technologies at the University of the West of England. As part of their work for this module, students are required to evaluate and carry out a context-based analysis as part of a requirements gathering process for a computer-based system.

Aim and Objectives of Proposed Research

The aim of this research is to investigate how smart phone applications should be designed to enable students to learn effectively in-situ.

To achieve this aim the following objectives have been identified:

- To construct a prototype for a pedagogical activity assisted by a mobile device to facilitate independent study.
- To consider various ways in which the prototype might enable reflection and critical thinking in a structured manner.
- To review the students' experience of using the prototype of locative media application in relation to effectiveness and usability of the system.
- To review students' perceptions of the formative feedback provided by the mobile application.

We are currently in the process of developing the working prototype.

Research Questions

- How effectively can mobile learning/technologies provide students with the necessary guidance in a situated learning activity without the physical presence of the tutor/lecturer? Effectiveness will be considered in terms of improving ability for critical thinking, evaluation and synthesis.
- What evaluation criteria and techniques can be used to evaluate such systems?
- How can the prototype be designed so that it is easily customisable for different activities and scenarios?

- The power of mobile learning occurs in personalisation. Based on the technology available to students, to what extent can the application be personalised?

Methodology

A number of research methods appropriate for human-centred design, have been reviewed to inform the research design. It seems best to implement this research using an iterative design and prototyping approach to ensure a high level of usability and utility. Within this approach the following phases are considered:

Requirement Gathering:

In order to have a deep understanding of the current learning activity as it is carried out, and to thoroughly underpin user needs, the first phase has involved a number of activities:

- A secondary literature review of mobile learning, applications and technologies, giving a comprehensive knowledge of the current state of the art. This knowledge is helping to shape the design and trigger ideas for the system.
- Interviews with the stakeholders (lecturers, students, administrators) involved in study. These help to give a better understanding of the structure of the activities carried out by each participating course, how the activity and students could benefit from implementing mobile learning, and the main problems faced by students in the activity. Interviews are significant in gathering requirements and understanding the needs of the users (Lazar et al., 2010).
- A survey to give a clearer picture of student ownership and use of smartphones in the locale of this research.
- Focus groups with previous students cohorts to help understand the difficulties faced by students when performing the activity prior to this research.
- A review of previous submitted coursework and feedback from lecturers on the work to give a better understanding of the weak points in students' work and the areas in which support is most needed.
- A comprehensive review of the relevant technology to identify suitable technologies to be adopted for the system.

Theoretical Framework Development:

The focus of this phase is to develop the details within a framework, based on the outcomes of the first phase. One significant framework that has been identified as being particularly relevant is the work of Ryu and Parsons (2008). Using this framework, the design of the requirements has been derived using the information gathered from interviews with the HCI lecturers.

System Design and Prototyping

In this research, an iterative design and prototyping approach is being followed. Conceptual design enables the translation of requirements into a conceptual model. A conceptual model is " a high-level description of how a system is organised and operates" (Johnson and Henderson, 2002 cited in Rogers et al., 2011).
Prototyping is an effective way to discuss design ideas with stakeholders. It helps in testing technical feasibility, understanding requirements, testing and evaluating, and assuring design compatibility (Rogers et al., 2011).
The iterative design and prototyping approach is a cyclic process of defining requirements, designing, coding, and testing.

As part of iterative approach of this project, paper prototypes, task flow models, and mock-ups are being implemented.

System Evaluation and Usability Studies

Usability testing will be performed on early prototypes of the system. This will include paper prototypes to test early concept through to working prototypes in the lab and in situ. Conducting a valid evaluation of mobile technologies presents a range of challenges in the field. This research is exploring a range of methods and it is envisaged that this will be a significant contribution.
Other methods for usability studies will also be employed such as observations and diary study methods. A set of appropriate usability criteria will be identified for the usability evaluation studies.

CONCLUSION AND FUTURE WORK

This paper outlines the background to the research being conducted in the area of location-based learning using mobile technology. The initial concept described in this paper is being designed to address the key components of a successful situated learning experience; this includes the necessity for the experience to take place in an authentic setting, in terms of contexts and activities, and to incorporate an element of collaboration between learners.
The application is focussed on helping students to develop their skills for critical thinking and analysis in real- world situations, and as such our priority in the first instance is to develop a clear theoretical framework that enables this. In taking a human-centred approach to the design we will be adopting an iterative design process to review the students' experience of using the locative media application considering the effectiveness and usability of the system, which will be critical to its success. We have completed the requirements gathering phase, translated the findings into an initial design concept and are in the process of developing the prototype.

As this work progresses we hope to better understand how smart phone applications should be designed to enable students to learn effectively in-situ.

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