Mobile Helper for University Students: A Design for a Mobile Learning Environment

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ABSTRACT

This paper reports on a design case study for a mobile learning (M-learning) environment that follows a user-centred design approach. This development of the system applied an M-learning design framework to identify appropriate design requirements in practice.

Author Keywords
Mobile Helper, contextual help, university, user-centred design

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

As mobile technologies have become more pervasive, many Human-Computer Interaction (HCI) researchers have seen opportunities to apply these technologies to the university environment. For example, about half of the papers published at the International Conference on Advanced Learning Technologies (ICALT) in 2006 examined the potential use of mobile technologies for pedagogical purposes. However, while there are many different levels of engagement proposed for mobile technologies, most applications simply make use of mobile devices to deliver the same learning content that is currently being provided by electronic learning (E-learning). We believe that this approach does not translate well into the mobile context, because M-learning has some unique characteristics that differentiate it from E-learning, which can be summarised as being ubiquity, convenience, location awareness and personalisation (Kukulska-Hulme & Traxler, 2005; Leung & Chan, 2003; Liu *et al.*, 2003). Therefore, this research began by reviewing university students' contexts and needs first, and then attempted to address them in the development of an M-learning application.

A very recent M-learning application in a university context showed a potential benefit of the approach we are taking in this paper. Portable Help Desk (PHD: Anhalt *et al.*, 2001; Smiailagic & Kogan, 2002) demonstrated the usefulness of context-awareness support, providing appropriate information to support students' school life at the right time and in the right place. However, an early test of PHD revealed that there was a lack of functionality related to learning. This paper replicates the benefits of PHD, but provides a versatile mobile learning environment. This development followed a user-centred design approach (Monk, 1998), so as to ensure that the system met the users' requirements.

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STAGE1: UNDERSTANDING THE WORK AND WORK CONTEXTS OF UNIVERSITY STUDENTS

We began by interviewing ten university students to identify what types of work contexts, tasks, information and design features would suit a university student's expectations. The interviewees were Massey University students, aged between 18 and 32. The data collected were mapped to a mobile-learning design framework developed by Parsons *et al.* (2006). This framework serves to specifically identify the design requirements of M-learning in terms of four perspectives: *Generic mobile design issues*, *Learning contexts*, *Learning experiences*, and *Learning objectives.* Firstly, 'Generic mobile design issues' examines four features: *User role and profile*, *Mobility*, *Interface*, and *Media*. The interview data revealed that new students had little idea of where the classrooms and laboratory facilities were located in a widely distributed campus. Because of this, students are often unsure of where their next meeting or lecture is to take place. In contrast, senior students are already aware of this type of information, but require more in-depth information about their personal studies. For instance, their concerns during "school life" revolve around the organisation of their studies, such as being aware of assessments, while also being up to date with messages and resources from lecturers and/or other students involved in their programme of study. The new students' requirements were relevant to aspects of interface design, such as map support (visualisation software), while the requirements of the senior students related to the personalisation of their learning environment. Table 1 summarises the interview data that are relevant to the generic mobile design issues.

The next consideration is the students' 'learning context', and how it would be supported by the generic mobile design issues described above. The interview data identified four sub-features: *Identity*, *Learner*, *Activity*, and *Spatio-temporal*. The first three of these would establish the situational contexts of M-learning, and the last would be associated with the environmental context. In particular, spatial awareness is very important for the

Table 1. Summary of the interview data, in conjunction with Parsons *et al.*'s M-learning design framework

Generic Design issues	Learning contexts	Learning experience	Objective
User roles and profiles o New students - few ideas of where the classrooms, facilities etc. are located o Senior students - aware locality information, but require more depth into personal studies, and assist in multi-tasking. **Mobility support** o Students roam the campus to attend all their different learning activities **Interface design** o Visualisation software (Map) o Mobile software o Avoid information overload **Media** o Images, Sounds, Text	**Identity** o Junior students o Senior students **Learner** o Students **Activity** o Navigation of the campus o Obtaining contextual knowledge o Social communication **Spatial-temporal** o Location awareness, so the information given on the PDA is really relevant to their current location. o Morning: the lecture or tutorial information that they must attend; Afternoon: more individual study organisation	**Organised contents** o Lecture, tutorial, and lab information o Assignments, assessments, library, and recreational information **Outcome & Feedback** o Locational references o Various sound alerts o Images and text in particular parts of the campus o Web links to the current learning modules **Goals and objectives** o To discover the locations of lecture, tutorial, and laboratory rooms (Junior students) o To be aware of the information that is relevant to organising their school life (Senior students) **Social Interaction** o Discussing the current learning module (Senior students want to discuss directly with lecturers)	**Improving learning situations**

junior students, but temporal issues were more relevant to the senior students, for example relating the time of day to their study schedules .

For example, when a senior student arrives on the University campus, the contextual information that they are searching for may be related to their course schedule for the day, room changes or important messages. Towards the end of the day, when the senior student leaves the University, the context may change. Their need to be aware of assessments that are due will take priority over their class schedule in helping them to organise their studies. These different activities define different design requirements. As noted above, the junior students want more navigational support on the campus, but the senior students require more contextual knowledge and social interaction. For instance, many of the senior students reported that they wanted to organise a meeting for their group project.

We also obtained information relevant to users' learning experiences. The interview data reported the four aspects of expected learning experience; *Organised contents*, *Feedback*, *Goals and objectives*, and *Social interaction*. The data demonstrated that the users would expect information such as lecture or laboratory locations in the case of the new students, while the senior students would prefer assessment information with links to in-depth data, library records, and the ability to communicate with others. General information requirements such as news about recreational activities or events were common between the interviewees. Therefore the main benefits of the system, based on the responses, were the ability to discover the locations of relevant destinations, and being aware of information that could enhance the students' "school life". All of these learning experiences can be mapped to an ultimate objective – "improving university learning situations".

STAGE 2: DESIGN OF MASSEY MOBILE HELPER

To address these design requirements, Massey Mobile Helper was developed on a PDA phone (HP-IPAQ 6700) with a Bluetooth GPS device (GlobalSat BT-338). It is able to locate the current position of each user on the university map, and to access the server using a mobile network. The aerial photos of the campus were obtained from the city council, and calibrated for use with a GPS device by constructing software for the task. Microsoft SQL server was used to relate the contextual information and the location data. Each component of software was built using Microsoft™ Visual Studio 2005.

The assumptions of typical users and the physical environment for the development of Mobile Helper were

that a student was concurrently studying four or more courses and that activities related to their daily study routine included accessing learning content and returning books to the library. In terms of their coursework, most courses include lectures, tutorials, and/or laboratory sessions. In terms of the physical environment, the Massey University campus consists of three separate areas, presenting spatial-temporal issues related to a student's locational context. For instance, most lectures take place in theatres in the upper precinct of the campus, while many of the tutorials and laboratory sessions are some distance away in the lower precinct. Therefore, students need to be constantly aware of the contexts of their learning activities. Figure 1 illustrates a screenshot from the Mobile Helper system. There are indicators representing the user's current position, and a path to their selected location. The map is synchronised with the users' location, moving and rotating in line with their movements. This type of feedback provides the user with the necessary navigational information. In addition, the user can select their next destination from the course calendar, and the path to the location appears on the map.

Figure 1. Screenshot of navigation software for a user who wants to get to the Quadrangle building

Figure 2 shows Mobile Helper's system architecture. Mobile Helper sends the user's request for information, with their current location, to the PDA server. The server builds the query for the SQL server, which retrieves the client's information from the database. The PDA server returns the information to the user's Mobile Helper. As users move through an area, the PDA server delivers contextual information relating the current position with the user's profile. Therefore the user can request information, providing new knowledge for the student and assisting their activities related to study at University.

Figure 3 is a screenshot of the contextual information that a student may receive. Because Mobile Helper knows the user's current location, and the server holds user profiles, the system can answer questions such as "what is my next lecture and where is it? Mobile Helper delivers information to the user in both a proactive and user-driven manner. A user receives proactive information when important notices are available such as new assignments or a cancelled lecture.

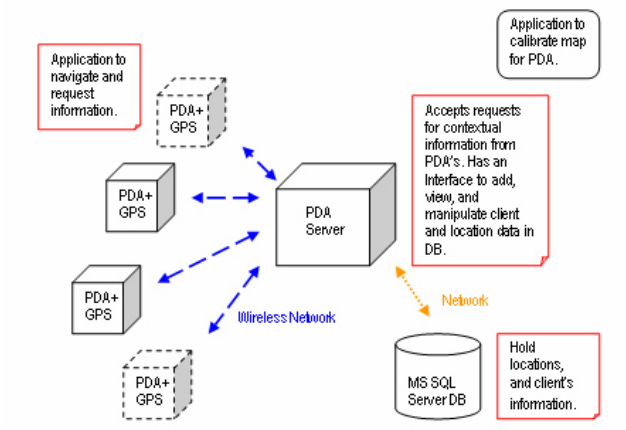

Figure 2. Mobile Helper system architecture. The system receives the user's query and matches it to an appropriate contextual help.

In terms of user-driven information, a user could use Mobile Helper to find what books have been placed on reference in relation to their course of study. As the user walks past the library, they can request this type of contextual information. Figure 3 demonstrates the type of contextual information a user may receive while walking close to a lecture theatre. In addition, if the user clicks the 'Assignment 1 available' link to their learning environment (see Figure 3), they can see what the assignment is.

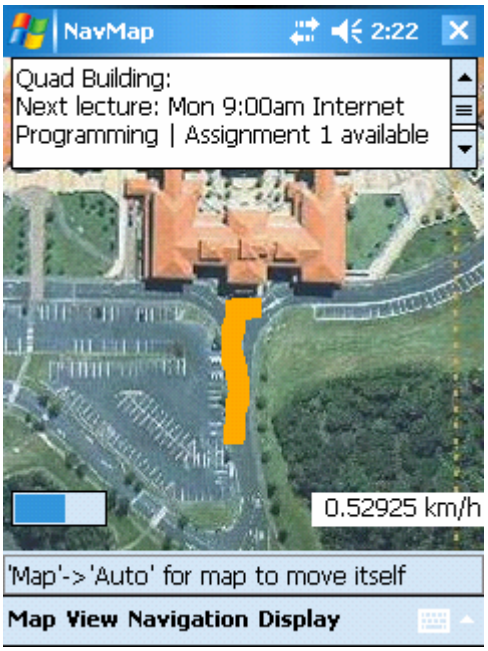

Figure 3. Contextual information presented to the user. If a user clicks 'Assignment 1 available' on the system, she or he can access the current e-learning module.

Table 2. Results from initial evaluation with four students

Statement	Strongly Disagree **1**	**2**	**3**	**4**	**5**	**6**	Strongly Agree **7**
Using the device would help me find unknown areas of Massey.					50%	50%	
Learning to use the device was difficult	25%	25%	50%				
Interacting with the device requires a lot of mental effort	25%	25%	50%				
I think the device would be very useful in my university life						75%	25%

STAGE 3: EVALUATION

To see the benefits and usefulness of Mobile Helper, we evaluated it with representative users. For the contextual help information, participant's profiles such as their interests, coursework, and library information were collected before the evaluation. Based on these profiles, contextual information for each participant was added to the system database. To evaluate the system in use, the participants roamed the campus for fifteen minutes, where they experienced the two major functions of Mobile Helper, finding the location of their classrooms, and contextual help. The first function is user-driven information, and the latter is proactive information by the system. Each user was first asked to find the location of their next lecture with Mobile Helper, and then get to that location. As they approached the location, relevant contextual information appeared. For instance, if the students were passing the library, the system proactively displayed library information, for example if there was a new book based on their interests or books due for return.

Table 2 presents the perceived usefulness and ease-of-use data collected. It showed the students efficiently utilised the system to discover new locations while feeling confident in themselves using the technology. They were also attracted to the contextual information. However, the small sample size made it hard to identify any behavioural differences between the new university students and the senior students.

To explicitly see how the students would interact with the system, we further assessed the system using the think-aloud technique. Three students were recruited from the campus, and the same task procedure was applied. Verbal protocol results concurred with Table 2, placing emphasis on ease of use and the ability to learn from contextual information. All the participants were able to complete the tasks in a straightforward manner. They would create an objective to either find a location, acquire some contextual information while moving around, or a combination of the two. In each occurrence the participants interpreted new contextual information, assisting in their purpose of studying at Massey. Also, they appeared to find the contextual information both useful and informative in relation to their goals of being at the location, such as "library books due" messages when they were near the library. The participants with specific information appeared to feel more satisfied with the system, and its abilities. Therefore they were more likely to have a positive attitude to and respect for the system, gaining and learning more.

CONCLUSION AND FUTURE WORK

This paper described the development of an M-learning environment, following a user-centred design approach. Its development owed much to both Parsons *et al.*'s framework (2006) and PHD (Anhalt et al., 2001; Smiailagic & Kogan, 2002), providing a broader view to take account of the learning context and objectives beyond the traditional learning environment.

The authors are continuing to develop Massey Mobile Helper. In particular, the SQL server could be utilised to identify a particular pattern of requests, and location sequences to enhance the degree of contextual information provided by the system. Indeed, this paper is not the final result of this research activity; the main objective here is to foster a wider discussion of M-learning design practices, based on an analysis of current research and future challenges.

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