Evaluating Student Attitudes on Ubiquitous e-Learning

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Abstract—**This paper describes our preliminary work in progress on ubiquitous e-learning. Ubiquitous e-learning is learning which can take place anywhere, anytime. Following this paradigm, ubiquitous e-learners use mobile devices such as smart phones, tablets, and laptops to learn wherever they are. Furthermore, ubiquitous e-learning implies context-sensitivity so that the style of learning as well as the material is adapted to the e-learner's immediate surroundings. Ubiquitous e-learning has been identified by researchers as an increasingly important paradigm for the future, for both non-traditional learners as well as for today's generation of students who are increasingly comfortable with mobile devices as their primary computing platforms. In spite of this, evidence about students' attitudes towards ubiquitous e-learning is scarce. In order to guide and inform our future research in ubiquitous e-learning research, we have performed a survey of our computer science students. In this paper we present the results of this survey, our evaluation of the results, and our reflection on how these results will inform our future research.**

Keywords - e-learning; ubiquitous learning; mobile learning; instuctional technology.

I. INTRODUCTION

Several emerging trends point towards the growing importance of ubiquitous learning – learning which takes place at any time and at any place. Among these trends is a growing population of non-traditional learners. Many of these learners have full or part time jobs which require them to fit the learning into a crowded schedule. Learning must take place wherever and whenever possible and it is not possible to fit this learning into a fixed, rigid schedule. Older non-traditional learners often have family obligations which render them non-mobile as well – the learning must come to them rather than the other way around. Younger, more traditional, learners also bring new demands to the learning environment. This generation is used to being entertained when and where they want, and may find traditional learning methods to be too constraining. In order to meet the needs of this generation, a more flexible, adaptive approach to learning is required.

In the following section, we briefly describe experimental prototypes which we have previously developed which illustrate different aspects of adaptability for ubiquitous e-learning. Section 3 surveys research in ubiquitous e-learning. Section 4 presents the results of a survey on the attitudes of students towards ubiquitous e-Learning. These results are meant to guide the development of our research. Section 5 presents our analysis of the student survey. Section 6 gives conclusions and discusses future research.

II. ADAPTABILITY FOR UBIQUITOUS E-LEARNING

This section briefly reviews our previous research in adaptability for ubiquitous e-learning.

In [8], we described our research in multimedia software engineering applied to distance learning – in particular the Growing Book project, a multinational research effort supporting multi-lingual, multi-modal and multi-level learning. The metadata for courseware was described using an XML (extensible markup language) language called TAOML (teleaction object markup language) whose definition was given. We also described a dataflow transformer, based on XSLT (extensible style sheets language for transformations), for transforming the courseware from one desired output format to another. A prototype data transformer was developed in Java and demonstrated.

In [9], we further developed this approach, concentrating on ubiquitous e-learning and showing how the dataflow transformation approach could be used to support e-learning on different types of devices as well as diverse learning styles, described by user profiles. We moved towards standards-compliant metadata for learning objects and we developed a prototype system capable of generating learning scenarios for several different types of devices.

In the future, we wish to explore ubiquitous e-learning by incorporating context awareness, social networking and support for new mobile devices and networks into our previous research. The exact direction we take will be guided by the survey whose results are reported in this paper.

III. OVERVIEW OF RESEARCH IN UBIQUITOUS E-LEARNING

Ubiquitous e-learning builds on the increasing popularity of smart phones and tablets and the widespread availability of wireless networks in order to adaptively recommend learning resources which are appropriate for a user's given context, and to supply them

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in a timely manner. In this section, we review previous research in ubiquitous e-learning.

Wang and Wu [1] developed a prototype system for ubiquitous e-learning for lifelong learners. Their system takes into account the learner's characteristics, behaviors and preferences to make appropriate courseware recommendations. Context-aware functionality was enabled through the use of RFID technology.

Chen, Chan and Wang [2] developed a website for ubiquitous e-learning with various devices (laptop, smart phone, etc.). A log of learning behaviors was kept at the website. SMS (short message system) messages were used to push information (e.g., reminders of homework and tests) to users. Information correlating device types to tasks performed was collected. The push and pull of course information to and from learners' phones seemed to increase student awareness.

Baird and Fisher [11] note the reliance on and expertise in social software of the rising generation of students and proposes the use of social networking media to foster the building of learning communities as well as to facilitate self-paced and customized learning experiences in synchronous and asynchronous learning environments. This work reviews the literature in Social Learning Theory and lists various social networking media with hints of how they may be exploited in e-learning.

Chen and Huang [3] designed a context-aware ubiquitous learning system based on radio frequency identification (RFID) in order to enable students to learn in an environment containing both traditional learning resources and resources from the real world. An experimental result is given showing the effectiveness of the approach.

Tzouveli, Mlyonas, and Kollias [4] aim at providing adaptability for web-based learning systems based on user profiling (similar to our approach in [9]). Electronic questionnaires were used to develop the user profiles and automatic assessment of the questionnaires is used to assign a particular profile to each user. The profile serves the proper learning material user to the learner. An experiment in five European countries shows the approach is promising.

Muntean and Muntean [5] combined the adaptability of [4] with a ubiquitous learning approach. They produced a system which provides support for the selection of learning materials, in the ubiquitous context, from one of a number of open corpus resources. Their system serves rich media content to the users which will best meet their needs while keeping in mind the limitations of the devices and networks currently being used.

Hwang and Tsai [6] give a survey of research in mobile and ubiquitous learning published in selected journals between 2001 and 2010. They find that the amount of research in this area has increased greatly over this time frame and that researchers have stressed the importance of situating students to learn from a real world environment as well as emphasizing the mobile and communication technologies which are key to supporting effective learning in the real world.

Agarwal and Nath [7] present a systematic study of various issues and challenges in ubiquitous e-learning. They identify the characteristics of ubiquitous learning as: Permanency; Accessibility; Immediacy; Interactivity; Situating of instructional activities; and Adaptability. Further, they identify six parameters which may be used to explore ubiquitous e-learning: Connectivity; Flexibility; Interactivity; Collaboration; Extended opportunities; and Motivation.

Liu and Hwang [8] explore the paradigm shifts in e-learning leading to the development of context-aware ubiquitous learning, proposing a set of significant values based on the relevant literature to guide the development of context-aware ubiquitous e-learning applications. They also present a context-aware ubiquitous e-learning case study. In addition to the RFID technology as identified in [3], they also mention Global Positioning System (GPS) as another technology which is expected to impact this area.

IV. SURVEY OF STUDENT OPINIONS ON UBIQUITOUS E-LEARNING

In order to guide our future research in ubiquitous e-learning, we performed a survey of our students. The students surveyed are all computer science majors. They are both undergraduate (bachelors degree) and graduate (masters degree) students, both domestic (U.S.A.) and international students. The survey (see Table I.) is composed of three parts: the first part (questions 1 – 3) concerns the use of mobile devices for study; the second part (questions 4 – 8) concerns the students' study environment; the third part (questions 9 – 12) concerns the type of ubiquitous interested in using. The survey employs a standard five-point Likert scale.

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TABLE I. RESULTS OF STUDENT SURVEY

	Items addressed	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree	Score
1.	I use a laptop computer for coursework (studying online slides, videotaped lectures, doing assignments, etc.).	34	3	1	0	0	4.87
2.	I use a tablet device for coursework (studying online slides, videotaped lectures, doing assignments, etc.).	6	10	10	6	5	3.16
3.	I use a smartphone for coursework (studying online slides, videotaped lectures, doing assignments, etc.).	6	10	5	9	8	2.92
4.	I do coursework while commuting (listening to taped lectures in a car, studying on public transportation, etc.).	4	6	4	15	9	2.50
5.	I do coursework in "slack times" (waiting for appointments, between classes, etc.).	9	18	2	7	2	3.66
6.	I do coursework out of doors.	5	10	8	11	4	3.03
7.	I do coursework while travelling (weekend outings, vacations, business trips, etc.).	5	8	7	15	2	2.97
8.	I do coursework for one class while in another class.	0	7	5	7	19	2.00
9.	I would be interested in viewing videotaped lectures with seamless scaling and remembered last locations across all of my mobile devices.	12	16	6	3	1	3.92
10.	I would be interested in a mobile app which would automatically highlight relevant material from related courses when I am following a lecture in a different course.	16	14	2	4	2	4.00
11.	I would be interested in a mobile app which would alert me when classmates are in close proximity so that we could have impromptu study sessions or collaboration.	6	12	7	10	3	3.21
12.	I would be interested in a social networking-type app which would let me know when my instructor and/or classmates are online for chat/help.	19	13	5	1	0	4.32

V. ANALYSIS OF STUDENT SURVEY

In order to guide our research in ubiquitous e-learning, we have analyzed the results of the student survey. We briefly summarize our analysis here.

The first part of the survey attempts to determine the extent to which the students are using mobile devices for coursework. It is clear that the use of mobile devices – laptops, tablets, and smart phones – is almost universal among students, but the question we ask is more specific – how much are these devices used for coursework?

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What we see from the survey is (as would be expected) that the use of laptops for coursework is almost universal. We also see that tablets score fairly highly, and smart phones just a bit less, with more than 40% of respondents agreeing (or agreeing strongly) that they use these devices for coursework. We take this number as a base level from which to start – if we can develop more useful apps for ubiquitous e-learning for tablet and smart phone devices, we would expect the number of users to increase. Overall, the results of this section are very favorable for the potential of research in ubiquitous e-learning.

The second part of the survey examines how much students currently work in situations which might be considered to part of the "ubiquitous" environment (out of doors, while between appointments, while commuting, etc.). While the responses show that many students do coursework while between classes or appointments (we conjecture that many of them are working on laptops between classes), the other possible learning situations have lower responses. This indicates a potential opportunity for more learning if we can enable this via appropriate applications.

The third and final part of the survey attempts to determine which type of mobile apps would be most appreciated by the students surveyed. The results of this section are very positive, with several of the proposed apps having very high scores. This indicates a willingness of the students to use such apps if they are available.

VI. CONCLUSION AND FUTURE RESEARCH

This work presents our initial research in ubiquitous e-learning. The results of our survey indicate both an opportunity for new applications (students have mobile devices and a significant number use them for coursework), an opportunity for significance (there are slack times, which are not currently regularly exploited for coursework), and a willingness to use the results of research in this area (indicated by the positive responses in the third part of the survey). We intend to use the results of this survey to direct our research direction in this area.

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