Ambient Learning Displays

Distributed Mixed Reality Information Mash-ups to support Ubiquitous Learning

Dirk Börner
Centre for Learning Sciences and Technologies
Open Universiteit in the Netherlands
Heerlen, The Netherlands
dirk.boerner@ou.nl

Keywords- ambient learning displays; ubiquitous learning support; research project.

I. INTRODUCTION

The presented research project focuses on the situated support of informal and non-formal learning scenarios in ubiquitous learning environments by enabling learners to view, access, and interact with contextualized digital content presented in an ambient way. The project explores the characteristics of ubiquitous learning and deduces informational, interactional, and instructional aspects to focus on. In order to measure the effects of ambient information systems on learning a conceptual framework that acquires, channels, and delivers the information framed in the learning process is proposed. The project sets up to establish awareness for relevant information; examine the personal, social, and environmental sense-making process; and evaluate the situated support on its effectiveness for authentic learning. Analysing the theoretical foundations and following an experimental design approach, the project will deliver scientific insights into the authentic learning support in informal and non-formal learning situations and provide suggestions for the future design of ambient systems for learning.

II. BACKGROUND

The growing adoption of mobile technologies accompanied with ubiquitous connectivity as well as the increasing pervasiveness of information technology are changing the conditions for lifelong learning. Especially informal learning is becoming more and more prominent in mobile learning approaches [1]. While rethinking the relationship of environment, technology, and learning, the promises of mobile and ubiquitous learning need to be explored to build a bridge between different contexts and situations learners are operating in.

Developing this potential is strongly related to authentic learning theories and situated learning. Authentic learning "allows students to explore, discover, discuss, and meaningfully construct concepts and relationships in contexts that involve real-world problems and projects that are relevant and interesting to the learner" [2]. Situated cognition suggests that learning is naturally tied to authentic activity, context and culture [3]. Situated learning is referred to as learning that takes place in the same context as it is applied [4]. Last but not least Donald Schön's concept of the reflective practitioner has an important influence here due to the strong relation to contextualized learning and different situated reflection perspectives [5, 6].

Theoretically based on these approaches the project takes an interdisciplinary perspective to explore the potentials of mobile and pervasive information technology to support learning. Hence, it combines technical models and concepts from research on ubiquitous computing, human-computer interaction, and computer-supported ubiquitous learning as well as educational theories and cognitive, respectively, social psychology.

III. METHODOLOGY

The discussed problems and the main research question are addressed on the basis of a conceptual framework followed by an experimental design cycle. The research design is derived from the research objective to support the ubiquitous learning process in authentic situations more efficiently through ambient information presentation. Initiated by a preliminary expert study an extensive literature review establishes the theoretical foundations for the research. The resulting conceptual framework will then be evaluated through several experimental designs to measure the effects on learning.

IV. PROGRESS

In the first year the project proposal has been written, externally and internally reviewed, and finally accepted in September 2010. The proposal defines the milestones of the project. While elaborating the proposal two papers were submitted to the doctoral consortia of the *4th European Conference on Technology Enhanced Learning* and the *IADIS International Conference Mobile Learning 2010* [7]. Additionally a preliminary expert concept mapping study was conducted and published in the *Campus-Wide Information Systems* journal [8].

The proposed conceptual framework was submitted as conference poster to the *Work-in-Progress Poster and Invited Young Researcher Symposium* for the *18th International Conference on Computers in Education* and published in the proceedings [9]. The poster was awarded with the "Best Work-in-Progress-Poster Presentation Award". Based on the conference poster, the two doctoral

consortia paper and the project proposal another journal article has been submitted and accepted for a young researcher special issue of the *International Journal of Technology Enhanced Learning* [10].

A. Literature Review

As first milestone of the project an intensive literature review has been conducted to analyse and classify works in the research field of ambient display design and evaluation. The resulting paper has been submitted to the *Computers in Human Behavior* journal [11]. In addition to the planned output the preliminary results of the literature review informed a proposal for an international workshop entitled *1st International Workshop on Enhancing Learning with Ambient Displays and Visualization Techniques* at the upcoming *6th European Conference on Technology Enhanced Learning*.

B. Experiments and Results

Defined as the project's second milestone a first experiment has been conducted in parallel to the work on the literature review. In cooperation with an internal campus project varying kinds of ambient display prototypes were used to raise awareness among employees on consumption, conservation and possible saving potentials of energy at the workplace. A broad range of quantitative and qualitative data has been collected and is currently analysed. It is planned to publish the results as journal article. Furthermore a full paper will be submitted for the *WMUTE'2012* conference describing the used prototypes.

The second experiment as the project's third milestone is already being prepared. Therefor additional funding has been acquired from the national innovation network *SURFnet* [15]. The organization specifically called for projects dealing with information and communication technology and conservation. The conceptual ideas of the first experiment will be pursued by more integrated ambient displays, stronger personalization as well as the introduction of social motivation patterns [12].

V. DISCUSSION

Regarding the expectations towards the doctoral student consortium workshop the project would benefit from a discussion about the specific issues and challenges related to design based research within ubiquitous learning settings. Especially the evaluation of ubiquitous scenarios in laboratory settings is self-contradictory. While ubiquitous computing and the derived ubiquitous learning scenarios are characterised by the "anywhere, anytime" paradigm, laboratory settings per se exclude these features as they postulate the full control of all confounding variables. Evaluation techniques need to take into account the current context, environment, and conditions the user is experiencing within the situation that is observed. Investigating and verifying available methodologies on their adequacy for the evaluation of ubiquitous learning applications and thus ambient systems for learning is essential for the project's success and thus the desired basis for discussion.

REFERENCES

[1] M. Ally, Mobile Learning: transforming the delivery of education and training. Edmonton, Canada: AU Press, 2009.

[2] M. S. Donovan, J. D. Bransford, and J. W. Pellegrino, How People Learn: Bridging Research and Practice. Washington D.C., USA: The National Academies Press, 1999.

[3] J. Brown, A. Collins, and P. Duguid, "Situated Cognition and the Culture of Learning", Educational Researcher, 18(1), 1989, pp. 32-42.

[4] J. Lave and E. Wenger, Situated Learning. Legitimate peripheral participation. Cambridge, UK: Cambridge University Press, 1991.

[5] D. Schön, The Reflective Practitioner. How professionals think in action. London, UK: Temple Smith, 1983.

[6] D. Schön, Educating the Reflective Practitioner. San Francisco, USA: Jossey-Bass, 1987.

[7] D. Börner, M. Kalz, and M. Specht, "Information mash-ups to support awareness in ubiquitous learning environments", In I. A. Sánchez, & P. Isaías (Eds.), Proceedings of the IADIS International Conference Mobile Learning 2010, March, 19-21, 2010, Porto, Portugal: IADIS Press, 2010, pp. 423-426.

[8] D. Börner, C. Glahn, S. Stoyanov, M. Kalz, and M. Specht, "Expert concept mapping study on mobile learning", Campus-Wide Information Systems, 27(4), 2010, pp. 240–253.

[9] D. Börner, M. Kalz, and M. Specht, "A Conceptual Framework for Ambient Learning Displays", In B. Chang, T. Hirashima, & H. Ogata (Eds.), Joint Proceedings of the Work-in-Progress Poster and Invited Young Researcher Symposium for the 18th International Conference on Computers in Education, November, 29-December, 3, 2010, Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education, 2010, pp. 34-36.

[10] D. Börner, M. Kalz, and M. Specht, 'Thinking outside the box – A vision of ambient learning displays', Int. J. Technology Enhanced Learning, unpublished.

[11] D. Börner, M. Kalz, and M. Specht, "Beyond the channel: A literature review on ambient displays for learning", Computers in Human Behavior, submitted.

[12] D. Börner, "Energy Awareness Displays – Making the Invisible Visible", SURFnet Innovatieregeling Duurzamheid & ICT, Utrecht, 2011, [http://www.surfnet.nl/Documents/slides_OU_EAD_13.05.2011.pdf].

[13] OpenScout Project, "Skill based scouting of open user-generated and community-improved content for management education and training", [http://www.openscout.net/].

[14] STELLAR Project, "Sustaining Technology Enhanced Learning at a LARge scale", [http://stellarnet.eu].

[15] SURFnet, "ICT-based innovation in higher education and research in the Netherlands", [http://www.surfnet.nl/en/].