

Information mash-ups to support awareness in ubiquitous learning environments

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INFORMATION MASH-UPS TO SUPPORT AWARENESS IN UBIQUITOUS LEARNING ENVIRONMENTS

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ABSTRACT

This paper describes the idea for a research project, focusing on information mash-ups to support awareness in ubiquitous learning environments. The characteristics of the research field are identified as well as different types of awareness for the ubiquitous learner in action and on the move. The paper outlines the related problems and challenges. Furthermore it formulates the associated research questions related to the utilization of contextualized digital content and services as the source for information mash-ups. Based on a detailed analysis a research approach and the underlying objectives are presented.

KEYWORDS

Mobile learning, ubiquitous learning, awareness, learning support, contextualization, ambient information channels

1. INTRODUCTION

Since the idea of *ubiquitous computing* with its siblings *pervasive* and *mobile computing* has first appeared, the relation between people and computing devices and thus the impact of technology on learning has changed. Present technologies starting from desktop computers with broadband network connections to mobile phones and laptops with wireless network connectivity provide already today parts of the complex fabric of a ubiquitous computing world. There is considerable interest in exploring the possibilities of mobile technologies and ubiquitous computing for learning.

On the one hand there is the promise of a seamless integration and enhanced support for learning in action and on the move, while on the other hand the diversity and continuous modification of technologies, changed interaction modalities, and the overwhelming amount of information challenge the learner as well as demand high standards for corresponding learning environments. In mobile and ubiquitous learning, adaptivity and awareness are more and more considered as key concepts especially for informal learning support (Syvanen et al., 2005). Ubiquitous access to learning support fosters new opportunities, such as content filtering by context or contextualized access to interaction facilities. Context in that sense is described as a broad concept, which allows adaptation ‘according to the location of use, the collection of nearby people, hosts, and accessible devices, as well as to changes to such things over time’ (Schilit et al., 1994), but might also include environment-induced aspects, e.g. illumination, noise, and network connectivity. Among others creating awareness for additional learning resources related to the learners environment is one way to assist the learner in context.

In the following paragraphs we describe the idea for a research project with the intention to support ubiquitous learning by enabling learners to view and access on demand, contextualized digital content and

services from manifold sources using desktop, mobile, or web clients facilitated through different types of awareness and a model to describe patterns for contextual learning support.

2. BACKGROUND & RESEARCH FIELD

Along the way to a knowledge and information society we are creating a constantly growing number of digital content using the means of digital media, such as pictures, videos, bookmarks, or web-log entries. Following the principles of participation, syndication, and tagging (O'Reilly, 2005), the content is distributed all over the Web and gets more and more enriched by metadata. Content is not only annotated and categorized collaboratively, but also linked to physical and virtual objects, e.g. by adding a geo-location to a picture. Also the other way round more and more physical and virtual objects get enriched with content and functionality and thus becoming service interfaces for digital media (Sterling, 2005). We consider the amount of digital content created by the means of digital media as well as the services shaping and reflecting them as valuable resources to support learning.

Beside that another aspect facilitates the relevance and usage of digital content – the emerging propagation of mobile technologies, which enables anywhere and anytime access. This mobile accessibility establishes a basis for formal and informal mobile learning scenarios complemented by an increasing personalization and contextualization of content. The mobile learning paradigm encourages learning that is personalized, authentic, and situated (Traxler, 2009). Based upon this paradigm but differentiated in its level of embeddedness in the environment is ubiquitous learning. This concept rests upon the idea of ubiquitous computing (Weiser, 1991), offering mobility combined with pervasive computing functionality (Lyytinen and Yoo, 2002). Enhancing learning environments with ubiquitous computing then creates ubiquitous learning environments, in which different channels of information and interaction are synchronized and orchestrated by instructional designs.

Permanency, accessibility, immediacy, interactivity, situatedness, and adaptability have been identified as the main characteristics for ubiquitous learning (Ogata and Yano, 2004). A closer examination reveals that permanency, accessibility, immediacy, as well as adaptability deal with informational aspects. Considering the amount of available digital information finding the right information becomes more and more important (Traxler, 2009). This indicates a need of information navigation competences and postulates the support and assistance of learners in order to enable them to navigate more efficiently through information and find the right information in any given situation (Koole, 2009). One essential aspect to implement this concept is to keep the learner continuously aware about the environment he is proactive in, including digital content and services that are available in a real world context.

Considering the mentioned awareness several types of awareness need to be distinguished. Based on current CSCW and CSCL research four types of awareness for ubiquitous learning environments have been identified; completed by knowledge awareness and context awareness as crucial 'to provide the right information to the right person at the right time and the right place with the right form' (Ogata, 2009). The different types of awareness are listed in Table 1.

Table 1. Types of Awareness (Ogata, 2009)

Awareness	Example
Social	Who can help to solve the problem? How can I interact with the peer(s)?
Task	Which task can I do? How much time is required?
Concept	What kind of concepts is necessary to complete the task? Do I need to revise any of my current ideas in light of this new information?
Workspace	What are they doing? What have they already done?
Knowledge	Who is using, changing, or discussing the same knowledge? What knowledge did they use, change, or discuss?
Context	What objects are available around them? Where are they?

In our research project we will focus on the different types of awareness within ubiquitous learning environments and their improvement capabilities in terms of accessibility and thus the utilization of digital content and services resulting in an enhanced contextual learning support. As a ‘simple metaphor of information channels that are ambient all around us’ the project builds upon the Ambient Information Channels (AICHE) model proposed by Specht (2009). The model allows the description of appropriate patterns and is based on four infrastructure layers encapsulating the sensor functionality, the informational aggregation, the instructional logic, as well as the visualization and interaction of a context-aware system and thus can be applied to ubiquitous learning environments. The *sensor layer* collects and handles all sensor information while the *aggregation layer* combines this information in a meaningful way, which is then used by the *control layer* to enrich the entities involved in the learning process. The *indicator layer* finally describes the user interface providing feedback to the user and enabling the interaction with the system.

The defined layer structure facilitates *sensors*, *channels*, and *artefacts* as components while using *control structures* to describe their functionality. The channels are the main component used to deliver information and services but also to feed information into the system. Therefore the channels are bound to sensors and/or artefacts. Sensors provide the system with measures about the user and the environment he is proactive in but can also be used as a direct source of information. While sensors are assembled in mostly invisible information grids, artefacts form a direct interface to the user, enabling the user to interact with the environment. The combination of components complemented by *aggregation*, *enrichment*, *synchronization*, and *framing* processes finally leads to contextual learning support, exemplified in Figure 1.

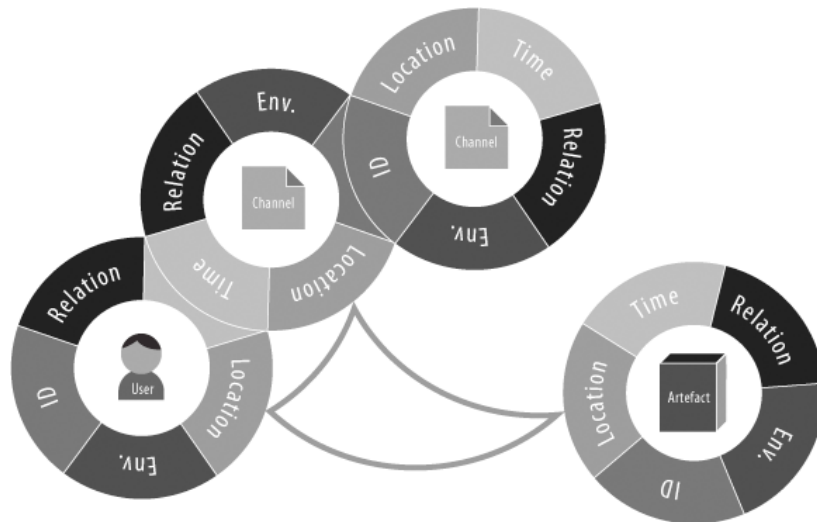


Figure 1: Ambient Information Channels (Specht, 2009)

3. PROBLEMS, CHALLENGES, AND RESEARCH QUESTIONS

The strength of ubiquitous learning environments is the variety of display and interaction modalities that can be utilized by the learner. The learner is free to select the currently best-suited learning support for his purpose. This main strength implicitly holds a major problem as learners are confronted with missing awareness indicators reflecting the available learning support in their current environment including the relevant digital content and services.

The main reason for that is the described wide distribution among different devices, platforms, and providers. Finding the appropriate content is difficult as it often takes more time and effort than it actually benefits. Once identified accessing the desired content is also difficult, as the different service interfaces differ in design and implementation as well as the used interaction metaphors differ among the learner's different devices, systems, and platforms. What makes it even more difficult is that content is often not linked and accessible in a contextualized manner, e.g. links between digital content and real-world objects are

missing. The other way round it is mostly not possible to create these links. Furthermore the threshold to reach the desired awareness gets insuperable, due to the vast amount of available content and services, which is constantly growing.

Therefore the challenges are to improve the identification of relevant digital content and services, to simplify the access mechanisms, as well as to enable and facilitate contextual relationships. New techniques of aggregation, visualization, and interaction need to be elaborated, as common techniques do not support ubiquitous learning environments and the required awareness for relevant digital content in a sufficient way. The outlined problems and challenges lead to the following general research questions:

- Which types of digital content and services can support learning in ubiquitous learning environments?
- Which sensors can be used and how must they be aggregated, filtered, and implemented in ubiquitous learning environments?
- Which methods of visualization, sonification, haptification, and so forth can be used to create awareness in ubiquitous learning environments?
- How are the awareness methods assimilated and perceived in ubiquitous learning environments and what are the implications for the design?
- Does the utilization of contextualized digital content and services support and enhance learning in ubiquitous learning environments and what are the effects?

4. RESEARCH OBJECTIVES AND APPROACH

The main objective is to create and evaluate information mash-ups of digital content and services as well as channels to distribute this information across contexts and devices. This research is following the AICHE model to describe patterns of awareness support and the effects on the personal sense-making process and competence development for ubiquitous learning. An additional objective is to provide a framework to support awareness, contextualize relevant digital content and services, and apply the AICHE model within ubiquitous learning environments.

In the project we will analyze the outlined problems, review the existing research about the different awareness types, and derive their influences on learning as well as the pros and cons for the learner in this context. We will then identify the entities enriched and linked to digital content and services, e.g. people, objects, rooms, or concepts involved in the ubiquitous learning process. Analyzing the different types of content emits the required infrastructure for ubiquitous learning environments made up of interconnected and embedded devices, systems, and platforms facilitated by the AICHE model. This allows us to examine the necessary aggregation and exploitation processes as well as the associated filter and synchronization mechanisms based on context parameters. Furthermore we want to analyze innovative interaction techniques that enable learners to interact seamlessly and intuitively within the ubiquitous learning environment without the need to proactively configure the information and interaction channels. Realizing the vision of ubiquitous computing all embedded devices, systems, and platforms shall be able to create on the move a dynamic context model according to the environment and configure the offered services to that, being able to remember familiar environments and also adapt to new environments (Traxler, 2009).

The project highlights the challenges and explores the possibilities that lie in the convergence of mobile and ubiquitous learning in combination with the utilization of contextualized digital content and services as valuable resources for information mash-ups to support awareness in ubiquitous learning environments.

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