Spontaneous Group Learning in Ambient Learning Environments

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Abstract. Spontaneous Group Learning is a concept to form and facilitate face-to-face, ad-hoc learning groups in collaborative settings. We show how to use Ambient Intelligence to identify, support, and initiate group processes. Learners' positions are determined by widely used technologies, e.g., Bluetooth and WLAN. As a second step, learners' positions, tasks, and interests are visualized. Finally, a group process is initiated supported by relevant documents and services. Our solution is a starting point to develop new didactical solutions for collaborative processes.

1 Introduction

In this paper, we discuss the use of Ambient Intelligence to support learning and teaching processes to facilitate spontaneous groups in a university environment.

In the last years, collaborative scenarios have gained an increased importance in university settings [1]. New scenarios have been constructed and evaluated by using mobile and ambient technologies [2]. Consequently, we propose the concept of spontaneous group building using Ambient Intelligence in a university setting. After a short review of existing research in this field, we introduce a specific Ambient Learning framework. We show the potential for learners and teachers to build groups based on their location, tasks, and preferences, i.e., on their context. Our intended implementation makes use of Bluetooth in the classroom learning space as well as wireless local area network (WLAN) applications on the campus. Using such technologies, we offer the opportunity to create new communication and interaction processes and new didactic scenarios.

2 Ambient Intelligence

Ambient Intelligence or Ubiquitous Computing applications denote the use of information and communication technologies (ICT) which are embedded in our natural surroundings, present whenever needed, and adaptive to the user [3]. In the context of e-Learning, this means that while the learners are moving with their mobile devices, the system dynamically supports their learning by communicating with embedded computers/systems in the environment [4], allowing for personalization and customization to their needs [5]. Consequently, Ambient Intelligence leads to Ambient Learning.

The main objective of an Ambient Learning Environment – contrary to typical more or less client-server oriented e-learning environments – is to provide answers to the following questions [4]: 1) Who has the same problem or knowledge?; 2) Who has a different view on the problem or knowledge?; And 3) ,who has the potential to assist in solving the problem? Accordingly, typical Ambient Learning services are device and network detection services, location tracking services, calendar and social activities services, or content access services [6]. Ambient Learning focuses on how to provide learners with the right information at the right time, delivered in the right way and to the right place, based on their context [4].

Ambient Learning Environments can be described by various key characteristics ([7, 8] cited by [4]): permanency, accessibility, immediacy, interactivity, and situating of instructional activities. These were extended by [9] with regard to the adaptability of Ambient Learning Environments, i.e., providing the right information at the right time and the right place. Accordingly, learners will be able to select the learning methods preferred by or suited to them [10].

Following the afore mentioned key characteristics [11] derived a framework for Ambient Knowledge & Learning Environments (ALKE). The ALKE-Framework provides the opportunity to approach this highly complex domain from six different perspectives (see Figure 1), i.e., knowledge management tasks, actors/competencies, ambient technologies, mobile technologies, cases, and context.

With in this framework the various perspectives are attached to typical knowledge management tasks. The knowledge identification, acquisition, development, distribution, preservation, or use – as a common subset provided by [12] – can be supported by various ambient and mobile technologies. These components of the framework define the technological aspects of the learning processes. [11] deliberately distinguish between mobile technologies which contain all technologies of adequate mobile devices and ambient technologies which are attached to a certain location (e.g., a certain position within a school or on a campus) or object (e.g., a machine). Consequently, learners can access learning processes depending on the context (e.g., external influences) and their profile. The context contains the main influence factors of such learning processes. Hence, Ambient Learning & Knowledge Environments are strongly dependent on the context, for example, in which context the actors demand specific learning materials. The ALKE offers a perspective of integrated professional experiences represented in various corresponding case studies. These cases increase the understanding of Ambient Intelligence and support the analysis of corresponding information. Besides, various characteristics of the learner (actor) must be analyzed, e.g., learning preferences, competencies, or experiences.

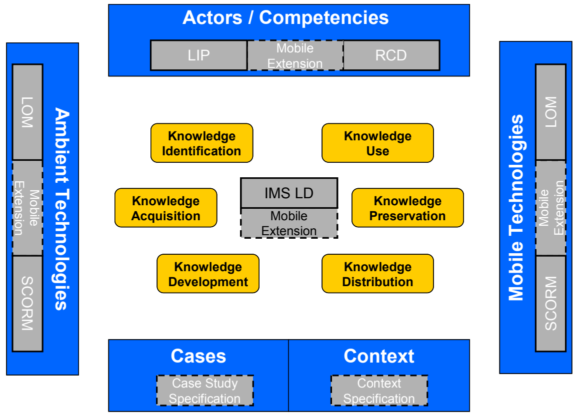

Fig. 1. ALKE-Framework [11]

To achieve a highly integrated and interoperable Ambient Learning & Knowledge Environment various standards have to be recognized on different levels of integration: devices, data, middleware, and application [12]. Ambient Intelligence standards thereby mainly focus on wireless networks and telecommunication between the various involved devices. The information transfer relies on wireless technology standards (e.g., Bluetooth), corresponding data exchange standards (e.g., Extensible Markup Language – XML) as well as specific middleware technologies (e.g., Web services). On the application level widely accepted learning standards should be used or adapted. However, not all aspects of ambient or mobile solutions are covered by the existing specifications [11, 12]. Figure 1 shows specifications which should be used/extended to implement an Ambient Learning & Knowledge Environment.

3 Spontaneous Group Learning

Learning in collaborative settings has been studied extensively in the last years [1]. Most reports focus on the facilitation of groups and/or teams either within classrooms [14] or in distributed environments [15, 16]. Spontaneous group building (also: ad hoc group building or spontaneous cooperation [15]) is one potentially successful method to initiate group (building) processes and social interaction for learning.

In extension to such methods for classrooms and internet-based environments, ambient and mobile technologies make possible new scenarios of interaction. For example, location-based messaging services are used to enhance presence and awareness of fellow learners [17, 18]. Furthermore, radio frequency identification

(RFID) networks are used to provide information on useful resources or persons [19]. Whereas in traditional approaches groups are usually formed by a tutor or agent [9], these new approaches enable learners to build their own networks based on there needs, requirements, and interests.

Our approach aims at supporting groups of learners in a campus environment: Spontaneous Group Learning (SGL). Students are enabled to form groups independently on the basis of their course, location, and user profile. This means that, for example, students in a certain course are able to form a group once they have the need to communicate and interact with others. As a second option, SGL can be used as a didactical concept by the teachers and tutors to form groups within a course on the basis of the user characteristics.

4 The Spontaneous Group Learning Environment

In the following, we describe our Spontaneous Group Learning (SGL) environment for students in Higher Education. The technical realization consists of three steps: 1) positioning, 2) visualizing fellow learners, and 3) initiating the group process. We focus on supporting students to build spontaneous groups by designing a learner awareness interface.

4.1 Infrastructure and Architecture

90% of the students in our study used common (mobile) devices: notebooks and cellular phones. We grounded our implementation on free or inexpensive network connections and widely available infrastructures, i.e., wired, wireless and Bluetooth networks. For the visualization, we aimed at developing an awareness component as a basis for collaborative processes. For further discussion cf. [20]. As Learning Management System (LMS) we used sTeam [21], a tool for cooperative knowledge management in learning groups. A specialized sTeam-client was developed to access the LMS with notebooks and Bluetooth enabled cellular phones.

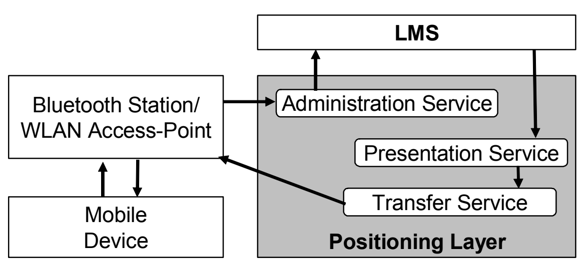

Fig. 2 Positioning layer architecture

Our architecture was based on the described ALKE-Framework (sec. 2). The positioning service was implemented on the software layer using routing data and

Bluetooth IDs to provide the positioning data for each learner to the LMS (Figure 2). The sTeam-client sent the corresponding login data, which was received by the positioning layer. For wireless and wired connections the IP-routing information was interpreted to identify the used access point and deduce which area the student was in. For Bluetooth connections the ID of the connected Bluetooth station was associated with an area and the end user device Bluetooth ID was used to identify the learner.

4.2 Positioning

As a first step, we identify the position of a student using both WLAN and Bluetooth positioning.

WLAN access points provide network access to larger areas. Thus, we use room identification numbers of campus buildings to provide a more accurate positioning. This was achieved by providing the server with a list of rooms with each access point covered. Using routing information of packages [22] sent to the positioning layer via IP-networks, we are able to identify which access point a client uses. Students who log into the system automatically get a list of rooms of their entry access point so that they can select their current position. Thus, the corresponding service can provide a fairly accurate position and enable students to conveniently contact their fellow students.

For a detailed positioning, we use Bluetooth technologies available on certain locations on campus. The Bluetooth positioning adds two features. It allows the learner already logged into the system to provide his exact position. Secondly, it gives the learner the possibility to show his interest in spontaneous group building without having his WLAN device available or in use.

A student can therefore have three states: 1) empty (the learner does not disclose his position or is outside the WLAN/Bluetooth range of the campus), 2) WLAN position (the object contains the description of the WLAN area the learner is connected with), or 3) Bluetooth position (the object contains the exact position of the learner based on the range of the Bluetooth access point).

As shown in the ALKE-Framework (sec 2), the status of the learner is stored as an extension to the Learner Information Package (LIP) [23]. This means that the characteristics of the learner are related to the position. To implement this feature – discovering and storing the position – the sTeam-client sends the local device Bluetooth ID to the positioning layer, which in turn adds the position to the LIP object in the LMS. In this way a student who logs into the network can automatically be assigned a position.

4.3 Visualization

Whereas the positioning is realized by network access point and Bluetooth IDs, the corresponding visualization of the students and their specific learning tasks is supported by a map of the campus and each of its buildings. Students using the client outside the campus network are depicted in a special off-campus area (Figure 3).

Fig. 3. Campus Map

Students are able to identify their fellow learners by selecting different attributes. In a first step, we use two attributes: 1) the current activity (e.g., self-study, performing an assessment), 2) a certain topic as part of a classification (e.g., course “E-Learning”, topic “User Modeling”, module “Stereotypes”). Furthermore, it is possible to select potential group partners based on their location. Figure 4 shows the visualization.

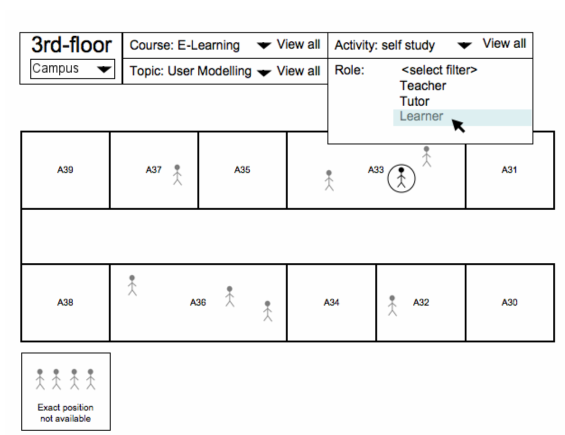

Fig. 4. Visualization

Applying this approach, the students will be positioned on the map (Figure 3) and add the positioning information to the LMS. Additionally, the actual learning activity the student is working on and the learning communities he is in will be retrieved from the LMS. The corresponding data is provided by the LMS and the position layer reformats the information for the end device(s) used.

4.4 Initiating the group process

The implemented selection process enables students to find fellow learners and to initiate a spontaneous learning session. To start a learning session, a group room is automatically generated in sTeam, providing a communication channel (via chat) and relevant documents. Since this is only the starting point for the face-to-face phase of the SGL, the chat is only used for the initiation. The following Figure 5 shows available information on fellow learners and corresponding documents in the initiation process.

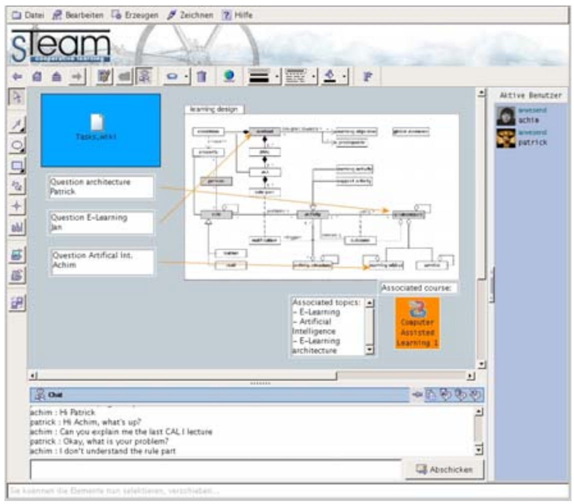

Fig. 5. Support Room

The presented SGL approach enables new possibilities for initiating spontaneous learning processes as a combination of electronic and presence cooperation. We provide new methods to initiate groups and corresponding learning processes. A main aspect is (independent) group building based on specific attributes, e.g., position or preferences. Our current attribute selection could be extended using further attributes, e.g., using LIP categories [23]. This can lead to new didactic scenarios and new scenarios based on widely used technologies.

5 Conclusion

We presented a technological solution to initiate and support Spontaneous Group Learning (SGL). Thereby, we have shown how to implement an SGL environment based on widely used and accepted technologies applying the ALKE-Framework. This solution enables new group building and learning processes. Using different attributes to select and contact fellow learners can also be helpful in other contexts, especially in the field of human-oriented knowledge management.

As a next step, we will evaluate the non-technological aspects of the approach, specifically the communication structure of electronic and face-to-face phases of the process.

By this promising approach we hope to create new creative learning processes and provide support mechanisms which can easily be implemented in current infrastructures.

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