concept and design of a mobile learning support system for mentally disabled people at the workplace

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Abstract—In the past years a shift of learning places occurred, from classroom to workplace. Since mentally disabled people have difficulties in memorization and the loss of knowledge from classroom to workplace is high, this transformation gives an opportunity to improve their way of learning. However, at the present, there is no comparison solution that assists mentally disabled people at workplace with mobile technology. To resolve this problem this paper proposes a new concept and architecture of a system, which helps them to learn and improve their work abilities in context with mobile devices. Our approach is based on knowledge gained from research and workshops with mentally disabled people, as well as pedagogical and didactical aspects of design that fits the special needs of our target group.

Index Terms—Mentally Disabled People, Mobile Learning, Mobile Usability, Pedagogy.

I. INTRODUCTION

Learning directly within the workplace is becoming more and more important, since new technologies and materials require training or further education. The benefits are obvious: a) prevent long absence of the worker while he is learning and b) to give hands on experience and examples. Mobile learning (m-learning) can easily cover these requirements, since it provides learning anytime and anywhere.

Kevin Walker (Institute of Education) [1: p5] says “Mobile learning is not something that people do; learning is what people do. […] Mobile learning is not just about learning using portable devices, but learning across contexts.”

The aim of this paper is to describe an ongoing study of a mobile learning support system for mentally disabled people in workplace that engages them for learning activities and new motivations. We apply special pedagogical and didactical aspects in the design of this system in order to get more effective results in learning processes.

The next chapter points to the related work within the fields of mobile learning and mentally disabled people. Chapter III presents our concept and methodology, including the didactical and pedagogy concept, as well as the system design and architecture.

II. RELATED WORK

A. Mobile learning

Mobile Learning (m-learning) can simply be defined as learning that takes place with the help of mobile devices [2] or as “any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” [3: p6]. Thus m-learning can provide formal or informal learning activities.

The learners can select different m-learning applications, encompassing the access of documents, libraries, quizzes or games, receiving live or archived lectures, audio or video clips, or being part of an online learning community. Since mobile technology is rapidly developing and new kinds of devices arise, the learners can also choose between a board set of mobile gadgets (e. g., PDA, cell phone, Netbooks) with different connectivity abilities (e. g., WiFi, UMTS, GPRS, MMS).

“Learning is mobile in terms of space, i. e., it happens at the workplace, at home, and at places of leisure: it is mobile between different areas of life, i. e., it may relate to work demands, self-improvement, or leisure; and it is mobile with respect to time, i. e., it happens at different times during the day, on working days or on weekends” (Vavoula & Sharples, 2002) [6: p165]

As Vavoula and Sharples (2002) point out in the quotation above, m-learning has to be a part of our daily life. As a consequence we need to provide “truly learner-centered learning” and educators need to become guiders of knowledge rather than being transmitters. According to John Traxler (2008) [4] we have come through the pioneering phase – knowing how to build and use m-learning applications – and from now on we must focus more on the context and how to apply m-learning within the environments, especially as part of blended learning approaches.

Different research projects exist in the field of m-learning. In the following we present the results of a literature analysis we have conducted to narrow our research field further down. We have identified three different areas in which research projects take place: mobile learning projects for 1.) educational institutions, 2.) workplace, and 3.) specific target groups. However, not all fields are elaborated equally.
M-learning projects for educational institutions.

Most research has been done in the field of educational institutions.

The “Learning2Go” project was conducted in Wolverhampton (UK) giving students access to “anywhere, anytime learning”. Different universities offer their students online lectures, also via iTunesU. Other approaches like “Skills Arena” try to use games to encourage learning.

A large amount of projects (e.g., “Curriculum Online” or “Lehrer Online”) deals with online curricula and try to support teachers by providing learning material they can use for their own classes. Some of these projects have developed frameworks to create learning material.

The “Futurelab”, “dimeb” or similar institutions have different approaches. They try to share the results from research and development. In several ICT projects they develop new ideas of learning and take them from the lab to the classroom.

M-learning projects for workplace.

The most prominent advantage of m-learning within the workplace rests on the direct connection to the context and the instant availability of information or learning material.

These kind of situated learning activities are also very well elaborated. The most prominent project in this field is MOBllearn, which was aimed to foster informal, problem-based and workplace learning with mobile technology. This project is the largest m-learning project to date.

Other projects within this field are “Games-to-Teach” by the MIT aiming at augmented reality educational gaming, the Australian project “Mobile Learning: Hand Held Innovations in Flexible Learning” – as part of the Flexible Learning Network – that examined the convenient and cost-effective use of mobile technology for the delivery of flexible learning in the workplace, and “Flexible Learning Toolboxes” an online offer for teacher and trainers with free learning objects.

The latest project “Vila-b” is aiming at virtual learning on construction sites and provides further-education for workers to acquire a qualification for energy retrofitting of existing buildings.

M-learning projects for specific target groups.

The majority was aimed at encouraging young people at risk of exclusion to become involved in learning.

The “m-learning” project [5] is the largest project within this field and was aimed to provide literacy and numeracy learning experiences for young adults. Within this project a toolkit for developing mobile learning materials was developed and evaluated. The authors conclude that m-learning has an impact on teaching and learning, because “is adds another dimension and additional resources to the teaching” [5: pViii] and it encourages the learner’s involvement and engagement, because they become more flexible in their learning since they can choose time and place.

Nevertheless, m-learning cannot only be used for common people – as it is the case of most existing approaches – but also to assist learners with disabilities. However, these projects are very rare and the only one we could identify is the still ongoing project EasyIT\(^1\) aiming on the inclusion of mentally disabled people in today’s information society by providing mechanisms to strengthen their ICT skills and to teach how to use ICT and benefit from it.

Taking a look at the snapshot gives an insight into the diversity of m-learning research globally. However, there are nearly no projects or approaches aiming at m-learning for mentally disabled people at workplace.

The next sections introduce this special target group and outline their special needs and challenges they are faced when dealing with mobile technology and mobile learning.

B. Mentally disabled people

World Health Organization (WHO) defines the disability as “any restriction or lack (resulting from any impairment) of ability to perform an activity in the manner or within the range considered normal for a human being” [12]. Mental disability (also called cognitive disability) is an intellectual impairment [13] that points to the mental process of knowing. Most of these people have difficulties in thought processes (perception, awareness, reasoning, memory, and judgment) and gaining new knowledge to be applied in daily work and some of them need special assistance for their daily life (this depends on the level of mental ability, see next chapter III).

“The perception of the mentally disabled is slow, rigid and insufficiently organized, which makes it limited, fragmental, incomplete, in short, there is a scarcity of elementary mental images.” (Suta et al. 2007) [7]

As Suta et al. point out, we need to provide clear and understandable mental images that foster better memorization. With these, it would also be possible to recover and improve the perception and learning ability for people with minor mental disabilities.

C. Mobile learning for mentally disabled people

As our literature analysis (section A) has shown, there are hardly any projects aiming at the exploitation of mobile learning environments for the needs of persons with mental disabilities.

Transferring knowledge learned from the classroom to the workplace will result in a loss of parts of it; this phenomenon is particularly prominent for mentally disabled people. As a consequence, our approach fosters learning processes directly within the context of use (workplace).

“The mentally disabled [people] learn less through listening, writing down, reading, and understanding than through watching and imitating, or having their movements physically guided by the teacher or trainer or steered through demonstration.” [8] Therefore, M-learning is a solution to help mentally disabled people to keep their physical movements and environment observations while

learning through mobile technology instead of sitting at a stationary PC and learning isolated from the real world; this results in a strengthened feeling of independency in workplace.

With the new technology available today, non-disabled learners can easier control the speed and direction of the learning process and adapt themselves with the learning environment. But for people with mental disabilities, this way of learning has to be modified to a flexible learning speed with a fixed structure.

According to Chen [9], the following principles of pedagogy have to be considered in a learning process:

- Urgency of learning need
- Initiative of knowledge acquisition
- Mobility of learning setting
- Interactivity of learning process
- Situatedness of instructional activities
- Integration of instructional content

The analysis of our workshops has shown that especially the last three principles are tremendously important. As we have also discussed with experts in our workshops, the learning process for mentally disabled people does not mean slow down the learning speed, but mainly presenting the learning material in a way which is understandable for the learners; although it might be presented slow in special points.

III. OUR CONCEPT AND METHODOLOGY

A. General approach and strategy

The high potential of mobile technology to enable learning has already been proven in several studies. However, understanding how mobile learning actually works is not well elaborated yet. This is especially the case for mentally disabled people. We know how they learn in the classroom, but how they learn with the support of mobile technology has not been analyzed. Our concept and design of a mobile learning support system for mentally disabled people shall build the foundation for a new field of research.

In the first instance, we are concentrating on people with mental disability. The results and findings seem to be transferable to other groups, but this has to be proven in the next steps.

Based on the classification of the American Association of Intellectual and Developmental Disabilities (AAIDD)\(^2\), our target group is aged between 18 and 65 years (male and female workers) and covers especially borderline, mild, and moderate levels, since people with a higher level of disability will not be able to operate the mobile devices on their own.

Most of our target group is employed at the Martinshof. It was established in 1953 [10] and is one of the largest sheltered workshops for people with mental disabilities and is located in Bremen, Germany. Martinshof trains the mentally disabled individually in various activities and adapts the workplace according to the disability of the workers instead of assigning people to the workplace. Due to our cooperation with Martinshof over the past two years, they supported us in different activities and workshops.

Our general approach is to engage these people for learning activities, new motivations and to enhance their self-esteem and confidence. Therefore they should become part of the learning application itself by showing them within the work context. Providing a simple and effective way of learning will enable them to understand their work tasks better. Additionally, our approach is supposed to enhance the learning performance with dynamic learning material and customization. In parallel the work load of the social workers (supervisor) is reduced.

B. Didactic and pedagogy concept

In general the outcome, which learners earn from a learning process is different from person to person. This fact is even more distinct for mentally disabled people. In traditional learning (e.g., schools or universities), teachers have less knowledge about their students and their abilities. So they concentrate more on their learning strategies rather than students. In contrary, in special-needs pedagogy, the focus lies more on the persons and their abilities, rather than the learning strategy – which is usually simpler compared to non-disabled people. As mentally disabled people have problems in memorization, teachers have to find ways to build up their memories. [8]

As a consequence, customization and personalization of the learning materials and activities will assure better performance in learning and individual training.

\(^2\) This classification is based on IQ tests, which shows the Intelligence Quotient (IQ), function performance of a person, and the score.

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Figure 1. Multi-dimensional Learning Cubic.

Our didactic and pedagogy concept applies this customization and personalization with respect to special-needs pedagogy to virtual mobile environments. It contains of three phases: 1.) analysis, 2.) personalization, and 3.) immersion.
Analysis Phase:
The system gathers the information about the user’s mental ability and knowledge regarding the assigned work context and analyses the specific requirements, limitations, and conditions of the learner. This information is entered once in the initial registration process either by the learner him/herself, or with the help of a second person (e.g., parents or teachers). The entered information will be compared to the following criteria:

- Intelligent quotient (IQ)
- Reaction time
- Memory ability
- Problem solving
- Physical abilities
- Audio/visual and reading abilities
- Other abilities

Personalization Phase:
Usually our target group has delay in their physical, cognitive, and social activities. They should be able to build associations between learning concepts and content. Thus the learning material should be divided into smaller, controllable and manageable workload.

As shown in figure 1, the appropriate learning entity is selected according to the user’s mental ability, knowledge and work task. The size of information blocks decreases from borderline to moderate mental ability of the users. In contrast, novice users will receive detailed and simple explanations and expert users will get compressed and abstract explanations.

Based on the results of the analysis phase the decision mechanism selects the appropriate learning material from the learning pool available in the database. On the other hand, the learning material in our system is assigned with special pedagogical metadata by the author. This metadata shows how, where and when a specific learning asset can be used.

Immersion Phase:
As a result of the personalization phase, the learner gets his/her own customized learning material on the mobile learning device.

To ensure that the learner gets engaged with the learning material, he becomes part of the learning application, this means he will see himself (instead of another person) depicted within the context of use (e.g., on a photo or video), for example, as he is working with a tool. This should provide better memorization and recalling of work procedures.

C. System design and architecture
The system consists of two components: mobile client and stationary server. They can either be connected via a wireless protocol to enable online access to information from remote site, or synchronized in the office.

The server provides the mobile client with the customized learning material. As mentioned in the previous section, this learning material is selected from the user’s profile and metadata of the learning material by the decision mechanism of the server.

When synchronizing with the mobile client, the server analyses the learning entities, the user has accessed during his work. This data is used to optimize the decision mechanism and to enable the supervisor to provide additional training or learning material and to give an overview of the user’s performance and improvement.

The mobile client, which presents the learning material, has to fulfill the following requirements:

- PDA size (8 x 16 x 3,5 cm)
- Large color touch screen
- Large buttons
- Ruggedized, min. IP64

The two most important aspects are the form factor and the physical characteristics of the device. Since mentally disabled people may also have difficulties with fine motor skills, the device has to lay good in their hands and has to have only a few and large buttons. Since the devices can be used in several work places with different environmental conditions (e.g., clean, dusty, dirty, dry or wet) the mobile devices has to be protected against any kind of liquids, dust or crushes.

![Figure 2. Server-Client Architecture.](image)

The mobile client provides additional features that are especially designed to support mentally disabled people either in learning or in the work task:

**SOS-button:** In case of an emergency or if the learner needs additional help, he/she can press a special function button of the device and call the supervisor and ask for assistance.

**Statistics:** Every access of learning material is been logged by the mobile client and synchronized with the

The International Conference on E-Learning in the Workplace 2009, www.icelw.org
server. This allows not only monitoring of the user’s performance but also improving the decision mechanism.

**Special User Interface:** Since mentally disabled people have difficulties with memorization and fine motor skills the user interface must be very simple and not overloaded. Therefore the mobile client provides at maximum only four buttons on the screen: home, next, previous, and help.

Large pictures, video and easy to read text guide the user step by step through the work task. According to the bad reading abilities of the user, every text is supported by audio output, but the user can decide to switch this feature off.

**D. Workshops and evaluation**

We have conducted different workshops and training programs between February 2008 and March 2009 (every workshop with 3 to 8 participants, 14–45 years old) in cooperation with Martinshof and the school for people with special needs.

The first set of workshops has focused on the role of digital technology in their daily life. The aim of these workshops was to verify their impression and familiarity about digital media especially mobile devices.

In the later workshops, we have analyzed their learning activities and the way of adaption to new technologies. We confronted them with different quizzes on mobile devices and asked them to try out the quizzes to get feedback on their interaction with mobile devices.

We observed that nearly all knew about mobile devices especially cell phones. For them a cell phone symbolizes the world to get connected to. They had mostly a private cell phone and knew how to use it. In most cases they need a mobile to organize help if needed or to get emergency information. Some of them were interested in other functions of like short message, audio or using the camera.

The small quizzes were not complicated for most of them, in contrary, they enjoyed to take the quiz, although some of them had to repeat the quiz several times in order to realize how it works. In some cases, we could give enough attention to the groups, which had difficulties to get success in the quiz. They learned to use the simple functions of new mobiles easily, and helped each other to use the mobiles in the proper way.

**Based on our observations, experiences and interviews with experts in different workshops we studied the special learning behaviors and distinguished the following aspects:**

**Attention:** This parameter is the absorption of information in a learning process. The lack of attention is regarded as a huge problem with mentally disabled; they can often hardly aim their attention to the important parts of a task and can be easily disturbed and distracted from what they are doing.

**Recall:** It refers to a call for stored information to bring things back to mind. The percentage of this factor is too much different with mentally disabled. The improvement of this factor can be defined somehow as a success in a learning process. The mentally disabled people, who attended in our workshops, play once a week a memory game at school that trains their ability of recall, memory and communication.

**Memory:** Mentally disabled have always problems in reproducing information. It is not the problem to save the information, but to reach the information. The process should contain imperative and structured learning material.

**Speech:** Experts proved that it gets easier to keep something in mind when you can name it [11]. In our approach, we try to design the learning process in a way that requests from the learner to name or repeat the objects and events in different periods of time.

**Praise:** Mentally disabled people often get disappointed and exhausted, because of their limitations in reaching their goals. The learning program has to motivate them to go forward and not to give up in middle way. Every small mistake should be corrected with an appropriate feedback (usually positive and in a motivating way) and every favorable outcome and success should be appreciated by the system. In many cases a small effort or advance should be considered as a success.

**IV. CONCLUSION AND FUTURE WORK**

In this paper we presented a new approach to support mentally disabled people in learning at workplace with mobile technology. Our workshops have proven that mentally disabled people can handle mobile devices very well, although they are handicapped in their mental and cognitive abilities. Mobile devices enhance the motivation of learning and can be used as a catalyst for improving their learning and work performance.

The communicative functionalities and social self-determined mobile activities will be a challenge for our future work. Thus the target group might form communities that can explore their world together.

**ACKNOWLEDGMENT**

We would like to thank Prof. Heidi Schelhowe and the workgroup Digital Media in Education (dimeb) of the University of Bremen, Germany, for the valuable comments and advises, as well as the Martinshof for supporting us during the last two years.

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Manuscript received 15 April 2009.

Published as submitted by the author(s).