CONTEXTUAL CUES: AIDING WIRELESS MULTIMEDIA COLLABORATIVE LEARNING

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ABSTRACT

Psychological theories state that an increase in contextual overlap between the original learning situation and review should result in an easier recall methodology. We propose a system which uses the contextual cues of relative timing of the presentation of key points detected during a traditional learning class by mobile phones that learners hold. Cut-down versions of learning material are stored on mobile devices present at the location of the lecture; a choice made from observations of increasing consumer demand for shorter and shorter 'chunks' of information. The proposed system is implicitly linked with an online community system, accessible from the mobile devices, where learners can use the cues to more easily search for, revise, collaborate on and recall difficult learning material using the multimedia capabilities of their phones.

KEYWORDS

m-learning, mobile, learning, context, communities, CSCL

1. INTRODUCTION

Our views of mobile phones as pervasive devices have enabled researchers to explore how we can educate ourselves outside of traditional contexts, making use of network connecting technologies to support learning wherever we are. However, traditional methods of teaching academic material will be used in the education system for some time, and we should not ignore research in this type of learning. This paper proposes a system based on psychological theories of optimising memory recall that suggests a way of improving existing learning scenarios using mobile devices with minimal altering of the traditional learning methods. We will show how the portability and the networking capabilities of mobile phones give them the potential to support learning practises where short spontaneous bursts of collaboration take place between fellow learners that would not be possible with traditional online learning systems and communities such as (Blackboard, 2004).

The remainder of the paper has been organised as follows: firstly a discussion will be made of existing research in m-learning, comparing two distinct types of systems. A discussion will then be made on why we should concentrate on exploring systems that take advantage of the social collaborative nature of learning as opposed to ones which simply replicate existing learning scenarios, albeit on mobile devices. A psychological theory of how context is linked with recall efficiency is described, and a system is proposed which takes advantage of mobile devices to promote spontaneous interaction and contextual cues to aid in recall and support collaborative learning.

2. M-LEARNING SYSTEMS

M-learning systems have been described in different ways. (Nyíri, 2002) describes them as platforms which enable "situation-dependent knowledge, the knowledge at which m-learning aims, by its nature transcends disciplines; its organizing principles arise from practical tasks; its contents are multisensorial; its elements are

linked to each other not just by texts, but also by diagrams, pictures, and maps". (Trifonova and Ronchetti, 2003) summarises existing m-learning systems and organises them into two distinct groups. One group, called "**accessing content**", includes the Ultralab M-Learning project (Ultralab, 2003), which in its infrastructure includes a learning management system that enables the learner to access a range of material using mobile devices.

A second group, "**communicating and interacting with people**", lists projects that *bank on the social collaborative nature of the way people learn, aided by mobile technology*, which is supported by Nyíri's philosophy on m-learning as being "learning as it arises in the course of person-to-person mobile communication" (Nyíri, 2002). It includes the UniWap pilot project (Seppälä et al., 2002), which breaks away from the traditional methods of teaching by reaching out into the physical space. Messaging services enable learners and teachers to interact with each other outside of the classroom, and by doing so promotes learning in real-life situations. The project motivation is that mobile technology enables students to learn in whatever situation suits them, and that students should be able to find guidance wherever they are.

The HandLeR project (Sharples, 2000; Sharples et al., 2002) is an attempt to gain an in-depth understanding of the process of learning in different contexts with the evaluation of a handheld learning device. The system is "...intended to support children to capture everyday events such as images, notes and sounds, to relate them to web-based learning resources, to organise these into a visual knowledge map and to share them with other learners and teachers" (Sharples et al., 2002). Systems of this kind promotes learning in complex environments where learning goals depend on a contextual factor, such as the route a learner has taken in a history museum, or the surrounding resources and co-learners.

The latter group of the two is the one which is of greater significance to m-learning researchers (Roschelle, 2003), as the systems do not simply make existing learning material accessible on mobile devices, but take advantage of the mobility of the devices and the change in context of learners. We must concentrate on studying social practises and improving learning efficiency, not the technology itself.

A system designed to enhance the collaborative learning experience must start on the basis of having a clear view on learning social practises. For example, a project at Kingston University (Stone et al., 2002) studied a system which used two-way SMS communication in a campaign for a UK youth brand. They believe that SMS could be used to facilitate creativity by providing a timely means for interactivity to learners. The reasoning behind this belief is the way we work with SMS; people find it more personal, which might be explained by the observation of users reacting with a mean response time of 17 times shorter than web methods. Simple communication technologies such as SMS has been developed by youth users into rich social practises (Rheingold, 2003), highlighting the potential of flexible m-learning systems.

(Dimitracopoulou, 2005) summarises studies of community-based learning systems and found that in formal and informal studies students preferred embedding collaborative comments in the context of the subject of discussion because it makes it easier to refer to parts of the artefacts and prevents the cluttering of comments by effectively assigning them contextual labels. Dimitracopoulou refers to these tools as "embedded communication tools". The range of these tools include the annotation engine evaluated by (Nokelainen et al., 2003), which enables users to highlight and annotate web documents recommended by course instructors as being relevant to learning topics. In this case, empirical results showed that self-made annotations were said to be more useful than annotations made by other users. This is likely to be due to users scaffolding new knowledge upon their personal, internal models of the current world, and then commenting on the relationships. A further, more detailed study is yet to be carried out to confirm the reasons behind this result in more detail, but we can fairly say that learning habits still heavily involve self-annotation; collaborative learning systems should not ignore that for many students, it is a very important part of the learning process (Nokelainen et al., 2003). A further result from the paper showed that students make no distinctions between annotations made by anonymous users and named users. This suggests that there may be less of a community atmosphere in the system studied, but a further study would have to be carried out to see whether the results were specific to the type of implementation.

3. CONTEXTUAL CUES

Tulving's theory of encoding specificity (Tulving, 1983), regarding retrieval of an item from memory, says that "*The probability of successful retrieval of the target item is a monotonically increasing function of*

informational overlap between the information present at retrieval and the information stored in memory". If the theory is correct, we could increase the learning efficiency of a student by providing them cues to the original place they had originally been exposed to the topic. For example, taking an exam in the same place you had lectures in on the same topic, or recreating the scents of the original room (Herz, 1997).

The pervasive identity we habitually carry around with us - the mobile phone, could be used to provide an additional contextual layer that could help with retrieval of learning material. It would be interesting to discover which contextual cues would help the most. We can design an experimental framework which takes its basic features from systems like (Blackboard, 2004), which is a large framework built up of instructional tools, collaboration and communication systems and tools for assessment and evaluation; and augment cues using the mobile phone as a sensor device. Several possibilities can be suggested: targeting visual memory by attaching photographs of lectures, including the instructors, to course summaries and notes; inferring and recording the proximity of fellow students in classes where physical collaboration is used in a learning exercise; or attaching time labels to specific parts of course summaries.

4. THE PROPOSED SYSTEM

A proposed system can be described as follows: students who have attended a lecture or class receive a copy on their mobile phone of key points that the instructor labels as important, which should be reviewed later. To support this, a plugin or tool installed on the teacher's Bluetooth-enabled computer would make it easy to highlight important points in the teaching material. During the presentation, the broadcasting of the key points together with a **timestamp** will take place parallel to the presentation of the related material. Software on the student's mobile phone would collect these notes in a pervasive, unobtrusive fashion. (Kendall and Kendall, 1999) described such systems as γ-push information delivery systems, where the provider *thinks* they know what the users would be interested in. However, filtering is an implicit part of the system because the receiver is assumed to be interested in information directly related to the class material. Such a concept is not unlike RSS (RSS Advisory Board, 2006), which has been discussed to be useful for education as a syndicated and filtered information source (Harrsch, 2003). (Beale, 2005) observes that information is being presented in smaller and smaller forms on the Internet, using RSS as one example. He argues that the society acceptance of shorter and shorter chunks of information means that it has become a powerful way of organising information for display on mobile devices.

5. SPONTANEOUS MULTIMEDIA COLLABORATION

Due to the system being available on the mobile devices, there is the possibility that more spontaneous interactions, meetings and collaborations would take place. The multimedia capability of the phones and the rise in popularity of WiFi-enabled phones means that video collaboration on course material would be technically possible. Students can exchange ideas in this way, and by making it easier to access course material and communicating with fellow colleagues, the process of learning may be more *spontaneous* and *enjoyable*. In line with (Nokelainen et al., 2003)'s research that showed students finding notes made by themselves important as well as collaborative annotations, such a system could enable learners to annotate the supplemental notes electronically, with voice clips, multimedia from either themselves or fellow learners. For example, a student on a Japanese course may be revising their grammar at home when they think of an excellent example that illustrates a grammatical rule they learned the previous week. They could easily refer to the original class structure where the rules were taught, and add to the example with a voice clip. Making the clip immediately accessible would mean that fellow students could start using the additional example and help each other by bringing up questions. Learning out of the context of the class has been said to have large advantages depending on the type of learning (Jones et al., 2001; Sharples et al., 2002). Learning a language is one good example, as it is something you must learn by *doing*, not just by being shown it.

The student would find the original notes easier because on their phone they can search what has been covered in class by date. The system could supplement the information with the timestamp, visualised as a cue of the relative timing of the actual presentation during the class, which could aid recall of learning material due to the increase in contextual overlap between the original class and the timing seen on the

visualisation (Tulving, 1983). It would also make it easier for users to find summaries without manual labelling of the date the material was originally covered. The design of the visualisation itself is for future work, but inspiration can be drawn from the Dance Dance Revolution arcade and console games by Konami (Konami, 2006) where a uniformly moving timeline denotes relative change in time, with time signature cues indicated with periodically displayed lines. These cues can be incorporated automatically in both the mobile software and the online versions of the notes.

Broadcast messages could also include information of the occupants present in the class which would also further increase contextual relation. A version of the lecture material would be automatically published online, accessible from the mobile devices, together with the summarised key points, allowing attendants to collaborate with each other by discussion. Finding the material would be easy, as the location would be transferred to the mobile devices as part of the pervasive broadcasting of messages during classes.

6. TECHNICAL DESIGN

The main technical implications of the system are how to integrate the summary message creation tool into the teacher's workflow and how to efficiently multicast the messages to hundreds of students using the proximity-based Bluetooth protocol. The first would have to be further worked on by surveying how teachers present their learning material, and the latter can be solved using Bluetooth multicasting techniques such as the one discussed in (Wang, 2005). An implementation of a working prototype would be very interesting for m-learning researchers for two reasons: a) we do not know how such a general system would be used in terms of collaboration patterns between students linked together in a way not unlike social networks. An ethnographic study of this may reveal interesting social learning patterns; b) most of the previous m-learning applications have been concentrating on the ways that we can represent learning material on a mobile device. This system would give us a detailed view on how people start collaborating when given tools which allow for easier virtual collaboration and the processes that they go through to increase their learning potential in the real world. The pervasive manner of the system means that it would not break the flow of normal teaching methods; it could be used as an addition to the learning process.

7. CONCLUSION

We have proposed a system drawing inspiration from a psychological theory on memory recall, previous research in m-learning on the way people learn socially, lessons learned from existing web-based note annotation systems and visualisations seen in video games. The system can be described as taking inspiration from both the ideal m-learning systems, where the whole philosophy of traditional learning is changed (Nyíri, 2002) and collaborative learning community systems (Dimitracopoulou, 2005).

The system makes use of tool installed on the course instructor's computer which is used to annotate key points on learning material to be presented in class. Students install a piece of Bluetooth-enabled software onto their mobile phones which receives in a timely manner the key points broadcasted by the course instructor's computer as the presentation proceeds. This serves two purposes: a) the student can review course material outside of the class without access to a computer terminal; and b) the timestamps on the messages, made possible by the mobility of the receiving devices, implicitly label the relative time that the material was presented, making it easy to find, annotate and discuss the subjects. A space for collaborating on the learning material can be easily placed on the web due to the integration with the presentation software, and the multimedia capabilities of modern mobile phones make dynamic and spontaneous virtual learning collaborations possible.

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