M-Education: Bridging the Gap of Mobile and Desktop Computing

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Abstract

Mobile Education or M-Education is a new conceptual paradigm in the use of mobile and wireless technologies for education. M-Education encourages distributed peer collaboration over wireless devices and desktop computers to create opportunities for discovery and education in the field and community. It is a project-oriented approach that will use a wireless virtual community to facilitate the learning activities of teachers, students, and peers through collaboration in a distributed environment. M-Education is significantly different from existing mobile learning systems in that it leverages its collaborative activities from an existing desktop-based online virtual community (MOOsburg), and thus offers a range of collaboration opportunities, such as synchronous and asynchronous interactions with peers, and viewing or changes to persistent data. In this paper, an innovative use of wireless and mobile technologies in education is explored as part of a scenario-based design process [7].

1. Introduction

Mobile Education—or M-Education—is a new way of using wireless and mobile technologies for education by extending access to a desktop-based online virtual environment called MOOsburg [6] to handheld devices used as part of a mobile collaborative community.

Networked computers and corresponding applications facilitate distributed education with the mediation of learning activities by a constellation of various tools (such as shared spaces, whiteboards, etc) having appropriate pedagogical approaches to collaboration and social interactions [1]. One such example is MOOsburg: a community-oriented collaborative environment that models the town of Blacksburg [6]. It provides an interactive map to navigate the virtual community, and a range of collaborative tools that provide access to shared content such as chat, message boards, and so on. Three versions of MOOsburg have been developed to date: a classic text-based MOO, a MOO extended to drive a Web-browser, and a Java-based system [6]. The current research considers how an application such as MOOsburg, which provides a collaborative learning environment, can be used to support educational activities in an active, mobile learning community.

M-Education is designed to support a wireless online virtual community that is linked to the existing MOOsburg community. This will enable users who are interacting from either handheld devices or desktop computers to merge their learning experiences in a shared collaborative environment, both synchronously and asynchronously, with reference to the same underlying data. The communication between a handheld and desktop is similar to that between two desktops.

MOOsburg is an integral part of the Learning in Networked Communities (LiNC) project (http://linc.cs.vt.edu/overview.html) that has developed and evaluated software tools and applications for collaborative learning activities. Research has compellingly established the importance of learning communities. At the same time, mobility, flexibility and instant access of handheld devices add considerable freedom for people to collaborate anywhere, anytime [2]. However, not enough research has been done in integrating the two concepts, for example trying to coordinate the use of desktop computers and handheld devices. We are beginning a research effort to do this; in this paper we use scenarios to explore an innovative use of wireless and mobile technologies in education.

The main contribution of this paper is to bring to light the potential of M-Education, and how the power of handheld computing can be combined with the traditional use of desktop computing to realize a new improvement in education. The remainder of this paper is divided into four additional sections. Section 2 briefly summarizes related work. Section 3 introduces the educational application domain that we are using to explore M-Education. We then describe the vision of M-Education by discussing hypothetical scenarios, outlining its integration with desktop computers using MOOsburg, and finally present some concluding remarks.

2. Related Work

Numerous efforts are being made in the direction of using handheld devices for educational purposes. In cases where efforts consider possible coordination between handheld and desktop environments, none have proposed the rich interactions we envision in M-Education. By examining a few related applications and concepts, we shall see how M-Education takes learning using wireless and mobile technologies one step further.

KNOWMOBILE is an exploratory and research project [3] that is conducting experiments on medical students during their field assignments. It focuses on how its users, in the context of their local environment, use handheld devices to access web-based medical knowledge and information. Although this project facilitates distributed and context-specific access to information, it makes no effort to coordinate such activities with other educational activities or peers.

Wireless Internet Learning Devices (WILD) [4] offers another vision for how one might use handheld devices in classrooms for computer-supported cooperative learning (CSCL). It is offered as a substitution for replacing CSCL applications that use desktop/laptop computers, a sort of paradigm shift. In contrast to our vision, the use of WILD in CSCL replaces—rather than integrates with—the use of desktop computers for distributed learning.

Perhaps the closest effort to the M-Education concept emphasized in this paper is [5], which uses handhelds to support collaborative learning. The authors merely suggest that handhelds may be used with desktops when the disadvantages of the former such as limited screen space become a considerable issue. M-Education takes the counter approach, emphasizing that when desktops are not available, collaboration is still possible using handheld devices providing the same enriched interactions as available on a desktop computer. Our vision is not simply to supplement desktop user interfaces, but rather to explore the new and varied educational activities that become available in a mobile-computing setting.

3. Application Domain

One of the target applications for MOOsburg is an ongoing community project called Save Our Streams (http://www.iwla.org/SOS/). Save Our Streams is a national watershed education and outreach program that uses hands-on activities, such as cleaning up stream corridors and monitoring stream health, to help restore watersheds. Through these activities, community members learn about the importance of protecting their local watershed and become more educated about the environmental, economic, recreational, and public health benefits of clean water.

The national Save Our Streams program consists of over 300 local chapters that coordinate activities for their local citizens. In Blacksburg, the Museum of Natural History at Virginia Tech organizes field trips for grade school children and offers training sessions that teach others how to monitor and adopt a stream section. One of the major activities is an assessment of the stream's health through biological sampling, such as insect counts. Participants on such trips learn about stream ecology and how to assess water quality. The data collected on these outings are often provided to the local and state government to augment their knowledge of the stream's condition.

Currently, the local Save Our Streams project conducts biological sampling at seven distinct locations. We have modeled each of these locations in MOOsburg, such that all of the data related to a particular site is available online. Through the use of synchronous and asynchronous chat tools, Save Our Stream leaders as well as other community members, can discuss interesting findings such as the overall condition of the local stream.

4. The M-Education Vision

In this paper, M-Education underscores the importance of merging the handheld devices with desktop computers for educational purposes by analyzing the need of a wireless online virtual community for the Save Our Streams group, or in general, any group working in the field that requires a collaborative channel for achieving an educational goal.

Assessing a stream through biological sampling is a particularly interesting activity for M-Education. In organizing an educational trip to the stream, Save Our Stream leaders want to engage people in hands-on activities and informative discussions about the local watershed. One way to encourage learning in this setting is to compare data collection results, explore trends, and communicate with other stream experts. Upstream activities affect downstream collection results and a stream can change over time. Accessing previous data while adjacent to the stream can foster an educational discussion of these properties and encourage participants to learn about what affects a stream's health. Also, communicating with other stream experts not on the trip can provide additional insight. These features are available through MOOsburg, yet they are not readily available in the field when people are learning.

A high-level depiction of the combined interaction between handheld devices and desktop computers using MOOsburg is given in Figure 1. In this figure, participants in the field can perform synchronous and asynchronous interactions with peers (non-field participants) and data, where data may consist of insect count readings stored in a file or the health condition of the stream a few weeks back that was discussed during a chat session.

Realizing the value of a collaborative environment for the Save Our Streams group, the following subsection describes the move towards a wireless virtual community that integrates with MOOsburg, discussing the technological and architectural aspects. Thereafter, possible scenarios are outlined and evaluated in light of the requirements of the Save Our Streams group.

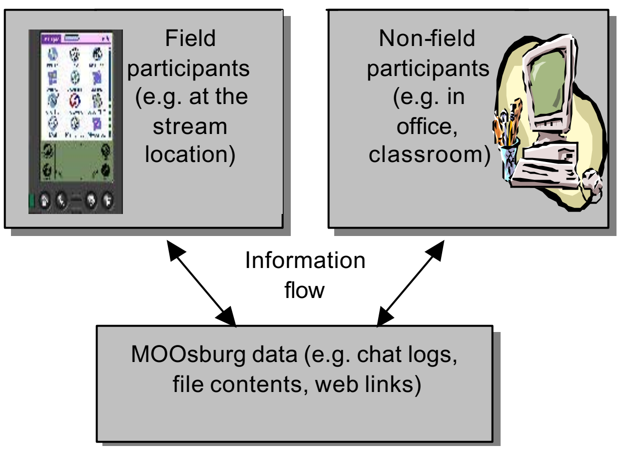

Figure 1. Coordinated use of handheld and desktop computing for learning

4.1. Technology and Architecture

To facilitate the Save Our Streams group in their collaborative learning activities in the field, a wireless online virtual community, MOOsburg++ [8], will be used. MOOsburg++ is an ongoing development effort to extend the accessibility of MOOsburg to handheld devices. It is being developed using Sun Microsystems's Java 2 Micro Edition. In addition to platform independence, the use of Java technologies provides easy integration with MOOsburg and the reuse of the existing MOOsburg standardized, modular components [8]. Furthermore, MOOsburg++ may be used on a variety of handheld devices (that include support for the Java Virtual Machine) such as PDAs, cellular phones, and pagers.

The role of MOOsburg++ in the Save Our Streams group is to provide synchronous and asynchronous educational opportunities and interactions, not just with peers but also with data maintained by the system. The collaboration partners may be located remotely, and may be using either a desktop computer or a handheld device. They may be working together simultaneously or at different times. For example, the data being collected or analyzed in an activity (e.g. stream PH-level) could be obtained in real-time through the collaborative efforts of a distributed team, or it might have been stored previously at a virtual location in MOOsburg, and accessed as needed while working in the field.

Porting systems like MUDs and MOOs to mobile devices would give even more importance to place-based presence and data organization, because the users interacting with the desktop are taken to a higher level of interaction that may be performed anytime, anywhere on anything [8]. This higher level of ubiquitous interaction would fulfill the educational goals of the Save Our Streams group, and in general, people in the field.

4.2. Example Scenarios

The following scenarios illustrate the prospective role of MOOsburg++ in the use of wireless and mobile technologies for educational purposes in the field. The first scenario given illustrates how accessibility to data stored within MOOsburg can enhance an educational activity in the field.

Save Our Streams leader, Bob, takes a small group of middle school students to a section of Stroubles Creek to conduct a stream assessment. As they begin to wrap up their invertebrate count at the creek, Bob is entering the numbers on his handheld and notices that the number of Mayflies is considerably lower than last year. The group discusses some of the possible reasons before Bob encourages the group to explore the data from some upstream sites. The students discover that there have been many water temperature changes over the past year and they discuss how these changes could affect the insect population.

This scenario demonstrates the usefulness of M-Education for an educational field trip. A traditional trip would have the students count invertebrates and record their data on a record sheet. But M-Education allows the lesson to continue. By entering the data and examining other results in the field, the group learns about the larger preservation effort they are contributing to. They learn that it is important to share their findings with others and that different groups can benefit from one another. Also, looking at the previous data helps to put their results into perspective and encourages further questioning and discovery activities.

In this scenario, the group discussed past insect counts and water temperature changes. Walking up the stream might help them investigate the cause of these changes, prompting another educational discussion. Access to the community database in the field provides both of these opportunities for Save Our Streams leader. It allows them to educate people about the larger watershed protection effort and encourage hands-on learning related to streams.

In addition to data access, M-Education also enables peer-to-peer collaboration and coordination between handhelds and desktops, as in the following scenario.

While training a couple of community members on how to conduct a Save Our Streams trip, Julie notices that the stream area they are visiting could use some improvement. She uses this opportunity to discuss these issues with the trainees and introduce the online virtual community. One of the issues raised concerns about the large amount of trash that is nearby. Unfortunately, Julie did not bring any supplies, such as garbage bags and gloves, to address this problem. The group also notices that the stream lacks shade and that planting some small bushes could be an easy solution. Julie does not want to have to remember these suggestions for the next visit, so she shows the group how to use their handheld devices to share their idea with others in the Save Our Stream community. Save Our Stream leaders often check with this online environment before going on a field visit so that they can see what has happened there recently. Shortly after they post their ideas, a new message appears from another stream expert. Apparently, he will be visiting this area soon with a local youth group and will be able to make the improvements.

This scenario demonstrates the usefulness of MOOsburg both in the field and in an inside setting using a traditional desktop PC. Providing access in both locations allows the collaborators to continue their communication despite their physical location. It also allows them to exchange ideas in a timely fashion and not wait until they have access to a desktop PC.

Supporting these interactions in the field adds new dimensions to the educational experience. In this example, the trainees quickly learned about the network of stream experts that they would be joining. They learned about how the larger group works together and discusses various issues concerning the watershed. Similarly, a group of college students could have benefited from a synchronous exchange with another stream expert. Possibly this person could not join the trip but they offer additional knowledge about the stream. Having access to MOOsburg through both handheld devices and desktops makes these collaborations possible.

5. Conclusion

We have presented a summary of design work in progress, describing our vision of M-Education, an architecture for integrating the use of wireless technologies into an existing collaborative environment. The consequence is that teachers, students, and peers in a distributed field environment can interact seamlessly with their counterparts in a desktop environment. They are also able to examine and modify shared data maintained in the online community. The basic architecture is in place and we are beginning to develop and evaluate scenarios of the sort described here.

6. References

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