Using a Handheld Concept Mapping Tool for Cooperative Learning

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Abstract

This paper reports our implementation of a handheld concept mapping tool to support cooperative learning in a nursing class. We investigated the effects of using handheld technology in a traditional classroom as well as issues associated with the use of handheld technology. Our findings showed that handheld tools enhanced interactions among students when proper class management and technology support were provided.

I. Introduction

With the advances in wireless communication technology and mobile devices, the application of handheld technology in education will likely continue to grow. During the past few years, many researchers (e.g., Davis, 2003; Smørdal & Gregory, 2003; SRI, 2004) have been exploring the potential of mobile and wireless devices in various educational settings. Research has shown that wireless handhelds offer new opportunities for innovative user interaction and communication - both in and out of the classroom (Tatar, Roschelle, Vahey, & Penuel, 2003).

Wireless handhelds have provided a unique opportunity for enhancing cooperative learning. Cooperative learning techniques are based upon constructivist and social development theories. The constructivist theory takes the view that learning is built upon learner's prior knowledge. Through cooperative learning activities, students have opportunities to interact with peers, which aids in understanding and student success. Vygotsky's social development theory (1978) proposed that the zone of the proximal development is the difference between what a student can do alone and what he/she can do with supportive collaboration. The theory assumes that interaction among students increases their mastery of the concepts in the tasks. With a mobile computer supported cooperative learning environment, the coordination, communication, organization of materials, negotiation, interactivity, and lack of mobility of traditional cooperative learning can be greatly enhanced (Zurita & Nussbaum, 2004). Roschelle & Pea (2002) demonstrated five affordances for using wireless devices in cooperative learning: (1) augmenting physical space; (2) leveraging topological space; (3) aggregating coherently across all students' individual contributions; (4) conducting classroom performances; and (5) students' acts becomes artifact.

The mobility and connectivity of handhelds allows the members of a group to have the physical control of the hardware, to continuously work on task, and to communicate with others while away from the group. It also allows sharing and exchange of work at a face-to-face personal level. Wireless handhelds support a more natural mobile collaboration environment (Danesh, Inkpen, Lau, Shu, & Booth, 2001; Imielinsky & Bradinath, 1994).

This paper reports our implementation of using handhelds to support cooperative learning in a traditional classroom setting. The objectives of this study were to investigate the effects of using handhelds from the perspectives of students' attitudes toward the tools and the learning activities, interactions among students and teachers, and class management issues.

II. Implementation

We implemented the study in a five-year junior nursing college in Taiwan. Fifty students who were taking a psychiatric nursing course participated in this study. The students were divided into twelve groups, each group consisting of four to five students. Cooperative learning activities were organized by using the Jigsaw method and took place over a three week period. The students met once every week for two hours. In each week a cooperative learning session was implemented for a lesson unit. A total of three lesson units were implemented in this study. The lesson units consisted of nursing care for: (1) patients with borderline personality disorder and depression, (2) patients with affective disorder, and (3) suicidal patients in an emergency room. Learning activities for each lesson unit were directed by the course instructor, supported by the first author, a computer teacher and technology specialist of the college. The instructor of the course had previously participated in a training session on using PDA in supporting cooperative learning. Students had also attended a one-hour training session on using PDA and its applications before the experiment.

A wireless connected handheld learning environment was established in a classroom to facilitate students' learning. In such an environment, every student was equipped with a PDA with IR (infrared), Bluetooth, and WiFi wireless capabilities. Students could use infrared to share files with each other, Bluetooth to submit or download files from the instructor's notebook, or WiFi to access the Internet. The environment was designed to make best use of PDA's power on mobility and connectivity. The PDA used in the experiment was a HP iPAQ 2210 model powered with a Microsoft Window Pocket PC operating system. The PDA came with many built-in application tools, such as Word, Media Player, etc.

We also installed a concept mapping software PicoMap (Figure 1) to help students construct their concept maps. PicoMap was developed by the lab of Highly Interactive Computing in Education (Hi-CE) of the University of Michigan (http://hice.org/pocketpc) and

is especially designed for PDA use. PicoMap has a user-friendly interface for students to create concept nodes and links, to readjust the shape of a concept map for better viewing, and to save and retrieve the constructed maps. The constructed concept maps can be easily "beamed" (using infrared) from a student's PDA to other's PDA by simply pressing a few menu buttons. One of its most useful features is that it assists students in their construction of links (relation) between two nodes (concepts). For example, if a student creates a new link *"eat"* between the existed nodes *"cattle"* and *"grass,"* the software will prompt a hint: *"Do you mean: cattle eat grass?"* to remind the student to consider whether the two nodes are properly linked (see Figures 1, 2). PicoMap has been used in many studies (e.g., Norris & Soloway, 2004; Hedestig & Orre, 2003) and the results have been positive.

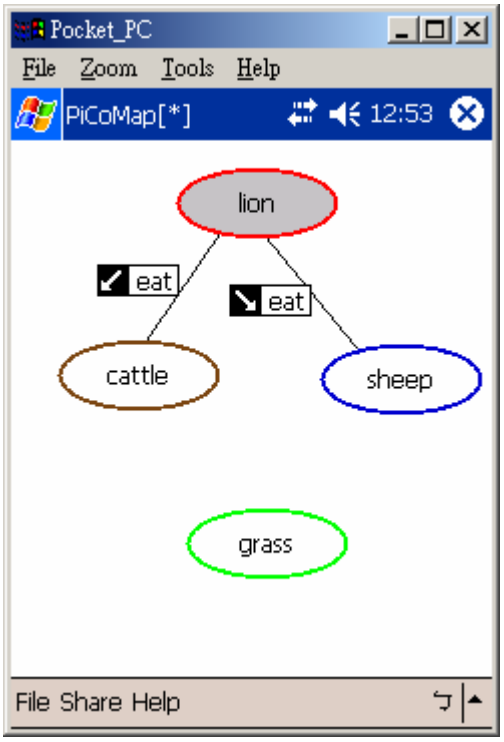

Figure 1 A concept map in PicoMap

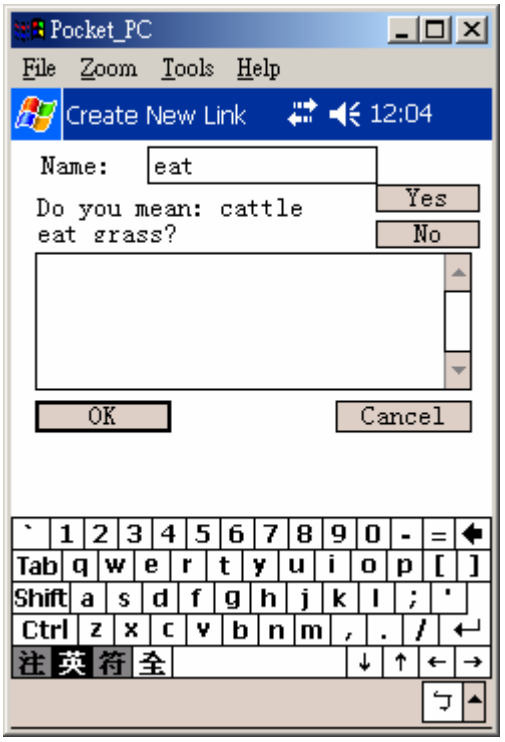

Figure 2 Prompt on creating a new link

The major roles of the wireless connected handheld environment played in supporting cooperative learning are depicted below:

(1) Drawing concept maps

Students used PicoMap to create concept maps before and during group discussion.

(2) Exchanging concept maps

Once two PDAs were in a head-to-head position within a short distance, they were ready to beam files to each other.

(3) Uploading student work

Students could use Bluetooth to transmit their work (e.g., concept maps, filled out worksheets) to the instructor's notebook. At the various stages of the cooperative learning, students have to submit their concept maps to the instructors.

(4) Downloading learning materials

Students could download worksheets, video clips, or other students' concept maps from the public resource areas of the instructor's notebook via Bluetooth transmit.

(5) Viewing videos

Students could use Media Player in their PDAs to view a video, and at the same time, discuss on the learning concepts.

(6) Presentation

The instructor's notebook, which was connected to a LCD projector, served as the device for class presentation. Students could first transmit their work to the instructor's notebook, and then projected it out for the class; or they could use a PDA screen emulator (Remote Display Control, http://www.pocketpc.com) to synchronize the notebook's screen with their PDA so that the PDA screen could be directly projected out through the notebook, without pre-transmitting a file.

III. Results and Discussions

Various data sources were collected to evaluate the effects of using PDA including: student questionnaires, classroom observation journals, audio recorded group discussions, students' concept maps, and interviews with the instructor. At the conclusion of the three week experiment all students were requested to complete a questionnaire to express their perceptions about the learning activities. Table 1 is a summarized result of the questionnaires submitted by the students. We will discuss the findings of the study based on the quantitative data on Table 1, along with the qualitative data collected above.

Table 1 Summarized results of student questionnaire

Statement	Agree & Strongly agree	Neutral	Disagree & Strongly disagree
1. I like to use concept maps in learning.	37%	52%	11%
2. Drawing concept maps is very easy.	39%	43%	17%
3. PicoMap helps me draw better concept maps.	54%	35%	11%
4. PicoMap is easy to use.	89%	11%	0%
5. The PDA facilitates exchange of files with other students.	63%	35%	2%
6. The PDA increased my interactions with others.	65%	33%	2%
7. The PDA facilitates group discussion.	54%	37%	9%
8. The PDA is convenient for uploading files.	36%	49%	16%
9. I encountered problems in using PDA.	79%	20%	2%
10. I like to use PDA in nursing courses.	35%	50%	15%
11. I had good interactions with other students.	67%	33%	0%
12. I had good interactions with the instructor.	44%	53%	2%
13. I like cooperative learning.	52%	48%	0%

1. Attitudes related to concept maps

Questions 1 to 4 asked students about using concept maps and the PicoMap tool. The results showed that most students were not particularly enthusiastic about using concept maps, although some of them like to use it (Question 1, 37% agree); nor did they consider drawing concept maps a very easy task (Question 2, 39% agree). However, 54% of the students agreed that PicoMap helped them produce better concept maps (Question 3) and the majority thought the tool was easy to use (Question 4, 89% agree). Apparently, students appreciated using the PicoMap tool, but did not particularly enjoy using and drawing the concept maps. Our observations found that students usually had problems in drawing the 'right' maps. Many had difficulties in determining an appropriate word to represent the relationship (link) between concepts (nodes), even with the help of PicoMap.

On the other hand, the instructor observed that the quality of students' concept maps were better than before the experiment in terms of their clarity, tidiness, and completeness (Figure 3). PicoMap has limitations on allowing only 12 characters in a node and 32 nodes in a concept map. These limitations caused problems when the students first used it. However,

this had the advantage of forcing students to make their concepts and words succinct -- in order to cope with the limitations.

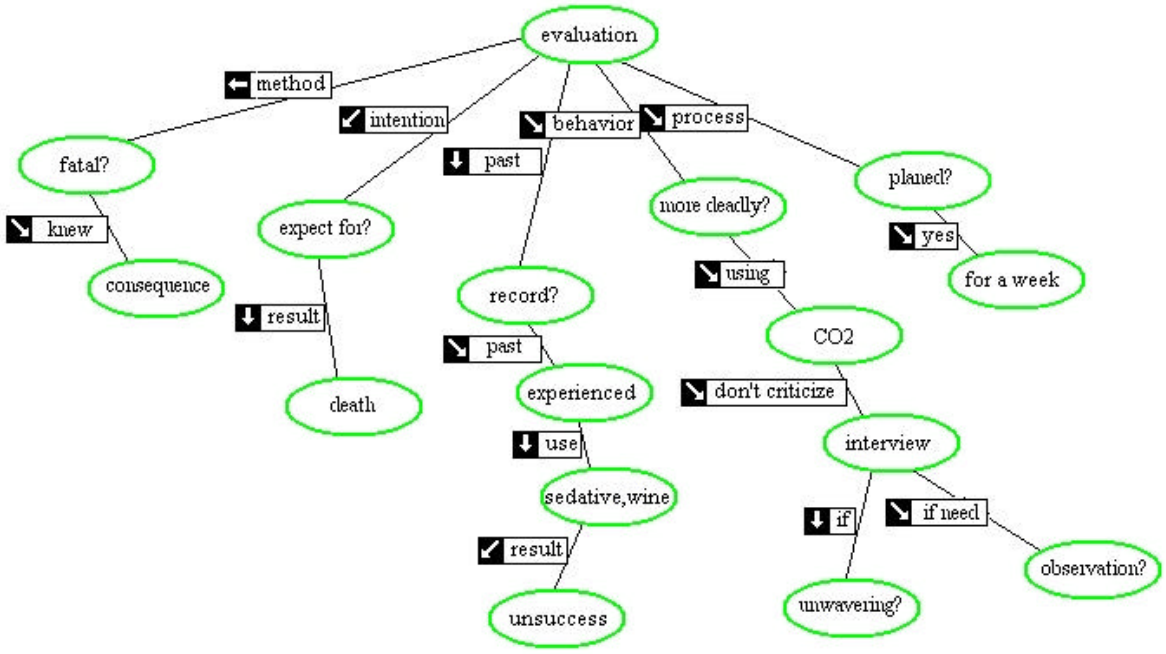

Figure 3 A student's concept map on evaluating the suicidal tendencies of a patient

2. Perceptions on using handhelds

Students expressed their perceptions on using the PDA in Questions 5 through 10. Most students agreed that the PDA facilitated their exchange of files and interactions with other students (Question 5 and 6), and, in turn, enhanced the group discussions (Question 7). The "beaming" function is so easy that students enjoyed and did a lot of sharing each other's concept maps throughout the experiment. During group discussions students would first beam their concept map to the group members, and then discuss each other's concept map by viewing their own PDA. The PDA acted as a sharing whiteboard in the discussion. However, students sometimes had problems in uploading files to the instructor's notebook (Question 8) and encountered difficulties in using the PDA (Question 9). The beaming function uses infrared to transmit file and can only work within a short distance in one-to-one situation -- that is, only two PDAs can exchange files at a time. Whereas the uploading function uses Bluetooth technology, it works in a broadcast mode with a many-to-many capability. Students can upload their files at the same time at any place of the classroom. The Bluetooth capability that comes with the PDAs is tremendous, but it adds complexity in managing and operating the uploading tasks. For example, to recognize "who is who" in a Bluetooth environment, every device (the PDAs and the notebook) needs to have a unique identity. If a wrong name is given, the function either does not work or transmits a file to a wrong device. Other problems that students encountered included things like: 1) unexpected system halts of the PDAs, 2)

inability to save a file in PicoMap, 3) not knowing know how to turn on the backlight feature, and 4) losing battery time. Many of the problems could be due to students' unfamiliarity with the PDAs, but some problems were caused by the instability of the handheld system and its software. Due to the frequent technical problems encountered, it was no wonder that only one-third of the students said they liked using PDAs in the nursing courses (Question 10).

3. Interactions among students and the instructor

Question 6 has shown that the beaming function was a great help to enhance interactions in the cooperative learning activities. When asked if students interacted well with their peers, two-thirds of them said "yes" and none said "no" (Question 11). Students' interactions with the instructor were slightly lower than those with peers (Question 12) is understandable given that students spent most of the time with their peers in the cooperative learning environment.

The PDA played many roles during the course of interactions. At the beginning of a group discussion, it served as an "ice-breaker" to trigger discussion. We observed that students often opened conversations by exchanging concept maps with others. After the concept maps were successfully beamed, they were usually excited with expressions like "Yeah! Yeah! It succeeded …," and the atmosphere of the group was enhanced for further discussion. With the capability of exchanging files, students could view others' concept maps in their own PDA while engaged in discussion, increasing opportunities and quality of sharing ideas. By observing other students' concept maps, students also became more involved in the group's task.

We have also found that group competition occurred on several occasions. For example, the instructor would project the notebook onto a LCD screen while students were submitting assignments via Bluetooth. When seeing that other groups had uploaded their assignments, students would urge their teammates "Hurry! Hurry! Upload!" Such behaviors showed that the class, as a whole, was moving toward a more positive learning climate: that of interaction and engagement. The final question (Question 13) asked whether or not liked the cooperative learning. Students were either satisfied or somewhat neutral when asked about how they liked using cooperative learning. They were, however, much more satisfied with cooperative learning activities than using the PDAs in the course (Question 10). It was clear that many students enjoyed the interactions in cooperative learning.

4. Class Management

The management of the handheld class requires much preparation before, during, and after the class, especially dealing with class with 50 students or more. The preparation work before the class included things like charging the PDAs, installing software, editing videos, and, more importantly, planning the learning activities. The work after the class was equally important, which included: checking that all the PDAs were returned and in working

condition, reinstalling malfunctioning systems and software, and grading the collected student work. Comparing to before and after class, the work during the class involved less effort. Although classrooms were noisier when using PDAs, students were more involved and paid more attention to their activities. Bluetooth also made the collection of students' assignments more simultaneous and efficient than before. The major efforts were in conducting the learning activities and resolving students' problems in using handhelds and PicoMap. In our implementation, the workloads were shared by the course instructor and the technology specialist. The course instructor was responsible for leading the learning activities, while the technology specialist took care of the technical duties. This model proved to be a feasible one.

Many of the efforts above can be greatly reduced if students become familiar with the use of PDAs, and if the handheld technology (and its applications) can be improved for ease to use and for reducing unexpected malfunctions.

IV. Conclusions

This study investigated the effects of using a handheld concept mapping tool in supporting cooperative activities. The results revealed that students appreciated the use of the concept mapping tool, and the PicoMap tool helped students create better concept maps. We also found that the wireless capabilities of the handhelds stimulated interactions among students which enhanced the quality of group discussions. The use of handhelds to support learning has many advantages, but still has many technical obstacles to overcome. At present, a successful implementation would require additional work from the course instructor and full support from a technology specialist. Students also have to be trained to use the tools in order to gain the benefits of using them. With the advancement of technology, we believe the efforts of implementing such a learning environment will be greatly improved and the resulting benefits will become more obvious.

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