HANDHELDS IN A GRADE TWO CLASSROOM: INNOVATIONS TO SUPPORT KNOWLEDGE-BUILDING AND EPISTEMIC AGENCY

Latika Nirula Earl Woodruff Marlene Scardamalia Patti MacDonald
The Institute for Knowledge Innovation and Technology
and the Ontario Institute for Studies in Education/University of Toronto

Abstract: This paper reports work-in-progress of a design experiment examining the use of handheld (PDA) computers in a grade two classroom. Specifically, the focal problem under investigation asks, how can the technological affordances of inexpensive handhelds be directed toward the support of knowledge-building and epistemic agency? Researcher observations are documented over a six-week period as a number of innovations are examined within a technologically enriched grade 2 classroom (N=22). Preliminary findings suggest the handheld can be an effective technological assist in the knowledge-building classroom and there is some evidence to suggest that the handhelds may have a role in fostering epistemic agency.

INTRODUCTION

Taking control of your own knowledge advancement is an important educational goal. One of the 12 Principles of Knowledge-Building outlined by Scardamalia (2002) identifies epistemic agency as a critical component of successful knowledge-building. Agency is evident when individuals set forth their own ideas and negotiate a fit between personal ideas and those of others, and take charge of their knowledge advancement. Epistemic Agency is supported when peer dialogue is fostered and idea diversity helps sustain knowledge work (Scardamalia, 2002). Children operating under a heightened sense of epistemic agency create their own goals, motivation, evaluation, and engage in long range planning –they take charge of the executive processes that are typically handled by the teacher. Metacognitive awareness is a key component in the development of epistemic agency.

Bereiter and Scardamalia (1989) interviewed young elementary school children on what they would do in order to learn, how long they thought it would take, how they would know if they had learned, what difficulties they anticipated, and how they would deal with them. Results indicated that all but a few exceptions had no realistic idea about how long learning would take, and had limited ideas as to how to deal with difficulties that might arise. Most elementary school students interviewed seemed to lack awareness about how learning can be problematic and therefore require strategic moves to achieve goals (Bereiter & Scardamalia, 1989). Thus, examining how epistemic agency can be fostered among elementary school children through technologically-mediated collaborative learning becomes an important area for research investigation.

New mediating-technologies in education may help achieve the delicate balance of private reflection and public sharing, while extending the cognitive potential of students beyond the scope of more traditional pedagogical approaches of peer collaboration. Handheld computers, known also as Personal Digital Assistants (or PDAs), have enormous potential in education given their compact size and affordability. Distinct from computers in a lab, the handheld computer can be a true "personal computer" to the students, enabling them to practice information literacy by gathering, storing, and receiving important information that is necessary for their own learning (Pownell & Bailey, 2002). Handhelds also provide the necessary one-to-one ratio (one student to one electronic device) (Brown, 2001) important for supporting pervasive knowledge-building (Scardamalia, 2002). They also clearly support cycles of doing and reflecting for the individual (Soloway, 2002), enabling the review and refinement of student created artifacts, and providing students with the means to support collaborative dialogues in a way that encourages greater epistemic agency. If innovations are carefully designed, for example, the handhelds can allow students to represent their thoughts first in a private domain, secondly in a small group setting, and then finally shared within the larger knowledge-building community. Therefore, this study explored the extent to which epistemic agency is fostered among children exposed to Computer Supported Intentional Learning Environments (CSILE), which aim to support intentional learning through a student-generated database (Scardamalia, Bereiter, & Lamon, 1994). It was felt that handhelds used in conjunction with computer supported collaborative learning (CSCL) software would enable students to extend inquiry discourse in a classroom of knowledge building (Yoon, 1999; Meyer & Woodruff, 1997), and thereby provide greater opportunities to develop a sense of epistemic agency.

The study's research methodology is guided by a design research approach (Bereiter, 2002). Bereiter describes four key features that constrain the design research methodology in educational research: (1) design research must be carried out collaboratively with educators; (2) the investigators must also be participant-researchers –with the pretense of objectivity abandoned in order for the researcher working to make something

happen; (3) the immediate goal of the research is to find some form of solution created out of an analysis of recent failures; and, (4) design research is guided by the vision of sustained innovations dependent upon new goals emerging from continual performance analysis. The design research approach was well suited for this study. Over the course of the six-week period, several innovations using handhelds were carefully designed in collaboration with the classroom teacher to suit the unique circumstances of a classroom and to encourage the development of epistemic agency in students. As it was unclear what the full intervention of handhelds in the classroom would be, a design research approach was especially useful in giving rise to "on-the-fly" innovations that would help us to understand the role that handhelds could play in a setting likely to have multiple technologies in use.

This study therefore examines how "always on" and "always ready" technology, such as handhelds, may be used to increase students' epistemic agency in classrooms where the pedagogy promotes a knowledge-building approach to learning. This design research study will help in redefining what the technological intervention of handhelds will truly come to mean for the elementary school knowledge-building classroom.

THE RESEARCH STUDY

Participants in this research study were 22 children, ages 7-8, drawn from a Grade Two class at a downtown, technologically enriched school in Toronto, Canada. The students and teacher—an experienced knowledge-building educator—had been working with CSCL software (Knowledge Forum®, Version 3.4) and knowledge-building pedagogy over the previous seven months.

A two-week observational period commenced at the beginning of a new unit of study on weather. The primary investigator observed the students in their classroom in order to document under naturalistic conditions how the existing technology in the classroom was being used. This period also enabled the primary investigator to read all notes posted in the Knowledge Forum database. The teacher met with the investigator prior to the introduction of the handhelds in order to develop ideas for their effective use in class. Several primary uses for the handhelds that were conceived included: (1) using the handhelds for the creation of notes by drawing illustrations on the screen or using the pop-up keyboard function to write out notes, (2) accessing teacher notes or resources to support curriculum content available on the handhelds, (3) using the infrared capabilities of the handhelds to "beam" information to peers, and (4) accessing this shared information on the Knowledge Forum database for further discussion and reflection. At the conclusion of the observational period, several students were gradually introduced by their teacher to the handheld computers. These students were given handheld computers to use opportunistically for the creation of notes destined for the database. This allowed the investigator to determine students' proficiency with the handheld computers, and to better design innovations using them. The gradual introduction of handhelds in the classroom also enabled the teacher and investigator to design more effective small-group training sessions for their use.

Small group training sessions were conducted by the investigator and carried out during regular classroom times. These sessions were designed to demonstrate the various capabilities of the handhelds, and allow students practice using them. The sessions were coordinated with current curriculum objectives, as students were instructed to devise their own theory about how clouds form (part of their weather unit) and following discussion and negotiation in their small group, create a group coauthored note for the database.

The investigator provided the students with ongoing technical help in using the handhelds, and assisted them in the upload of information onto the Knowledge Forum database for the students throughout the study. Activities using handhelds and the Knowledge Forum database were integrated into the regular curricular activities as designed through frequent collaboration between the classroom teacher and research investigator. Some classroom activities using handhelds were audio taped for later analysis.

The research study proceeded in seven stages: 1) Observational Period, 2) Orientation to handheld computers, 3) Innovation 1: video note-taking followed by group coauthoring of database note, 4) Follow Up Interviews, 5) Innovation 2: database notes on handheld followed by group coauthoring of note, 6) Follow Up Interviews, and 7) Innovation 3: literacy activity with handhelds. Researcher observations and student interviews were documented over a six-week intervention period.

RESULTS AND DISCUSSION

Preliminary analysis indicates that the handheld computer can be an effective technological assist in the knowledge-building classroom. The convenience and portability of handhelds enabled students to take advantage of knowledge-building opportunities more readily. For example, when given the option to record notes on their handheld computers during the viewing of an information video, several students enthusiastically requested the use of a handheld computer. Recording of notes were often promptly followed by requests to upload these notes to the Knowledge Forum database.

Observational data also suggests that small group work using the handheld computers resulted in richer "Knowledge Building" discussions, in which the whole class discussed common problems of understanding for the community. Opportunities to present and discuss 'half-baked' ideas recorded on their handhelds to a small group, enabled students to clarify issues with greater skill later during full class discussions. The creation of small group coauthored notes on the handhelds seemed to encourage consensus building around key ideas in the weather unit early on, whereas previously the database held a scatter of notes containing very similar ideas with a much slower progression towards addressing the community's problems of understanding.

Opportunities for students to use the handhelds during video viewing for the purposes of note taking focused the students' attention towards meaning rather than repetition of information. As they were unable to use the "pop-up keyboard" on the screen fast enough to copy down the narrator's scripted talk, students created notes that focused on meaning and concentrated on a key fact that would add to the community's understanding of weather. In a follow up interview, a student remarked: "Well, when we wrote things in the Palm Pilots during the movie we didn't have to memorize everything. And then we could beam it to each other…we don't have to keep it telling each other, and they would forget what the other person said."

New behaviours associated with the inclusion of the handheld computers in the classroom were evident. Students seemed to favor the portability of the handheld computer. Children were often seen sitting alone during research time, working privately in a corner on their notes. They were not restricted by the physical set up of the computers in the classroom, and therefore could move to an area in the room more conducive to their learning. Ideas of handheld ownership also seemed to manifest themselves. Several students during activities with the handhelds would specifically request "their" handheld computer, whether or not their previous work was still on the handheld. Ownership of ideas was also evident through their physical presence on the handhelds. Students were conscientious to oversee that their ideas were 'beamed' to their peers, and were read and considered during group discussions. Some students made requests to create research notes on the handheld computers, often lengthy, which were uploaded to the database with assistance. A student remarked upon seeing her handheld note appear in the database, "Oh good, I don't have to type it all over again." For students who data entry on the handhelds proved more challenging, notes were short in length, and often these students declined from the role of recorder in small group sessions. However, when the teacher or investigator served as group recorder, interestingly, group coauthored notes were more detailed and longer. Noteworthy, student handheld generated notes were typically of comparable length to student desktop computer generated notes in the database. Therefore difficulties in data entry on the desktop computer often translated into similar difficulties in data entry on the handheld computer.

The handheld computer also seemed to foster epistemic agency in some students, evident in their small group discussions. The private reflection space afforded by the handheld computer allowed students to reflect upon and later articulate their understandings of phenomena before public sharing, through the 'beaming' of individual notes in a small group. Several students were eager to negotiate the survival of their individual ideas within their group-coauthored note, striving to find similarities between their ideas and those of their peers. As stated by a student during the creation of a group note, "What else do you think we need? Maybe…how about we go back to *my* note."

Notably, a number of students exhibited awareness of their ideas being scrutinized by the community in the database, and therefore were keen to only include ideas in their group note that reflected points of consensus and importance. Another student suggested a point evident in several individual notes still excluded from the group note, "We still don't have anything about water evaporating from oceans, lakes and rivers. I think we need that." In another group, the focus remained on the inclusion of important points that would advance the community's understanding. Student #1 remarked that "clouds fill the sky" should be included in the group note. Another group member, Student #3 retorted back, "How's that important? Hot air will bring the water vapour up and it will all go together to form a cloud." Student #1 was still dissatisfied and suggested, "Well…she's leaving out some important facts like…the ground is warm. There are two different cycles, the water cycle and the cloud cycle."

Small group discussions where students 'beamed' individual notes to peers and created a new group coauthored note on their handheld, provided a platform for the emergence of new problems of understanding and the elaboration of theories. This is exemplified in this excerpt from a small group discussion:

> Student #1: "They are not saying that the sun heats the water. And the water vapour is a warm front for the ground and it goes up, and it's cold up in the sky, so it turns into this puffy cloud. The air is COLD up in the sky."
>
> Student #3: "But, we know that hot air rises and cold air sinks."
>
> Student #5: "Why don't we just say that when the hot air rises, and when it's really cold in the sky, then the hot air turns into cold air."
>
> Student #3: If hot air rises, then it makes the air in the sky warm. Because the wind is cold, the wind will blow to make it cold air."

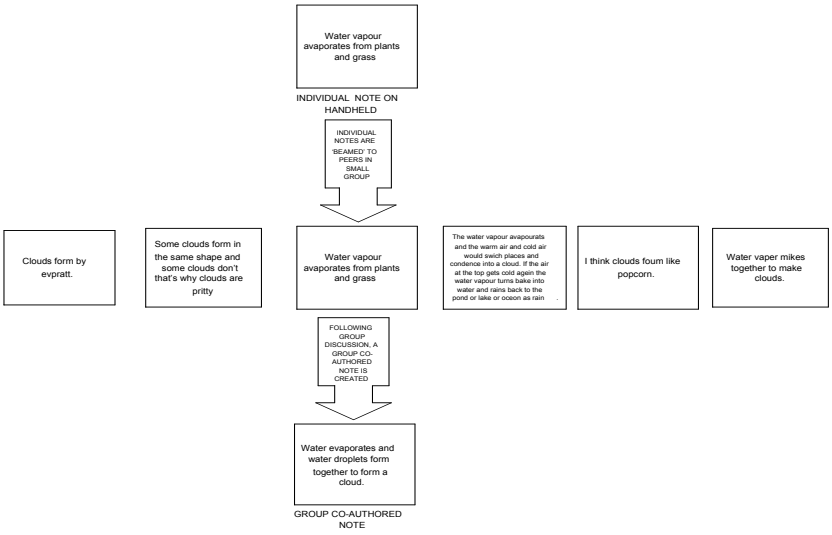

Fig.1: The creation of a group co-authored note using handhelds in small groups: "How do clouds form?"

CONCLUSIONS

The findings being reported in this paper represent work-in-progress. Attempts are made in this study to discern how epistemic agency emerges among children in their early elementary school years, and how technological supports such as handheld computers, may provide opportunities for students to exercise their epistemic agency. It is clear that epistemic agency and gaining competency in knowledge-building are strongly related through classroom observation from this study. One of the major frameworks underlying the research program on knowledge-building communities by Scardamalia, Bereiter and their colleagues is Karl Popper's (1989) three worlds of knowledge. World 3, described as the world of ideas or possible objects of thought, may be evident among children operating with a heightened sense of epistemic agency. We aim to describe epistemic agency in the context of the development of World 3 knowledge.

In the near future, we intend to carefully design innovations using handheld technology to provide students with opportunities to create goals and long-range plans for their own learning within knowledge-building communities. Then in a series of design experiments, we intend to evaluate, refine, and redesign such innovations in order to inform the use of handheld computers within CSCL environments such as Knowledge Forum.

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