DOCUMENT RESUME

ED 396 677 IR 017 853

AUTHOR Rowley, Peter
TITLE Collaborative Technology for Revolutionary Classroom Structures.
PUB DATE 94
NOTE 9p.; In: Recreating the Revolution. Proceedings of the Annual National Educational Computing Conference (15th, Boston, Massachusetts, June 13-15, 1994); see IR 017 841.
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Comparative Analysis; *Computer Mediated Communication; Computer Networks; *Computer System Design; Computer Uses in Education; Educational Environment; Educational Objectives; Educational Technology; Elementary Secondary Education; Foreign Countries; *Formative Evaluation; *Intentional Learning; *Learning Processes
IDENTIFIERS Collaborative Learning; Knowledge Acquisition; Philosophical Influences

ABSTRACT

The Toronto-born Computer-Supported Intentional Learning Environment System (CSILE) is an advanced computer-supported cooperative learning system being developed at the Ontario Institute for Studies in Education. This system has been refined by working closely with teachers and students engaged in an educational approach called "knowledge-building." This paper explores the guiding principles of this approach: deep understanding through conflict between new knowledge and old preconceptions; scrupulously organized pursuit of understanding; knowledge in a social context; and knowledge building as a goal rather than an eventuality. Used with this approach, CSILE has demonstrably positive effects on standardized test scores and a variety of measures of deep understanding. Specific technical ways in which CSILE supports an information-sharing infrastructure tailored to this theory are discussed, including the ability to aggregate knowledge, to link pieces of knowledge, and to create integrated discussions. CSILE's capabilities are compared with the AppleShare fileserver. Reproductions of computer screens illustrate the discussion. (Contains 12 references.) (Author/BEW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 396 677

U S DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

- This document has been reproduced as received from the person or organization originating it
- Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Donella Ingham

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Collaborative Technology for Revolutionary Classroom Structures

Peter Rowley
Ontario Institute for Studies in Education
252 Bloor Street West
Toronto, Ontario, Canada
M5S 1V6
(416) 923-6641 Ext. 2676
rowley@phoenix.oise.on.ca

Keywords: collaboration, networks, cognition, CSILE, knowledge-building

Abstract

The CSILE (Computer-Supported Intentional Learning Environment) System is an advanced computer-supported cooperative learning system being developed at the Ontario Institute for Studies in Education. Over the last seven years, this system has been iteratively refined by working closely with teachers and students engaged in creating an educational approach called "knowledge-building". Used with this approach, CSILE has demonstrably positive effects on standardized test scores and a variety of measures of deep understanding. We give a brief overview of the principles that guided development of the system and some of its facilities and conclude with a comparison of CSILE and the Apple Macintosh AppleShare™ 3.0 file server with respect to their support for classroom collaboration.

IR017853

BEST COPY AVAILABLE

ERIC

Introduction

Networked computer systems have a great potential to revolutionize how classrooms are organized and the extent to which they succeed in helping produce aware and intelligent citizens capable of contributing in the 21st century world of "knowledge work" (Marshall 92). Unfortunately, many networks are structured to emulate the organizational patterns of traditional classrooms, despite the known limitations of these patterns (Resnick 89).

In a teacher-centered traditional classroom, the primary flow of knowledge is from the teacher to the students (see Figure 1). On occasion, students are prompted for evidence that they have absorbed the content delivered previously by the teacher.

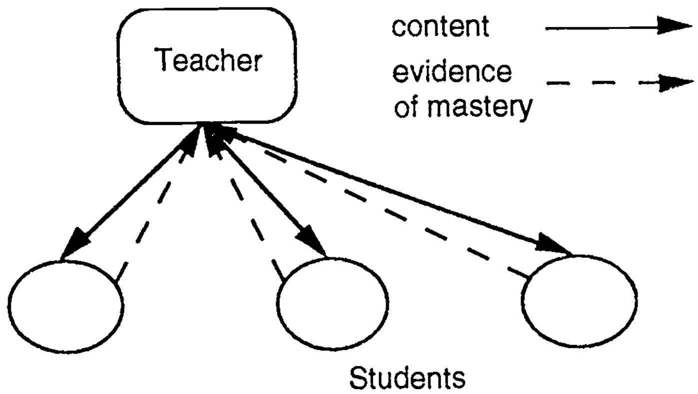

Figure 1.

Integrated learning systems (Merrill 92) typically emulate this structure, replacing the teacher with a file server of lessons, the student's desk with a workstation, verbal delivery of content with network delivery, and classroom question-and-answer with automated testing. The ILS has the advantage of allowing students to proceed at their own pace, and multimedia ILS systems may appeal to a broader variety of students by virtue of their appealing graphics, video, and animation, but users of these systems typically gain little or no experience in research skills or collaboration, both of which are central to knowledge work.

For the last seven years, the members of the CSILE™[2] Project at the Ontario Institute for Studies in Education[3] have been developing a different model of classroom organization, called collaborative knowledge-building, and a computer system to support it, called the Computer-Supported Intentional Learning Environment (CSILE, pronounced "SEE-sil"). Used in over a dozen schools across North America in grades 1-12, with an emphasis on grades 5 and 6, it has been shown to positively affect a variety of measures (Scardamalia 92), including performance on standardized language skills tests and comprehension of difficult text. The approach and the system are based on several principles (Scardamalia 89, 93), including :

- Deep understanding comes when students actively bring new knowledge into contact with their own preconceptions, so that contradictions surface, leading to conceptual change as they construct their revised knowledge.
- Knowledge workers must be skilled at organizing their own pursuit of understanding, and therefore students must gain experience in this arena. This involves such activities as identifying gaps and

2 CSILE and MacCSILE are registered trademarks of the Ontario Institute for Studies in Education.

3 This work has been supported by the Government of Ontario (via the Ministry of Education, the University Research Incentive Fund, and the OISE transfer grant), the Social Sciences and Humanities Research Council of Canada, Apple Computer Inc. (External Research), Apple Canada, IBM Corporation (Advanced Workstation Division), and the James S. McDonnell Foundation.

BEST COPY AVAILABLE

ERIC

confusions, stating and testing tentative hypotheses, and finding new information to resolve outstanding issues.

- The construction of knowledge usually occurs within a social context , therefore a students must learn how to build knowledge collaboratively with others.
- Learning is enhanced when the construction of knowledge is an explicit goal of school activity and not a hoped-for incidental by-product of either teacher-set tasks or student-selected activities.

In a knowledge-building classroom, the teacher is a participant in the ongoing research and a coach, helping the students become expert learners. This dramatically alters the flow of information within the classroom, moving toward the situation depicted in Figure 2.

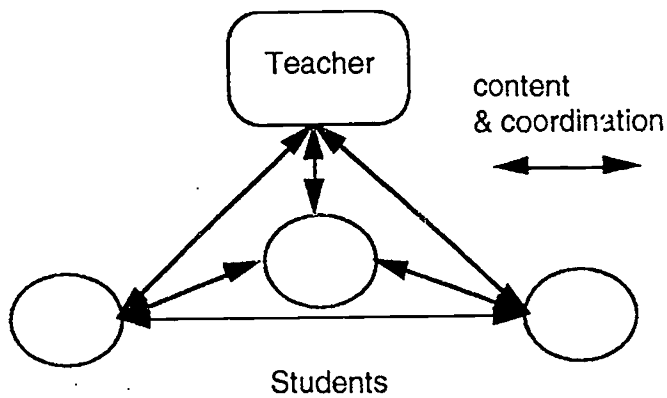

Figure 2.

In this classroom, curriculum content and information about coordination of group activities flows between all participants in the classroom. Any participant or group of participants can dramatically influence the course of classroom work if they have a contribution (idea, question, comment, etc.) that captures the attention of the class.

For a student, knowledge-building is cognitively more stimulating, but more difficult, than sitting while a teacher lectures. For a teacher accustomed to a model of teaching based on content delivery, it is cognitively harder to be a coach to a group of learners (each with their own differences in learning style) than to be responsible for a given body of content. Consequently, while the rewards of a knowledge-building classroom are many and highly motivating, it can be hard to get started. We have found that three elements are required to establish and maintain a knowledge-building classroom:

- a classroom culture which values collaboration and hard questions
- sufficient access to information resources
- an information-sharing infrastructure tailored to support knowledge-building

This paper focuses on the last of these.

An Information-Sharing Infrastructure for Knowledge-Building

The CSILE System is an example of work in Computer Support for Collaborative Learning. Other examples include Newman's EarthLab (Newman 88), diSessa's Boxer (diSessa 90), and the other systems discussed in this symposium. All systems provide a shared workspace for their users, tailored in specific ways to support particular kinds of collaborative activities.

CSILE's shared workspace allows the information flow of Figure 2 to be practical in a classroom with over 30 students. If paper had to be used instead, the flurry of Post-It™ notes and the expanse of bulletin boards needed to facilitate the

BEST COPY AVAILABLE

required communication would be overwhelming. With CSILE software and one computer[4] for each 3 or 4 students, we have found the model to be entirely manageable.

The system is designed to be as simple as possible, so that it is easy to learn and use, while still providing the necessary supports for a knowledge-building community. We provide a brief account of its core functionality here. The objects in CSILE's shared workspace are called *notes*. Currently, there are three kinds of notes: text, graphics, and discussion. Each has one or more authors, a title, and several attributes (e.g. keywords). All notes can be read by all users, but edited only according to permission rules. *Labels* can be embedded within notes and hypermedia-style *links* can be created between labels and other notes. A note may be created as a *comment* on another note. Authors are notified of comments on their notes.

Students using MacCSILE™, the version for the Apple Macintosh computer, work at computers attached via a local area network to a CSILE server which maintains the shared workspace. They create and save notes into the workspace using the familiar Macintosh File commands New and Save. As others create notes they can, within seconds, view and comment on them.

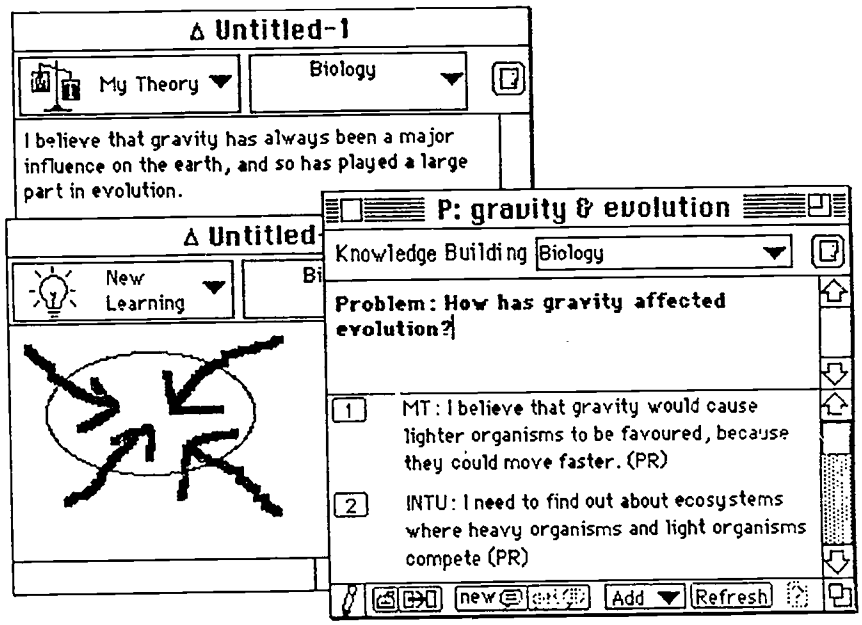

Figure 3.

Figure 3 shows, clockwise from the top, examples of a text note, a discussion note, and a graphics note. A note's header contains a "thinking type", a curriculum unit tag, and a button to access more information about the note's attributes. Below the note are buttons to create labels and links, to create and retrieve comments, and, for discussion notes, to add to the discussion.

Thinking types are a good example of CSILE's explicit support for knowledge-building. We want students to assume executive control over their learning, i.e. to make conscious decisions about what learning step to take next. An important first step is becoming aware of the role of a particular piece of work. The thinking type tags help students become aware of the nature of their contributions by encouraging them to indicate whether, e.g., they are expressing a theory of theirs (My Theory) or entering, for the benefit of themselves and others, something that they have learned (New Learning). CSILE's asynchronous nature makes such a facility possible, giving it a significant advantage over face-to-face discussions where such reflection is much harder due to the speed of the interaction.

[4] CSILE has been implemented on the Unisys ICON, under BSD UNIX™ with the X Window System, and on the Apple Macintosh computer running System 6 and System 7. The version for the Macintosh, called MacCSILE, is currently the most widely disseminated. Macintosh LC's are used as student workstations along with a Macintosh IIci or faster as a central server.

BEST COPY AVAILABLE

Thinking types are used in discussion notes (Hewitt 92) to structure the discussion. Each *entry* (marked 1 & 2 in Figure 3) has an *entry thinking type*, used to indicate the kind of contribution. Students follow an expression of their current understanding of a problem (MT - My Theory) with a statement of what they feel they need to clarify or elaborate (INTU - I Need To Understand). Other tags provide support for similar kinds of steps in pursuing an answer to a problem or an explanation of a phenomenon. Much of the CSILE research of the past two years has focused on a variety of extensions to discussion notes, to support laboratory or microworld experimentation and deeper exploration of problems.

Students can retrieve notes on the basis of attribute values, producing a note list (similar to the list view of the Macintosh Finder (Apple 91)) of note titles and information about the note (see Figure 4).

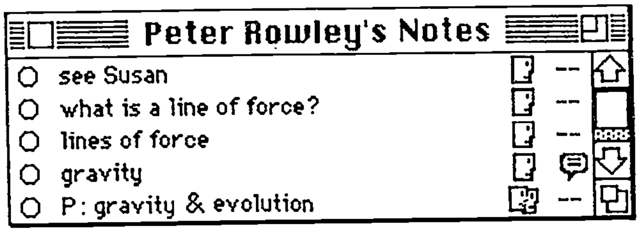

Figure 4.

Each line corresponds to a note, with a single face representing a singly-authored note, a double face representing a multiply-authored note, and a balloon representing a note that has been commented on. Double-clicking on a note title brings up the corresponding note.

For examples of student work constructed with CSILE, see (Scardamalia 92) and (Scardamalia 93).

CSILE Support For Collaboration: Beyond File Sharing

Many of CSILE's facilities will appear familiar to users of the Macintosh Finder and integrated applications such as ClarisWorks (Claris 93). Yet CSILE offers distinct advantages over use of such applications with a networked file server such as AppleShare 3.0 (Apple 92). The following sections examine those advantages and thereby illuminates how the design of CSCL software can encourage or discourage various kinds of collaborative classroom activities.

Aggregating Knowledge

The Macintosh file system, extended over a network with AppleShare 3.0, supports a hierarchical set of named folders which may be used to cluster documents (see Figure 5).

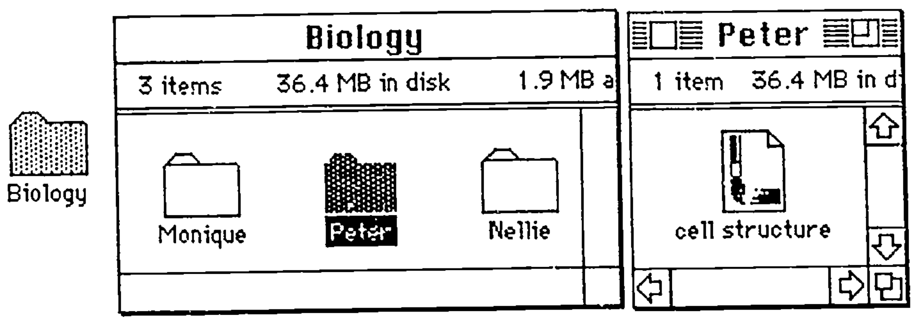

Figure 5.

Different classrooms may construct different arrangements of folders to serve their different needs. Aliases may be used to allow a single document to act as though it is in several folders.

BEST COPY AVAILABLE

In contrast, MacCSILE supports a single pool of notes, each with a number of attributes. A student retrieves a set of notes with given characteristics for a particular purpose at a particular time. Students are not bound to a static organizing structure for retrieval and the teacher does not have to expend effort setting up a particular structure and further effort maintaining it to adapt to changing classroom interests. Moreover, changing an attribute for a particular note is very straightforward (usually just a pop-up menu choice). Usage data gathered by MacCSILE shows that students use all retrieval options (e.g. author, topic, keyword, thinking type) on various occasions.

Sharing Knowledge

For each folder, Macintosh file sharing defines an owner and a registered user or group (a set of users constructed by a network administrator). Different permissions to see and use the files and folders within the folder can be set for the owner, registered user/group, and everyone else. By default, all files within a folder are private. AppleShare 3.0 administrators can set an option on a folder so that all folders created within it inherit its set of permissions.

In contrast, by default MacCSILE makes all notes viewable by others but only editable by the owner or by a list of users the owner has specified. This promotes sharing and allows the creation of transient groups to be practical, as no action by a central authority is required. Further, MacCSILE can be set so that any user may add to a discussion note or so that only listed users can add to it.

Usage data shows that MacCSILE students create transient groups often. In one class of 32 grade 5/6 students, 48 different authorship groups were created over the course of the school year. The ease with which this is done facilitates classroom collaboration considerably and allows group structures to adapt to changing social structures and patterns of shared interests.

Linking Knowledge

Using the Macintosh System 7's Publish-and-Subscribe facility, a user may construct a document which includes within it all or a portion of another document. If the second document is changed, it is straightforward to obtain a new version of the first document which reflects those changes. In this way, the first document references the second. In order to establish a linkage between a document A and a document B, the author of document B must first publish the relevant section and then the author of document A may subscribe to it.

In contrast, MacCSILE supports separation between the contents of a document and links to other documents so that all users may establish links between any two notes. The destination note of a link does not appear embedded within the source; this allows for more flexible use of screen space.

MacCSILE supports linking with and without content labels. To make a link without content labels, a user specifies the source and destination notes using a simple interface based on drawing a line between the two notes on the screen.

Linking with content labels is illustrated below. The upper note is linked to the lower note via the label [diagram].

ERIC

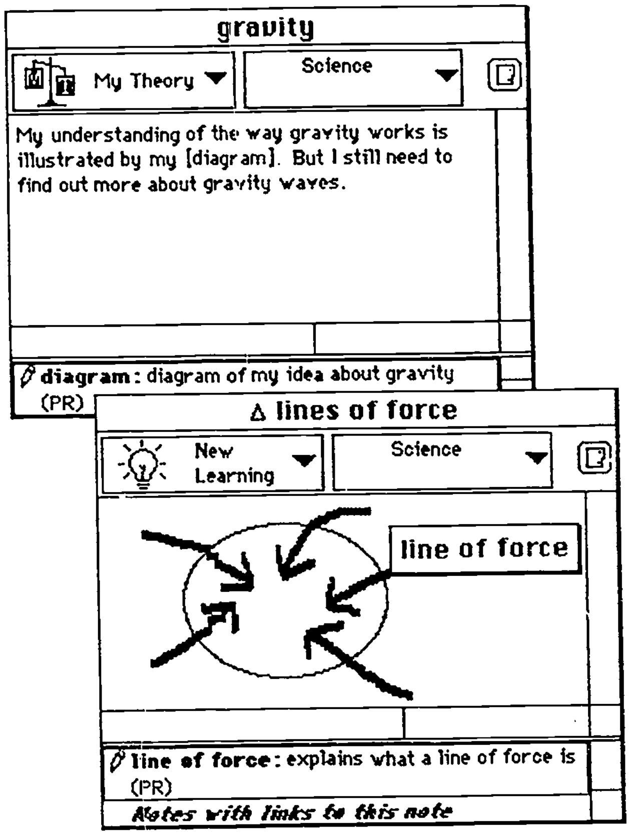

Figure 6.

Links are listed below note contents with an icon indicating whether the current user may edit the link, the link label, the reason the link was made, and the initials of the user who created the link. If there are links *to* a note, a special "Notes with links to this note" item is available to traverse the links backward.

Students have used this mechanism to depict hierarchies ranging from the structures of plants, eyes, and volcanoes (with labels on parts linked to magnified views of those parts) to task coordination for group projects. It is often used for "see also" references. Over a 5 month period, 27 students in one grade 5/6 CSILE class created 176 links. This would not have been practical with Publish-and-Subscribe.

Integrated Discussions of Knowledge

As discussed above, one of CSILE's note types is *discussion* (see Figure 3). Much like a bulletin board conference, discussion notes support a group discussion of a particular problem. However, a discussion note has important advantages relative to a typical BBS conference:

- Each entry has an entry thinking type, encouraging a contributor to reflect on how they are adding to the discussion.
- It is straightforward to create a link from a label in a discussion to supplementary material such as a graphics note that provides a visual look at a point made in the discussion -- or to another discussion.
- The entries of a discussion are juxtaposed rather than presented separately, making it much easier for a contributor to add relevant material to the discussion and for a reader to follow the discussion.
- Entries may be edited after they are added to the discussion, so that contributors may fix spelling and grammar. This increases participation since students know they can recover from mistakes.

BEST COPY AVAILABLE

Conclusion

MacCSILE offers several advantages ov . AppleShare for the support of knowledge-building communities:

- flexible mechanisms for aggregating information that do not require premature commitments to particular hierarchies
- flexible mechanisms for sharing information that support transient groups
- linking mechanisms that support examination of part/whole relationships, deal with the realities of small screens, and allow linking of any two notes by any member of the knowledge community, provided that a justification is given
- support for discussions that have significant reflective components, in terms of the overall goal of the discussion, the roles of each contribution, and the flow of the discussion over time.

We hope that CSILE and other CSCL systems like it will help to bring about changes in classrooms that will result in students being better able to enjoy the excitement of learning and be ready for a working life that will in all likelihood depend on their ability to learn rapidly and deeply and solve problems that others have not encountered before.

Acknowledgments

Thanks go to Marlene Scardamalia and Carl Bereiter, CSILE project directors, for their vision and unwaveringly high expectations of students and schools and to the rest of the CSILE Team for creativity and persistence over many years. Special thanks go to the current members of the system development team, Carol Broderick, Jim Hewitt, Aron Kwok, and Alan Rosenthal, for their good humour and excellent work and to past members of the systems development team who contributed many long hours to CSILE's success: Sheryl Brock, Earl Fogel, Robyn Kozierok, Wayne Liu, Russell Owen, Ed Semeniuk, Jim Thornton, and Tom White.

References

(Apple 91) Apple Computer Inc., *Macintosh Reference*, Cupertino, California, 1991.

(Apple 92) Apple Computer Inc., *AppleShare Server 3.0 Administrator's Guide*, Cupertino, California, 1992.

(Claris 93) Claris Corporation, *ClarisWorks User's Guide*, Santa Clara, California, 1993.

(diSessa 90) diSessa, A. A., "Social niches for future software" in M. Gardner, J. Greeno, F. Reif, A. Schoenfeld, A. diSessa, and E. Stage (Eds.), 301-322, *Toward a scientific practice of science education*, Lawrence Erlbaum Associates, Hillsdale, NJ, 1990.

(Hewitt 92) Hewitt, J. "Designs to Encourage Discourse in the OISE CSILE System", Poster presented at *1992 Human Factors in Computing Systems Conference*, Association for Computing Machinery SIG on Computer-Human Interaction, Monterey, 1992 (May).

(Marshall 92) Marshall, Ray, and Marc Tucker. *Thinking for a Living*, Basic Books, New York, NY, 1992.

(Merrill 92) Merrill, Paul F., Kathy Hammons, Marvin Tolman, Larry Christensen, Bret Vincent, and Peter Reynolds, *Computers in Education* (2nd ed.), Allyn and Bacon, Boston MA, 1992.

(Newman 88) Newman, D. "Sixth Graders and Shared Data: Designing a LAN Environment to Support Collaborative Work.", *Proceedings of 1988 Conference on Computer-Supported Collaborative Work,*, Association for Computing Machinery, Portland Oregon, 1988 (September).

(Resnick 89) Resnick, Lauren B. Introduction to *Knowing. Learning. and Instruction* (ed. by Lauren B. Resnick), Lawrence Erlbaum Associates, Hillsdale, NJ, 1989.

(Scardamalia 89) Scardamalia, M., C. Bereiter, R.S. McLean, J. Swallow, and E. Woodruff, "Computer-supported intentional learning environments", *J. Educational Computing Research*, 5 (1989), 51-68.

(Scardamalia 92) Scardamalia, M., C. Bereiter, C. Brett, P.J. Burtis, C. Calhoun and N. Smith Lea. "Educational applications of a networked communal database", *Interactive Learning Environments*, 2, 1, 1992, 45-71.

(Scardamalia 93) Scardamalia, M., and C. Bereiter, "Technologies for Knowledge-Building Discourse", *Communications of the ACM*, 36, 5 (May 1993), 37-41.

BEST COPY AVAILABLE

ERIC