

DOCUMENT RESUME

ED 334 984

IR 015 147

AUTHOR Goodrum, David A.; Knuth, Randy A.
TITLE Supporting Learning with Process Tools: Theory and Design Issues.
PUB DATE 91
NOTE 17p.; In: Proceedings of Selected Research Presentations at the Annual Convention of the Association for Educational Communications and Technology; see IR 015 132.
PUB TYPE Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; *Computer Assisted Instruction; *Computer Networks; Computer System Design; Cooperation; Epistemology; Higher Education; Hypermedia; *Instructional Design; Learning Theories
IDENTIFIERS Collaborative Learning; *Constructivist Theory; *Learning Environment

ABSTRACT

This report begins by discussing the implications of a constructivist epistemology for instructional design and development, as well as drawbacks of the content database in instruction, the lack of special tools to help the learner actively construct knowledge, and emphasis on learning environments based on individual learning. The whole learning environment is considered from a constructivist viewpoint, and the need for tools that will support the construction by learners of their own representations and understandings is recognized. The development of a networked electronic environment referred to as RoundTable as one part of the Enhanced Learning and Information Environments (ELIE) project at Indiana University (IU) is then described. Designed to test constructivist notions of process tools, the RoundTable environment attempts to support comprehension, idea generation, analysis, composition, reflection, and communication in a social environment. A first prototype of the experimental system was developed to support the process of argument analysis in a class on critical reading taught in the School of Education at IU. The original networked version included only comprehension, idea generation, and analysis tools. Comments from the students after working with the system for four days and observation of their use of the tools indicated that most of the problems experienced had to do with the physical operation of the computer rather than the use of the tools to support the group task. It is concluded that RoundTable provided powerful conceptual tools for students to utilize actively in an electronically supported collaborative setting. Development of the system is continuing, working with other courses and settings. Comments from student evaluations of RoundTable and sample screens are appended. (24 references) (BBM)

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

ED 334 984

Title:

**Supporting Learning with Process Tools: Theory and Design
Issues**

Authors:

**David A. Goodrum
Randy A. Knuth**

IR 015149

BEST COPY AVAILABLE

PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Michael R. Simonson

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

Introduction

We have been working to develop our understanding, in terms of instructional design and development, of the implications of a constructivist epistemology (Brown, 1989). From this perspective, learning is seen as a *constructive* rather than *accumulating* process. That is, people actively construct knowledge and understanding through their individual and social experience in, and interaction with, the world (Streibel, 1986). According to Resnick (1985, p. 2570), "These constructions respond to information and stimuli in the environment, but they do not copy or mirror them." Every concept that we learn derives its meaning through its relationship to the context in which it is intimately embedded and from the tasks in which it is used. Brown and his colleagues have referred to this notion as situated cognition (Brown, Collins, & Duguid, 1989).

We believe that the design of learning environments that afford opportunities to experience concepts embedded in authentic contexts and authentic tasks must embody two characteristics: 1) a rich database representing both core content and its related context; and 2) support for cognitive processes, both individual and social. These components have historically been supported through a strategy of human contact and more recently through computer technologies.

The Tension Between Content and Process

We have seen, however, a lopsided investment of technological energy and instructional focus into one of these components: the content database. The major area of effort has been in the delivery of a specific core and contextual database along with practice strategies aimed at student retention and understanding of the database. Computers and other teaching machines have seemed to offer an efficient and consistent method to deliver sequenced material with a navigation strategy of branching and co-requisite learning activities such as tutorials, simulation, and drill and practice. Most recently, hypertext and hypermedia seem to offer the designer's dream in putting at the learner's disposal unheard of amounts of potential source material along with a navigational strategy of browsing and, when that fails, guided tours.

The focus on the content database has occurred, we believe, because of a belief about the nature of learning which is often contrasted with constructivism. Instructional designers have traditionally focused on creating learning environments intended to transmit a set of information to the learner, for example through appropriate displays and sequences (Merrill, 1983) which promote *individual* learning. New technologies, for example hypermedia environments, have, by and large, been based on this same view of learning. Hypermedia is thought to provide learners with the ability to *browse* through information spaces, acquiring information and knowledge as a result of their journey (Byers, 1987). The learner's goal is to *find the particular information* that he or she is to know. The design of hypermedia systems has centered on the creation of large navigable databases.

Unless special tools are made available to help the learner actively construct knowledge, hypermedia databases might actually encourage the learner to be a passive receiver of information. Passive browsing of an information space (i.e., text) results in superficial learning (Brown, 1981). Additionally, typical hypermedia systems provide little or no feedback (Hammond, 1989) — a critical component to the traditional approach to instruction. In contrast, good readers are active readers who utilize a variety of strategies or processes for managing their understanding of the material (Garner, 1987). For example, they take notes, highlight important passages, make outlines, mark text to be reread, paraphrase summaries, and so on. Processes shown to promote even higher levels of understanding include designing a presentation, writing a synthesis paper, keeping a journal, and using a critical analysis strategy to analyze the material. An important relationship exists between the artifacts

created from doing authentic tasks in authentic contexts and the learner's constructed knowledge.

The development of learning environments based on the individual learning and information transmitting paradigm also does little justice to take advantage of the social nature of learning. We have come to value the notion that not only is learning a constructive process but also that meaning is negotiated through collaboration with others. Each of the processes listed in the preceding paragraphs is enhanced through collaboration. In Vygotsky's view (1978), an individual is limited in the problems that can be solved and the tasks that can be completed on one's own. Help from others can provide a way for going beyond one's current level of competence and working on problems in one's *zone of proximal development* (ZPD). An expert, for example, can include an individual learner's attempts in accomplishing a task and provide feedback. In this way, the individual can perceive the appropriateness of the attempts and can come to see the task as the more expert person sees it. It is this social interaction with the expertise of others that assists the individual in actively constructing an understanding of the problem domain (Newman, 1990).

It is our assumption, therefore, that the path from novice to expert is accomplished by an active engagement with the important concepts *in concert with others*. As is commonly believed, a good way to come to understand a concept fully is to teach it to someone else. Part of this is the preparation a teacher or tutor goes through with content materials. Teachers report having learned more about both the content and the abilities of their learners through social interaction with their students (Cobb, & Steffe, 1983). Clearly, learning for both novice and expert, requires substantially more than simply 'seeing' the concepts. Unfortunately, the common technique of having individuals browse through a hypermedia database encourages the learner to stay at the novice level.

Process Tools

What constructivist ideas make evident is that we have paid too little attention to the cognitive and social processes that are an equally inherent and important part of learning. We have, therefore, shifted our focus to the identification of learning processes and to building tools — that is, *process tools* — designed to support these processes. We don't dispute the value of employing database technology in the educational setting. What we object to is the lack of attention given to the development of process tools and their integration with content databases.

We anticipate that process tools will also have an advantage over traditional approaches to instruction in the area of motivation: people inherently value that which they themselves construct. Learners commonly evaluate didactic instruction based on what they received, or less tactfully, on what it did to them. Our contention is that this reaction is encouraged by the passive nature of the instructional presentation. Similarly, in many extant educational applications of hypermedia systems, people are encouraged to browse through information, sometimes with explicit goals, sometimes without them (Hammond, 1989). They then leave the experience with no product — perhaps a few memories, perchance some incidental learning — and often just a score on an exam. Process tools, on the other hand, are designed for use by learners to collaboratively construct a product of which they have intimate ownership.

Computer Supported Work

We have found interesting research and development in the area of process tools, although they are generally not referred to as such. However, this research and development is occurring in disciplines from which either educators or instructional developer's seldom draw. Designers in the areas of group decision support systems (GDSS) (e.g., DeSanctis & Gallupe, 1987) and computer supported cooperative work (CSCW) (e.g., Greif, 1988) have developed

exciting electronic tools to support group processes, usually for business, research, or military operations. In fact, we have borrowed ideas from this work for our project. Borrowed ideas, however, are useful only in their ability to transfer from one domain to another. Some portions of the analogy will inevitably fall short. We have found that GDSS and CSCW analogies map very well to our domain at the level of systems design and even group interaction technology. Where it does not seem to apply in an educational domain is in its focus and purpose. The systems developed by these fields are primarily intended to help people in business and research situations accomplish tasks. In the fields of education and instructional technology the primary focus, in light of a constructivist epistemology, is to help people *learn* how to accomplish tasks.

A subtle but important difference exists between the intended purposes of tools in work and learning settings. It is necessary for both workers and students to be involved in authentic tasks. Process tools need to make more efficient and explicit the learning and social processes so that students do not have to flounder in trial and error. Process tools for business, on the other hand, need to help workers get the job done more efficiently regardless of how much learning occurs. This is the dilemma that instructional designer's faces when trying to create or find authentic tasks: Taking the tenets of situatedness to their logical conclusion would be to simply send students to work. But, since the primary purpose of work is to get the job done, businesses attempt first to employ people who *already know how* - who, in a sense, are experts - to accomplish the task. Learning that naturally occurs as a result of doing the task becomes secondary to getting the task done. Thus, sending students to work does not work for the business and does not work for the student: schooling needs to make the learning processes explicit, that is encourage learners to be reflexive about their learning (Cunningham, 1987), whereas business can afford less tolerance for learning at the expense of getting the job done.

In other words, the crux about what "business" is about is not learning but in accomplishing (doing) tasks as the *primary* activity. Furthermore, groups are brought together because *physical proximity* is the strategy (i.e., *technology*) that gets things done (Kraut, 1989). In contrast, education is about *learning to do* a task, about making people better thinkers. In education, *learning* is the primary activity. Constructivist theory explicitly suggests that the *strategy*, or, again the *technology*, that best accomplishes this is having learners *experience the doing of a real task*. Another central component is to have people learn *together* under the guidance of an *expert*; but not because that's the best way to succeed in accomplishing the task -- it's because it's the best way for people to learn! Certainly, as Resnick (1987) suggests, these are two sides of the same coin -- the coin of work.

People who are learning to do something are not efficient enough to "get the job done" in time for competitive markets. People who are working, who do not have "learning support" at their fingertips, cannot learn fast enough to do the task better until, perhaps, the next time around. And people in earlier stages of physical and/or intellectual development are not up to the demanding environments of adult work.

In our view, the most advantageous aspect of fields like GDSS and CSCW is that they are concerned with supporting people, especially groups, in accomplishing tasks. The most serious deficiencies are that they are not concerned with individual or group learning, with the stages of individual development, or with promoting reflexivity about learning as their primary mission. For this reason, although the process tools of decision support and education will be similar to a degree, they are necessarily different in some respects.

Design Implications for Process Tools

To create situated environments, that is, environments which afford opportunities to engage in authentic tasks, we need to provide the same components provided in the work world. We have found a useful framework for understanding the dimensions of work, i.e., authentic tasks. Moran & Anderson (1990) describe the three aspects of what they call the *workaday world* which they present as a CSCW design paradigm. The three components are 1) technology

(e.g., tools for communication, computation, composition, analysis, presentation, and so on), 2) sociality (e.g., opportunities to form social relationships both formal and informal), and 3) work practice (e.g., the knowledge, skills and routines for accomplishing specific tasks). The processes of the three are not distinct, there is a dialectic between them, and they cannot be entirely separated from each other. Thus we need to deal with constructing and studying whole environments, not just the technology we inject into them. Furthermore, the technology, i.e. tools, is there to support and "enhance, sustain, facilitate, encourage, etc., people in their work as well as be a resource for creative deployment." (Moran & Anderson, 1990, p. 387).

Tools that we create or provide must support the work practices and the sociality of the environment in authentic ways. For example, tools must provide access to source information (not just textbooks -- they don't provide the complexity or depth required) and artifacts. In order to facilitate their learning, learners must be involved actively by employing specific tools which support their analysis, personal construction and reconstruction (i.e. synthesis) of the information and artifacts (Scardamalia & Bereiter, 1985).

In studying hypertext systems, we initially saw three implications for design. First, the learner must have the ability to extract from (e.g., copy, highlight) and link to (e.g., bookmark) a content database. Second, the learner must have the ability to filter, re-word, and paraphrase from an existing database, in effect reconstructing their own version of the content domain. Third, the learner must be able to build a personal or community database in reaction to given information (e.g., commentary and critique) or from scratch (e.g., generating and explicating self-generated ideas) (Duffy & Knuth, 1990).

When considering the whole learning environment from the constructivist viewpoint we recognized the need to develop tools to support explicitly the construction by learners of their own representations and understandings. We must also build tools and strategies into the learning environment to provide authentic relationships between peers whereby they can readily communicate with each other and tap the relevant individual skills, experiences and perspectives of others in their workgroup. Similarly, our environments must support an authentic relationship between learners and experts. Thus learners must be supported in communicative and dialectical tasks with other learners and with experts as well as with the content and artifacts.

An Instantiation of Process Tools

As one part of the Enhanced Learning and Information Environments (ELIE) project (a joint research and development project of Indiana University, AT&T University of Sales Excellence, and AT&T Bell Laboratories) we have rapid-prototyped (e.g., Trip & Bicheimeyer, 1990), using HyperCard™ and Spinnaker Plus™, a networked electronic environment referred to as *RoundTable* to test our notions of process tools. In its current state of development, the *RoundTable* environment attempts to support the following processes in a social environment: comprehension, idea generation, analysis, composition, reflection, and communication.

Comprehension

To facilitate comprehension of the database we provide functions included in typical hypertext applications: note-taking, bookmarking, extraction (copying and pasting), searching, indexing, and dynamic linking. In addition, it is possible for individuals to share with others the bookmarks and links that they make.

Idea Generation

To facilitate the generation of ideas for topic-focused discussion we have developed a group brainstorming tool in which the discussion becomes part of a community database. The

discussants establish new or use existing topics and sub-topics, articulate ideas and share them with the group, and react by commenting on other peoples' contributions.

Analysis

To facilitate the analysis of ideas for topic-focused discussion we have developed an analyzer tool in which the analysis becomes part of a community database. The participants establish new or use existing topics and sub-topics, articulate positions, classify positions according to a teacher-chosen logic or classification structure, share with the group, and react by commenting on other peoples' contributions.

Composition

To facilitate the construction of reports, presentations, etc., we have developed individual and group paper-writing tools where writers can create working drafts, "publish" versions to receive reactions, and then view those reactions.

Reflection

To help learners develop an awareness of their cognitive processes and development we have provided an electronic journal tool in which they are encouraged to reflect on class topics, tasks, learning strategies, group strategies, teaching strategies, and so on, as well as on the electronic environment. This journal is a private space that may be shared with the instructor.

Communication

To facilitate the self-management and coordination of group activities as well as provide the means for informal, social communication, we have provided messaging tools in which individuals can send electronic mail to other individuals including the instructor, to their work-groups, or to the entire class.

Though many of these types of tools are available commercially, we have felt it necessary to build each of them because of the need for 1) a consistent and appropriate user interface; 2) integration of information across tools; and 3) the tools to work in a unified, collaborative environment.

Case Study: Supporting Argument Analysis with RoundTable

Our first efforts in rapid-prototyping *RoundTable* involved supporting the process of argument analysis in a class "Critical Reading in the Content Areas" taught at Indiana University in the School of Education by Sharon Pugh (1990). An initial networked version of *RoundTable* was quickly developed that at the time included only comprehension, idea generation, and analysis tools. *RoundTable* was used by students synchronously (i.e., all students used *RoundTable* at the same time) to share their ideas from multiple perspectives. The students went to a computer cluster and were divided into small groups, consisting of three to four students in a group. The individuals each had their own computers and small-group members did not necessarily sit near one another. The task that we attempted to support was the analysis of case study materials portraying different viewpoint towards grading in a high school situation.

Students first started the Macintosh computer, copied the software from the server to their workstations, started the program, entered their name, selected their group, and entered an individual one-letter code (see *Illustration 1a*).

After reading through the case on-line (students were instructed to be familiar with the case materials before coming to class) and bookmarking critical passages in the text, the students used a brainstorming tool (see *Illustration 2a*) to exchange personal opinions on the case situation and characters. The brainstorm tool allowed students to react to the issues in the case as they identified them and potentially to project themselves into a similar situation as beginning teachers.

Second, an argument analysis tool (see *Illustration 3a*) provided a three part structure consisting of premises, conclusions, and evidence with which to classify the positions taken by the characters in the case. It was the instructor's perception that the argument analysis tool changed the nature of the discussion, allowing the students to focus more clearly on the task of constructing perspectives rather than interpreting issues, which appeared in the brainstorming function (Pugh, 1990).

The class used *RoundTable* for approximately one hour per day. The first day was taken up mostly by orienting the students to the Macintosh interface (most of the students had little or no prior experience with computers in general and none with the Macintosh) and having them explore and mark the case materials on-line. The students were quite verbal with questions concerning such issues as moving the mouse, clicking and double-clicking, and highlighting text.

On the second and third days the students were oriented more to the task and had substantially fewer questions and problems. They were asked at the end of class to write on a sheet of paper the best and the worst experience for each day. Students' best comments included: "I really enjoyed being able to immediately comment on the other group members' writing", "I like the way it works that we don't have to type the commands by ourselves but we just choose instead", "For the first time computers were fun, not frustrating. It easier sometimes to communicate on computer rather than verbally", "I'm not sure yet", "I actually remembered how to do a few commands. This gives me a slight feeling of power over my computer", "I got into the system - almost - on my own. I'm starting to understand what I am doing", "It was often easier to generate my own ideas when I was able to readily see my classmates' responses. Working with this type of computer system is efficient and fun", and "I was able to take the problem into my own hands and develop and think of my own problem-solving for the situation. It makes me feel as if my opinion is the most important."

Students' worst comments included: "When working a computer system for the first time its always confusing and frustrating. It is so easy to get behind when following instructions", "I'm unsure if I would feel comfortable using this system without assistance", "[The worst was] the mouse, but I'm getting better", "At this point I would prefer small group discussion", "I didn't have a worst thing, my failures were yesterday", "There is not a way to comment on a comment", "I still can't do it all myself. I'm afraid when this week is over I'll be lost again.", and "There are so many little things to remember (when to single or double-click, when to hit the escape or quit to get out of something, when putting something in the trash ejects or erases)."

The comments from the students as well as from our observing them use the tools indicated to us that 1) because of their novice level we needed to, if possible, insulate them from the Macintosh file system interface; 2) we needed to greatly automate the startup and login steps involved in gaining access to the tool; 3) from the very start, training on the tools should focus on actual and not practice tasks; and 4) care must be taken in design to indicate to the user through appropriate interface cues which actions are currently appropriate and those which are not. In general, the majority of the problems that people experienced were more concerned with the physical operation of the computer rather than the use of the tools to support the group task.

Dr. Pugh had regularly taught this critical reading technique to her class prior to our development of *RoundTable*. Our hope was to use technology to augment and extend this process. We were also curious about the effect of computer-mediated discussion on the social aspect. Research in GDSS had suggested that there are distinct differences in the exchange activities of computer-mediated and face-to-face groups (DeSanctis & Gallupe, 1987).

By the fourth day, the students were able to work independently. They directed most of the problems that they did have to other students and not to us, or used the brief "cheat sheets" that we had developed during the course of the week based on student's questions. The students, at the end of four days of using the *RoundTable* synchronously, were asked to comment - using the brainstorming tool - on their general impressions of using the environment. The full text of these evaluations can be found in the appendix. Below is an excerpt from these evaluations which we feel points to the potential benefits of using computer technologies to support mediated collaboration in the accomplishment of tasks:

[...] It has definitely made me think more critically because sometimes when talking in small groups, it is hard to get your opinion stated either because someone else may say what you wanted to say or your thoughts just get stirred up in your head and you cannot verbally say what you are thinking. It is much easier to write down my thoughts because I can type as I think. I don't have to wait my turn to talk. It is so beneficial to see everyone else's opinions on the subject. It helps to have it right there in front of you because I can always go back and refer to someone else's statement as well as my own [...]

It was not possible to utilize *RoundTable* for the entire course or outside of synchronous group sessions because of the limited amount of Macintosh computers available on campus and networking obstacles that proved frustrating for both students and developers. We believe *RoundTable* provided powerful conceptual tools for students to utilize actively in an electronically supported collaborative setting. However, *RoundTable* is still in an experimental stage because of the limited networking capability on campus. In our view the instructor and students should be able to access *RoundTable* from any place on campus as well as from home, providing a powerful tool for collaborative learning. We are continuing development along these lines, working with other courses and settings at Indiana University.

Conclusions and Future Directions

It has been suggested that effective instructional design is possible only when the developers start from a theoretical basis for learning (Bednar, et al., 1991). It was from our experience in attempting to support a specific process with technology that we have become aware of the possibilities of designing learning environments *from a constructivist epistemology*. Our experiences have emphasized for us that collaboration is not a strategy but a fundamental component of both learning and work. We are finding that capturing and evaluating the processes that these tools support is difficult and are working to develop appropriate frameworks and metrics to inform our iterative design process as well as suggesting other classes of process tools. We are interested in a variety of data, including the emerging patterns of activity by tool users as well as the quality of their constructed products, the efficiency and effectiveness of the interface design, and the affective reactions of users towards both the tools and the processes.

We realize that we need additional experience in attempting to support other types of processes if we are to envision what a full system would entail. The attempt to support argument analysis was our first attempt of constructing a *RoundTable* environment. The interaction with the students during the four days described above, as well as additional sessions with other groups of students, has led to successive iterations of and extensions to the original tools (see *Illustrations 1b, 2b, and 3b* for representations of the current interface), as well as the development of additional tools to support critical writing by a group. We believe

that the best approach to defining the attributes of authentic environments for a range of authentic tasks is by observing students in their attempts to use tools in the completion of tasks and to change the tools based on student criticisms, requests, and needs.

What is clear to us is that starting from the basis of constructivist epistemology leads to radically different approaches to the design of learning environments and the need to glean from other fields directions for conceptualizing, designing, and making sense of processes of work and learning.

References

- Bednar, A. K., Cunningham, D., Duffy, T. M., Perry, J. D. (1991). Theory into practice: How do we link. In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future*. Englewood, CO: Libraries Unlimited.
- Brown, A. L. (1981). Metacognition: The development of selective attention strategies for learning from texts. In M. L. Kamil (Ed.), *Directions in reading: Research and instruction*. Washington, DC: National Reading Conference.
- Brown, J. S. (1989). Toward a new epistemology for learning. In C. Frasson & J. Gauthier (Eds.), *Intelligent tutoring systems at the crossroad of AI and education*. Norwood, NJ: Ablex.
- Brown, J. S., Collins, A. and Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18, 32-42.
- Byers, T. J. (1987, April). Built by Association. *PC World*, 245-251.
- Cobb, P., & Steffe, L. P., (1983). The constructivist researcher as teacher and model builder. *Journal for Research in Mathematics Education*, 14(2), 83-94.
- Cunningham, D. (1987). Outline of an educational semiotic. *The American Journal of Semiotics*, 5, 201-216.
- DeSanctis, G., & Gallupe, R. B. (1987). A foundation for the study of group decision support systems. *Management Science*, 33(5), 589-609.
- Duffy, T. M. & Knuth, R. A. (1990). Hypermedia and instruction: Where's the match? In D. Jonassen (Ed.), *Designing Hypermedia for Learning*. NY: Springer-Verlag.
- Garner, R. (1987). *Metacognition and reading comprehension*. Norwood, NJ: Ablex Publishing Corporation, 105-126.
- Greif, I. (Ed.) (1988). *Computer-supported collaborative work*. Los Altos, CA: Morgan Kaufman.
- Hammond, N. (1989). Hypermedia and learning: who guides whom? *ICCAL Proceedings '89*. 167-181.
- Kraut, R. E. (1989). Telecommuting: The trade-offs of home work. *Journal of Communication*, 39(3), Summer 1989, 19-47.
- Locatis, C., Letourneau, G., & Banvard, R. (1989). Hypermedia and instruction. *Educational Technology Research and Development*, 37 (4), 65-77.

- Marchionini, G. (1988, November). Hypermedia and learning: Freedom and chaos. *Educational Technology*, 8-12.
- Merrill, M. D. (1983). Component Display Theory. In C. M. Reigeluth (ed.), *Instructional-Design Theories and Models: An Overview of their Current Status*. Hillsdale, NJ: Erlbaum.
- Moran, T. P., & Anderson, R. J. (1990). The workaday world as a paradigm for CSCW design. *Proceedings of the Conference on Computer-Supported Cooperative Work*, October, 1990. Los Angeles, CA.
- Newman, D. (1990). Opportunities for research on the organizational impact of school computers. *Educational Researcher*, 19(3), 8-13.
- Pugh, S. (1990). Examining student change in a teacher education course using dialectical reasoning as a strategy for critical reading. Paper presented at the National Reading Conference, Miami, FL.
- Resnick, L. B. (1987). Learning in school and out. *Educational Researcher*, 16(9), 13-20.
- Resnick, L. B. (1985). Instructional psychology. In T. Husen, & T. N. Postelthwaite (Eds.), *The international encyclopedia of education*, 2569-2581.
- Scardamalia, M., & Bereiter, C. (1985). Fostering the development of self-regulation in children's knowledge processing. In S. F. Chipman, J. W. Segal, & R. Glaser (Eds.), *Thinking and learning skills: Research and open questions*. Hillsdale, NJ: Erlbaum.
- Streibel, M. J. (1986). A critical analysis of the use of computers in education. *ECTJ*, 34(3), 137-161.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Appendix: Student Evaluations of RoundTable

The tool has been helpful to see many perspectives on a case. I really benefitted from seeing my classmates comments. I like this tool although it was a little tough at first. It can be helpful and would be ok to use for the semester to see others comments. Once you learn the commands it becomes much easier and not really discouraging. I enjoyed this experience and am glad I had this opportunity. The tool is great. RT is better than EC!!!!!!!¹ This was a very beneficial learning experience. I wish that we had more time to work with the program. I think that it would be great if future X401 students could use this to analyze cases.

Once I got the hang of working the system, it was really easy to generate ideas concerning the case. The system enabled me to quickly jot down my own opinions and then I was able to look at the opinions contributed by other members in my group. Additionally, when I was stuck on a particular topic, for example Frank's warrants, I could simply go to another topic and work on that one until I had come up with some ideas for the previous topic.

This program is great. It has definitely made me think more critically because sometimes when talking in small groups, it is hard to get your opinion stated either because someone else may say what you wanted to say or your thoughts just get stirred up in your head and you cannot verbally say what you are thinking. It is much easier to write down my thoughts because I can type as I think. I don't have to wait my turn to talk. It is so beneficial to see everyone else's opinions on the subject. It helps to have it right there in front of you because I can always go back and refer to someone else's statement as well as my own. All in all, this was a valuable experience. For the first time the computer was fun and I looked forward to coming each day.

I am so glad that I have been able to use this program and feel very satisfied with the fact that I have learned to use the whole program in four days. Except for the kinks, everything is wonderful. When can we use this in our classrooms? How can I make further use of this program and how do you program in your own lessons? Is this an experimental program? Round Table would be excellent to use in classrooms and allows critical thinking and commenting with out limiting it to discussion times within the classroom. Every student can comment on a topic and interact with their peers in quality time span. Great! Thanks for the help and patience. Better than EC.

I think that the RT is a good tool to use and to develop critical thinking skills. Reading people's perspectives can increase your own. I have read many perspectives that I never would have thought of. The CHEAT SHEET is a tremendous help. After spending the week in this lab, I think my skills for these MACS are increasing (still a long way to go). Comparing the RT to the EC, the RT is better because the thoughts are organized and you don't have to go through everybody's thought to get to the one you want to comment about. The RT seems better structured. It seems that with the RT, there is more to comment about. I am not sure if it because it is divided up or what!

I see how this type of activity can be useful if, for no other reason, it is different and, therefore, interesting. It could break the monotony of the normal classroom. I like the opportunity to be able to share ideas all at once without having to interrupt one another. The argument analyzer has been positive in that it has really encouraged dialectical thinking. We've had to take each person in the "Making the Grade" and look at the same situation from their varied perspectives. The most positive thing to me has been another opportunity to get my hands on a computer and grow to be more comfortable in using it. Thanks!

[The] cheat sheet would have been more helpful on first or second day rather than last. I like the argument analyzer, the set up helps organize your thoughts and shows your argument clearly and that of others in your group. I would have liked to see opinions of other group their perspective is different.

¹ Electronic Classroom -- a menu-driven, character-based topic oriented discussion tool on the VAX computer.

I think this was probably a good experience even though I don't like to use computers. I found the Round Table program interesting. I think that you underestimate the amount of work that could be done in an hour. I found myself getting bored because I was finished with what we were supposed to be doing. I also felt lost most of the time as to what was to be completed. I think the class could be more productive if we are told specifically what needs to be done or what we can work on. Sometimes I wanted to just write, like a journal entry, but I wasn't sure if I was allowed to do that, and I didn't know where to do that. I think this program would be good to use in an English class that I want to teach on ethics. I think it would help students to open up and feel free to write down what they wanted without feeling that they would be criticized. I also like the idea that the students would be able to write back and forth with comments.

give me a week. I'd love to learn this system. I like the fact that it can hook up to its resources at almost any given moment, like the link hook up. I need to learn how to shuffle the cards better. And the filing is a little hard to understand at times, but I suspect that the reason is because I Am not familiar with all of the language yet.

I think the cheat sheet was very helpful.

I really liked using this system. I like the graphics. The best part about this program was that we were able to view the ideas of everyone in our group and then comment on them. Reading other reactions helped to form my own thoughts. Thanks for teaching us how to use this program. I didn't like not being able edit comments that I've entered. I also wish that I could've seen student opinions other than those in my group. There were only 3 of us, so we had a limited number of statements.

There have been times that I wanted one of my group members to read a response that I made to one of their comments. But there was no way to call their attention to it. I just had to hope that they would eventually update in that particular window. (Or I could walk over to them and call their attention to it). Overall, this has been an interesting way to interact with class members. I would not mind using it once in awhile, but my preferred method would be face to face. The more I use it the more comfortable I will become and may wish to use it more.

In my opinion, this computer program is very useful. It helps a lot in making doing the assignments easier and more convenient. Although it may seem to be quite complicated at first, it is not too difficult once we get used to it. All the commands are also not too difficult to remember. I like the idea that we can work together with other people in the same group. For example, we have a chance to exchange our ideas and opinion. Once again, it is really useful and I like it.

Illustrations

On the following pages are sample screens of tools in *RoundTable* at two distinct points in time. The first of each set is the original version used with Sharon Pugh's class. The second of each represents the same tool at the current time.

One of the guidelines we used for the first iteration was that the capabilities of the tool should be explicitly available to the user. Thus, buttons were provided for the major functions of the tool. Based on reactions of students who used the tool over a period of four days, we felt that this approach basically worked, but that the screen caused some confusion because it was unclear which button was the *appropriate* one at any given point in time. In the current design, buttons are not displayed on the screen unless they are part of the current action. For example, the "Add" button is only displayed when the person is in the process of writing a statement and then clicking the button signals that the person is finished and wishes to share the statement with the group. The "Comment" button is only displayed while the person is making a comment on a specific statement. The major functions are still made visibly available to the user through the pull down menus at the top. When a person pulls down a menu, only the appropriate choices for the current task are displayed in bold type; the others are shaded grey.

The most significant addition as a result of *RoundTable's* use in Sharon Pugh's class, was the addition of mail, initially at the group level. Since the sessions were synchronous, and their discussion was updated almost continuously, it had not occurred to us that they would have trouble communicating with each other. But there was a specific expressed need for a way to coordinate group direction.

Illustration 1a: Original startup screen

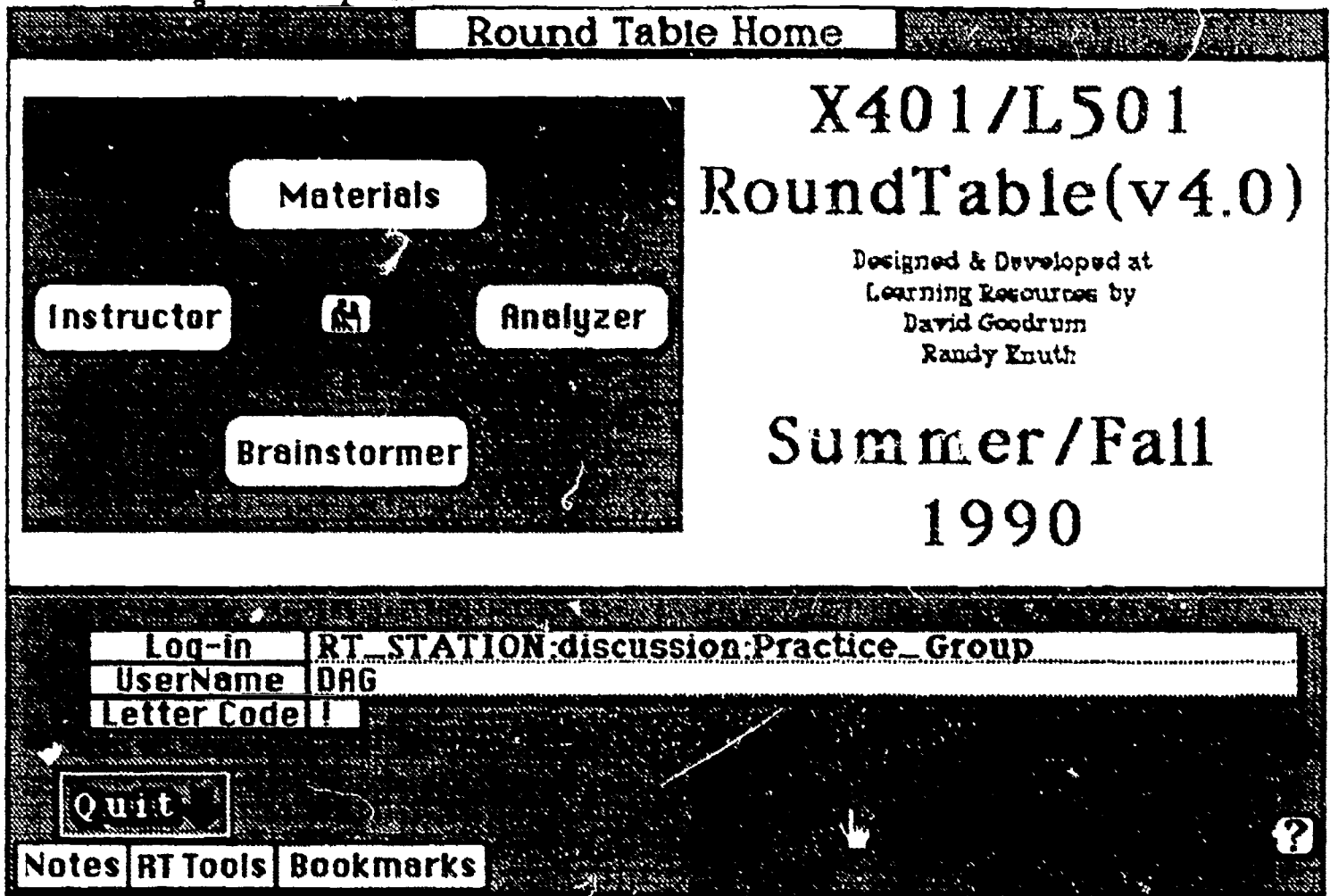


Illustration 1b: Current startup screen

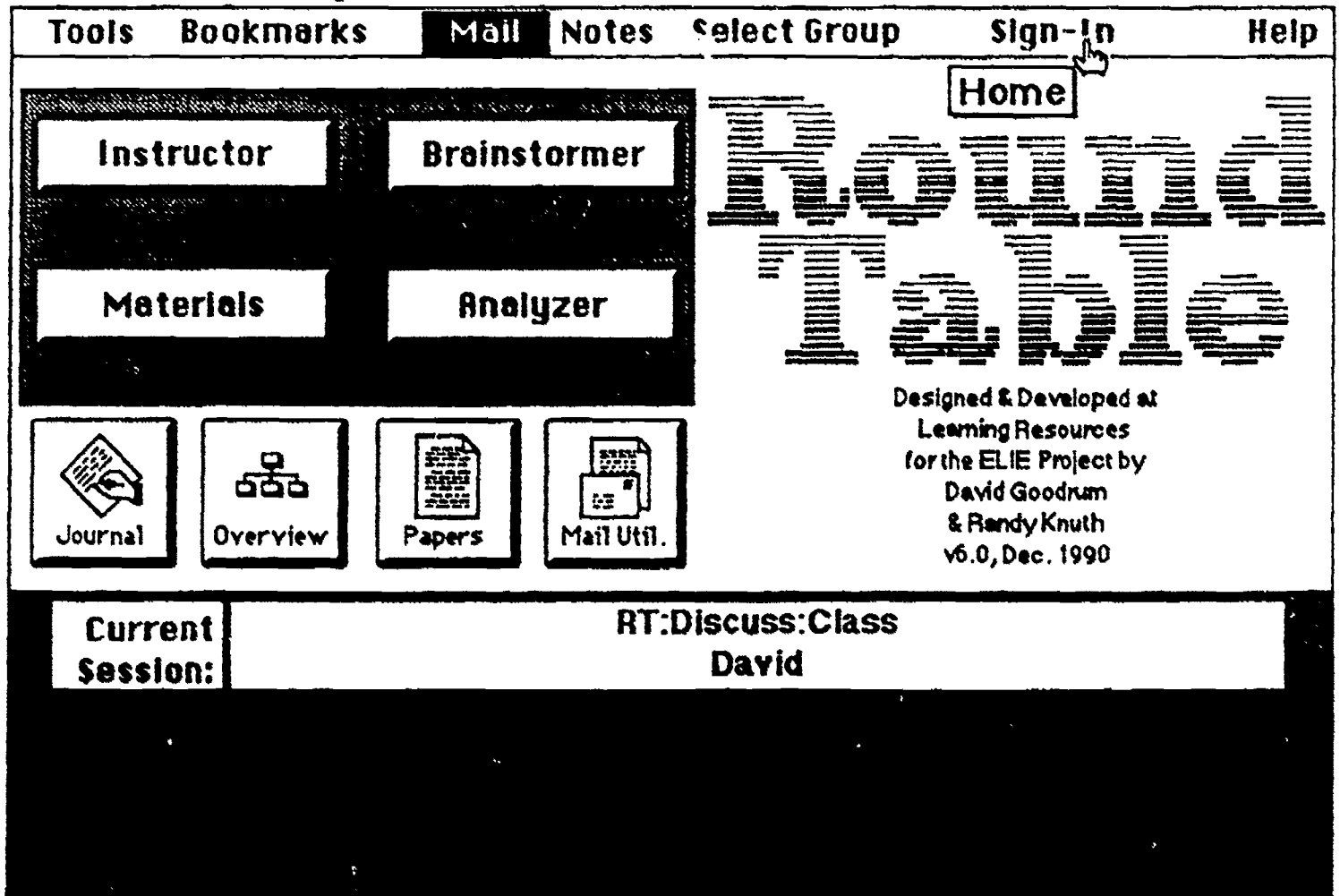


Illustration 2a: Original Brainstormer screen (student names are blanked out)

G The Case
Round Table Work Area Command Menu

(G S01) I bet grading will be a problem. You can tell from the start that she is wishy washy. She should have had a set grading scale at the beginning. (Not, "Oh, I guess tests will count more, . . .?) I guess her problem is that she has to please everyone. That is hard.[-----]

(G S02) I think that this case showed that there was not a set rule at this school in regards to a set method of grading. This was the main problem because it led to the confusion of Jan, the students, and the other teachers.[-----]
COMMENT: I agree with this. Do you think everyone should be required to one set scale?<----->

(G S03) When I first began reading this case I thought of a conversation I'd had with a fellow education student here. We were talking about grading and I said that I would never use a curve in my grading system. He said he was glad he never had me as a teacher. I told him that it was his loss because my students will earn their grades even if that happens to be all A's.[-----]
COMMENT: If everyone in your class had only

Update

My thoughts on the case are...|

Topics	L	Add
Bookmark	i	
RT Tools	n	
Notes	k	

Comment

Illustration 2b: Current Brainstormer screen (writing a comment)

Tools Topics Bookmarks Mail
Notes Links Work Area Class Help

(G S01) I bet grading will be a problem. You can tell from the start that she is wishy washy. She should have had a set grading scale at the beginning. (Not, "Oh, I guess tests will count more, . . .?) I guess her problem is that she has to please everyone. That is hard.[-----]

(G S02) I think that this case showed that there was not a set rule at this school in regards to a set method of grading. This was the main problem because it led to the confusion of Jan, the students, and the other teachers.[-----]
COMMENT: I agree with this. Do you think everyone should be required to one set scale?<----->

(G S03) When I first began reading this case I thought of a conversation I'd had with a fellow education student here. We were talking about grading and I said that I would never use a curve in my grading system. He said he was glad he never had me as a teacher. I told him that it was his loss because my students will earn their grades even if that happens to be all A's.[-----]
COMMENT: If everyone in your class had only

Update

A Review Criteria

Round Table Work Area

My thoughts on the case are...|

COMMENT ON: (A S02)

Comment

Cancel

Illustration 8a: Original Analyzer screen (student names have been blanked out)

A Jan		Round Table Work Area	Command Menu									
P r e m i s e s	(A P01) Jan believes that a curved grading scale means there have to be winners and losers and that there shouldn't have to be losers. [-----]											
	(A P02) Jan thinks that there should be a grading system that is not too hard or too easy. She wants to motivate her students, yet keep											
E v i d e n c e	(A E01) Jan has the students grade themselves and then negotiate their grade with her at the end of the grading period. As a result, they seemed to be learning better because of the relaxed atmosphere of the classroom. [-----]											
	(A E02) She made the topic interesting and motivated them by letting them know they could											
C o n c l u s i o n s	(A C01) She doesn't want to use a curved grading scale but a different one that allows everyone to be "winners" if they earn it. [-----]											
	(A C02) She doesn't want there to be a curve because it has winners and losers instead of treating each student as an individual. [-----]											
Update		<table border="1"> <tr> <td>Topics</td> <td>L</td> <td rowspan="4" style="text-align: center; vertical-align: middle;">Add</td> </tr> <tr> <td>Bookmark</td> <td>i</td> </tr> <tr> <td>RT Tools</td> <td>n</td> </tr> <tr> <td>Notes</td> <td>k</td> <td>Comment</td> </tr> </table>	Topics	L	Add	Bookmark	i	RT Tools	n	Notes	k	Comment
Topics	L	Add										
Bookmark	i											
RT Tools	n											
Notes	k		Comment									

Illustration 8b: Current Analyzer screen (discussion text can be expanded to fill the entire screen)

Tools	Topics	Bookmarks	Mail	Notes	Links	Work Area	Class	Help		
P r e m i s e s	(A P01) Jan believes that a curved grading scale means there have to be winners and losers and that there shouldn't have to be losers. [-----]			<table border="1"> <tr> <td colspan="2">A Jan</td> </tr> <tr> <td>Round Table Work Area</td> </tr> </table>				A Jan		Round Table Work Area
	A Jan									
Round Table Work Area										
(A P02) Jan thinks that there should be a grading system that is not too hard or too easy. She wants to motivate her students, yet keep										
E v i d e n c e	(A E01) Jan has the students grade themselves and then negotiate their grade with her at the end of the grading period. As a result, they seemed to be learning better because of the relaxed atmosphere of the classroom. [-----]									
	(A E02) She made the topic interesting and motivated them by letting them know they could									
C o n c l u s i o n s	(A C01) She doesn't want to use a curved grading scale but a different one that allows everyone to be "winners" if they earn it. [-----]									
	(A C02) She doesn't want there to be a curve because it has winners and losers instead of treating each student as an individual. [-----]									
Update										