Ninth Graders' Use of a Shared Database in an Internet Research Project: Issues of Collaboration and Knowledge-Building

Jeff Kupperman, Raven Wallace, and Nathan Bos

School of Education, University of Michigan

Abstract

In a student Internet research project, 82 ninth-grade students created and used a shared bibliographic database of resources which they found on the World Wide Web. This paper analyzes the students' use of the database in terms of two dimensions: 1) how much students were involved in collaboration as opposed to individually-oriented activities, and 2) how much they were oriented toward knowledge-building as opposed to focusing on completing discrete tasks. Although students used the database in various ways during the project, we saw little evidence of knowledge-oriented activities. We discuss challenges and issues related to supporting greater knowledge orientation in collaborative student Internet projects.

Keywords—K-12 collaborative learning strategies, computer networks, World Wide Web.

Introduction and Theoretical Model

As the Internet becomes a common feature in K-12 schools, teachers and researchers have begun to search for ways to take advantage of its potential for students. Innovative uses of the Internet have tended to fall into two general classes: its potential use as an information resource, and its use as a setting for collaboration between students. As an information resource, a key challenge is to get students to pursue the acquisition of knowledge as a goal rather than focusing on completing discrete tasks. As a collaborative medium, a key challenge is to help students work as a group, aware of and benefiting from the work of their peers, rather than as a collection of individuals coincidentally working on similar tasks. We have as our goal to combine these two benefits into a single type of learning, collaborative "knowledge-building" (Scardamalia & Bereiter, 1996), where students work with the intention of adding to, examining, negotiating, testing, and improving group knowledge.

The University of Michigan Digital Library (UMDL) Teaching and Learning Project group has for several years been pursuing the goals of supporting knowledge-oriented activities -- activities that go beyond simple information-retrieval, where students can use the resources of the Internet to pursue interesting questions that require critical evaluation and synthesis of the information they find (Bos, 1997; Wallace & Kupperman, 1997). However, students need to overcome many challenges before they are able to take advantage of the Internet as a tool for knowledge-building. The ability to use knowledge from diverse sources requires higher-order skills of evaluation and synthesis (Brown & Day, 1983; Moore, 1995; Moore & St. George, 1991; Wineburg, 1991). In the culture of school, on the other hand, tasks tend to emphasize the individual completion of short-term, isolated assignments, and this gives students incentive to look for single, pre-digested information sources rather than multiple information sources in need of interpretation (Brown & Day, 1983), thereby inhibiting real knowledge-building (Scardamalia, Bereiter, & Lamon, 1994).

Computer networks also allow new opportunities for collaboration, which in turn can support knowledge-building (Brown & Campione, 1994; Scardamalia et al., 1994). Following Teasley and Roschelle (1993), we define collaboration as mutual engagement toward a goal, rather than simply a division of labor among members of a group who complete their tasks individually. In order for students to truly collaborate, they should focus on solving a group problem, with some sense of the larger purposes and goals of the group. This also presents a key classroom challenge, in that the culture of school has tended to encourage students to focus only on their individual tasks. (See Table 1.)

Internet affordance	Associated challenge
Allows open-ended inquiry in a complex information space	Focusing students on knowledge rather than on completing products
Allows collaboration between students	Focusing students on group goals (as well as) their individual tasks

Table 1: Internet affordances and associated challenges

In our work, we have focused on small-scale, incremental efforts at providing tools for supporting collaborative knowledge-building within existing classroom contexts. In the spring of 1997, we provided a shared Internet database to a group of ninth grade classes doing an Internet research project. The database gave students a place to publish summaries and URL's of good sites that they had found, and to access the summaries of other students. While the project in which the students participated included many types of collaboration, the focus of this paper is on how the shared database in particular contributed to collaboration on the project. To make sense of the ways students used the database, we analyzed student behaviors along two dimensions: 1) as collaboration-oriented (students mutually working toward a goal) or individually-oriented (individual use of resources or tools, although the resources themselves may be shared); and 2) as product-oriented (done merely to complete an assignment) or knowledge-oriented (done to increase knowledge). Combining these two dimensions gives us four types of actions (see Figure 1). Quadrant IV represents our vision of collaborative knowledge-building, quadrant II represents the most traditional "school" model of individual product focus, and quadrants I and III represent variations between these.

Context

During the 1996-97 school year, we worked with a group of 82 students and three teachers comprising an "interdisciplinary block" at a large public high school in a middle class community. The school had a computer lab with 30 Internet-connected computers, and several times during the year students were given two to five class periods to search the World Wide Web for information on broad topics such as "rocks and minerals" or "Africa."

In the spring of 1997, during their third such project of the school year, the three teachers and three student teachers planned a group Internet research project for a unit on the Middle East. Each teacher or student teacher was responsible for a group of 12 to 15 students who investigated a relevant broad-based topic, such as the Gulf War Syndrome or the importance of water to the region. These topics and group membership were pre-chosen by the teachers.

Each group of students used the Internet in the computer lab during five class periods to gather information on their topic and compile their findings into a printed-out group "book." Each group divided their topic into between six and nine "subquestions," most of which were chosen by students from a list provided by the teacher. (An example of a subquestion under the Gulf War Syndrome topic was "Why did America get involved in the Gulf War?") One or two students researched each subquestion, which became the subject for a chapter in the book. Each chapter was to contain an introduction and conclusion written by the students, but the body of the chapter could contain pictures and large sections of text that the students downloaded from the Web, with the condition that they identify the sources of the material in the chapter or in a bibliography at the end of the book. Students had access to a project home page with descriptions of the group topics, links to search engines, a short list of recommended Web sites related to the Middle East, and a link to the shared database. The teachers also prepared handouts for each group containing lists of additional Web sites specific to that group's topic. While they worked on-line, students could access a shared database (described

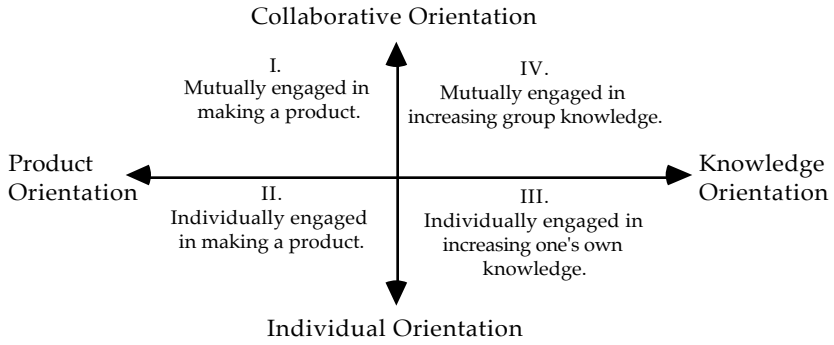

Figure 1: Types of student actions related to shared information

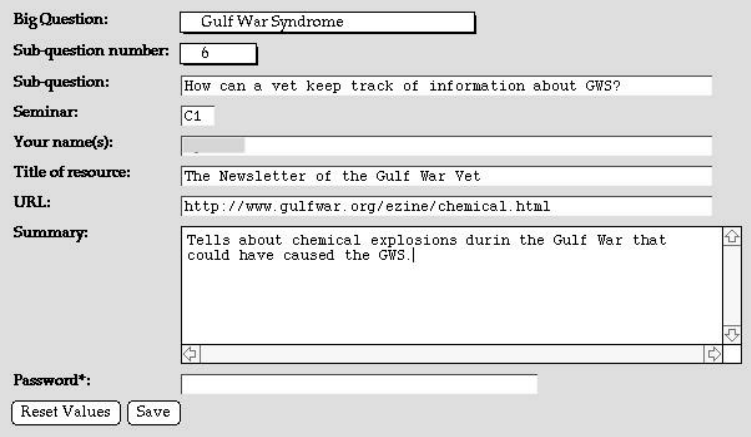

Figure 2: Database entry screen

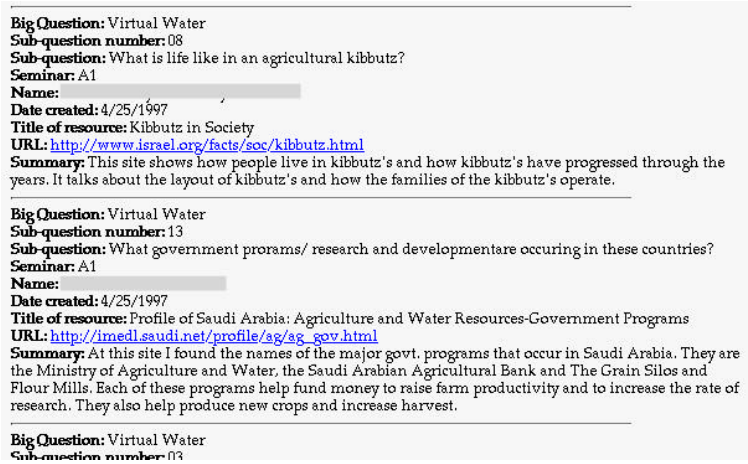

Figure 3: Student entries

below), where they could post URL's and descriptions of sites they found, and look at other students' postings.

In addition to research on a subquestion, students took roles in the creation of the book, such as editor, cover page designer, or compiler of the bibliography. Each group met four times during the project to assign roles, check progress, and organize remaining tasks. Students were given a week after the last computer lab period to complete the task on their own, and some students spent time after school formatting and printing sections of the book. The books that were turned in ranged from 20 to 95 pages each, with the differences in size being related mostly to the amount of copied text and pictures that were included. Students were given a group grade based on the book as well as an individual grade based on their contribution to the project.[1]

The Shared Database

As a way to facilitate information-sharing during the project, we created an on-line database (*http://macstage.soe.umich.edu/oil&water/share.html*) for World Wide Web resources that the students found during their research. Using commercial software tools[2], we built a simple system where students could create and view a database of Internet resources via a Web browser. Using an HTML form on the Web, students entered their main topic for their group project, the subquestion they were working on, their names, the title of the resource, the URL, and a summary of the contents of the resource (see Figure 2). A password allowed them to retrieve and edit or

[1] Teachers reported that grades were given on a scale rather than a curve, and that the group grades and most of the individual grades were high B's or low A's.

[2] We used a FileMaker Pro™ database on a Macintosh™ server, interfaced to the Web via Tango™ software.

delete previously entered records. The database could be searched by main topic, subquestion, or keyword in the summaries, resulting in an unordered list of matching entries that contained all the information the students had entered except for their password (see Figure 3). The URL line on each entry was "hot," providing a direct link to that Web page.

The database was mentioned during the introductory explanation of the group project, and on the first day in the computer lab, a teacher demonstrated how to use it, explaining that it would be a way to "share sites that have valuable information." Two of the teachers checked the database regularly from home in the evenings to monitor their group's progress.

Data and Methods

Classroom observations were made during all times when the groups were in the computer lab, and fieldnotes were coded for evidence of database use by students, teachers' instruction about use of the database, and other collaborative activity not related to the database. By supplementing these observations with computer-generated logs of database use, copies of the student-created books, the database entries themselves, and a year-end survey of all students, we were able to create a general picture of overall database use.

More detailed views of database use were obtained through video records and interviews. The on-line activity of six focus students[3] (one from each group) and their partners were recorded using "process video" equipment, which captures video output from the computer along with an audio recording of the students' conversations. The process video data were reduced to narrative summaries, and we identified passages where the students used the database, where they asked questions to the teacher about the database or received instruction, and where they talked about the database or resources in the database with other students. We then analyzed these passages for patterns of database use and evidence of the students' attitude toward the database. The six focus students were later interviewed and asked explicitly how they used the database and what they thought of it.

Results

Over 80% of all the students made at least one database entry (see Table 2 and Figure 4), and one student made 11 entries. All but 8 of the records were added during the five periods students spent in the computer lab. Students retrieved records a total of 300 times (see Table 2). One hundred twenty-five of these were by individual password, which brought up one's own entries for re-reading or editing.

Student Database Entries (N=82)	
Total number of entries at end of project	132
Mean number per student	3.5
Median number per student	3.0
Students with at least one record	66
Maximum records per student:	11
Record Creation	
Records added	139
Records deleted	7
Record Retrieval	
By individual password	125
By topic	87
By subquestion	83
Total retrievals	300

Table 2: Student use of database

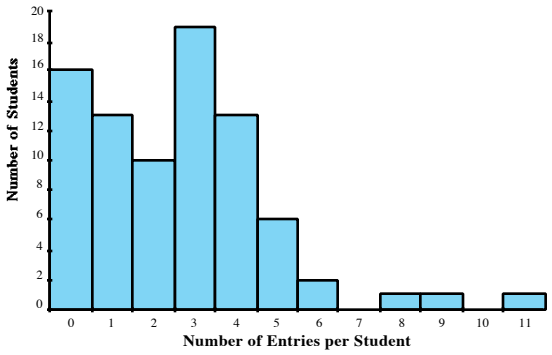

Figure 4: Database entries

We categorized students' actions according to the model presented previously in Figure 1. Below are examples of actions that fall into the four categories.

Type I: Product Orientation + Collaborative Orientation. Many students found the bibliographic database technically useful for completing the project. The most obvious use of the database was for making a collective bibliography for the group book. Four of the six groups used the database this way, and the bibliographies of two of these four groups consisted simply of printouts of database entries. A specific example of this type of orientation came from Ellen[4], a focus student in the role of editor, who was responsible for compiling the information found by the rest of the students in the group. Besides compiling the bibliography, Ellen used the database to check on the progress of the other group members, and she later explained in an interview that at that time "it was late in the projects and a lot of people

[3] At the beginning of the school year, we asked the teachers to choose six focus students for us with the conditions that they represent gender and racial diversity, and that they be neither very high nor very low academic achievers.

[4] All student names are pseudonyms.

hadn't handed in their chapter yet, so I just wanted to make sure that people at least had something."

Type II: Product Orientation + Individual Orientation. Although the outcome of the project was a group product, students were responsible for individual work, and many of their actions on-line reflected this. As teachers stressed the importance of adding entries to the database, for many students adding an entry became an assignment in itself. We recorded a focus student, Sam, saying after briefly looking at the sharing pages: "I want to be able to put something in here so I can feel like I've actually done something." Sam then checked other entries in the database, not in search of information relevant to his sub-question, but rather to make sure that the information he was submitting had not been found by another student. Sam seemed focused on completing his individual task, and the database was a way of showing he had done his work.

In another example of this type of action, a focus student Joe and his partner were told directly by their teacher to add a site to the database. After they had done so, the following conversation took place:

> Joe: [Click on] add resource to database.
> Partner: We already did.
> Joe: We need to add another one.
> Partner: Do we?
> Joe: Yeah.

Later, a classmate with several entries let Joe and his partner change the name on the entry to their own, saying, "You guys will look like you did a whole bunch of work." Joe never looked at the site in question.

Type III: Knowledge Orientation + Individual Orientation. We observed few instances of students using shared information primarily to increase their own personal knowledge. Focus students occasionally got interested in the content of a web page, but we saw no evidence of students using the database to look for information of personal interest. At one point a focus student, Barbara, read an on-line article about the Gulf War Syndrome (which she posted to the database) and became curious about what would have happened if the government had acknowledged the illness earlier. However, she did not think of the database as a resource useful for answering this question but instead asked a student teacher, got a simple verbal answer, and never explored the subject further.

Type IV: Knowledge Orientation + Collaborative Orientation. Some aspects of database use seemed to lean toward a knowledge orientation: Out of 132 entries in the database, 85 had summaries that described the site in the students' own words (e.g., "A detailed history of the PLO, complete with timeline"), and 22 contained evaluative comments (e.g., "It gives many other links that are very good"). However, it is not clear how much these entries were used as a way of helping the group become more knowledgeable about the topic, and how much they were simply considered part of the assignment.

Some students seemed to have a vague notion that someone would use their database entries, although they did not consider exchanging this kind of information to be a crucial part of the project. Barbara told us:

> I think [the database] wasn't really all that useful when we were working because everybody was doing different topics, so we just kind of had to stick to our topic, but ... I think it's nice, especially if somebody else is doing this and they want to know where to look.

Another focus student, Shawn, commented similarly that she "kind of forgot about" the database during the project, but she added, "I know [the database] is important now, because ... it has all the information on it." Although the students did not act on these beliefs during the project, these are hints that some students see sharing knowledge as something intrinsically valuable, which could be a step toward collaborative knowledge-building.

A final incident also points toward encouraging possibilities, although the incident itself had little to do with the shared database. While Shawn was researching the assassination of Yitzhak Rabin, she found a list of Jewish e-mail pen pals, and she and her partner decided to interview Israeli kids via e-mail. Through a free, Web-based e-mail provider, they sent three messages asking how people in Israel reacted to Rabin's death, and they received two replies. Shawn's actions cannot quite be called collaborative knowledge-building: her enthusiastic involvement in this self-designed task was evidence of a knowledge orientation, but although there was information exchanged via e-mail, in terms of the group project her actions fall short of being collaborative. Shawn used the shared database to post the URL of the e-mail site she used, but she was evidently unconcerned with sharing the information with the group -- the entry was posted under the wrong group topic, and the summary was a description of the replies she received, without a word about the site itself. Nevertheless, the success of Shawn's e-mailing activities suggests that exchanges such as these could be part of collaborative knowledge-building.

Discussion and Recommendations

Overall, we observed a fair amount of collaboratively-oriented as well as individually-oriented activity related to the shared database, but nearly all of this activity was product-oriented rather than knowledge-oriented. The database was clearly a helpful tool for completing the group project, in that it facilitated

logistically difficult tasks such as compiling a group bibliography and checking various students' progress. However, despite the potential for knowledge-sharing, neither the database nor the group assignment in itself seemed to facilitate knowledge-oriented actions. In fact, the few knowledge-oriented actions we observed were idiosyncratic and unplanned. What might have kept the students from taking on more of a knowledge orientation? There are many possible reasons, and the limited scope of this study prevents us from drawing general conclusions. However, in this activity the following four barriers to knowledge-building seemed critical:

1. **Project priorities and task structure.** Scardamalia, Bereiter, and Lamon (1994) have commented that in schools understanding is often undercut by an emphasis on the completion of a task or the creation of a product. This project was no exception. The students were focused on getting their task -- i.e., the book -- done. This task required them to find at minimum one unique Web page which they could use as the basis of their chapter. There was little perceived overlap between the groups' topics, and so there was little incentive to look at another group's entries. Even within a group, since students were focused on their own subquestion and their own resources, looking at resources other students had found may have seemed unnecessary. Students were graded on the quality of the group book and their contribution, not on how much they learned about the topic as a whole. Knowledge was not emphasized nearly as much as the product.
2. **Time pressure.** Related to the issue of project priorities is the matter of time. Students were given only five hours of class time to research and produce the book, and focusing on something other than production may have seemed to be a waste of valuable time. In the end-of-year survey, ten students mentioned explicitly that they were not given enough time to complete Internet research assignments.
3. **Student's lack of subject knowledge and research skills.** The students were researching topics that they knew very little about, and this made it difficult for them to determine whether information they came across was relevant or not. Without this knowledge, and lacking general skills for evaluating and synthesizing information, they tended to reject information that was not clearly and obviously tailored to their question.
4. **Lack of useful content when needed**. At the early stages of the project, when the students spent the most time searching for information, the database contained relatively few entries. Later, when there were more entries, the students were busy compiling and formatting the books, and they did not have the time or inclination to look for more information.

Overcoming these barriers is a complex challenge. We have seen that on-line sharing tools such as our bibliographic database, even when they are used collaboratively, do not automatically encourage knowledge-building. However, our work points to certain recommendations for giving collaborative projects more of a knowledge orientation. These are:

1. **Supporting collaboration consistently**. If Barbara and Shawn are typical, some students realized in retrospect that the database could be a valuable store of information, although they used this information sparingly during the project. If sharing tools were used throughout the year, and collaboration were a consistent goal, students might be more concerned from the start with creating and using shared knowledge.
2. **Scaffolding research skills.** Part of the difficulty students had in sharing knowledge may have been related to their difficulty in evaluating resources on the Internet and building evidence from them. Students will not learn these skills automatically, and we need to find ways of giving them the guidance that they need.
3. **Supporting direct question-asking.** Shawn and her partner obtained their key information from questions to e-mail pen pals, and while doing so they were consistently engaged and motivated. On the other hand, students who tried to find information on the Internet as a whole got frustrated quickly and turned to a teacher for help. Collaborative activities could capitalize more on the appeal and motivation of asking direct questions of another person.
4. **Making knowledge-sharing a goal.** It is not possible, or even desirable, to eliminate the creation of end-products such as reports or presentations as outcomes of student projects. However, these products can be designed to emphasize synthesis and group debate rather than the individual contribution of unique information. Students can still do their own research, but they should have a reason to be interested in what other students find.

These are not easy changes to make, but they are key challenges worth exploring if we are to make the Internet a resource for supporting thoughtful learning.

Acknowledgments

We deeply appreciate the cooperation of the teachers and students who participated in this study. This work was supported by the NSF/ARPA/NASA Digital Library Initiative, cooperative agreement IRI-9411287; by

a grant from the NSF NIE Initiative for the University of Michigan Digital Library project (RED-9554205); and by the University of Michigan.

References

Bos, N. (1997, March). Student publishing of value-added resources in a WWW digital library. Paper presented at the AERA, Chicago.

Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice*. Cambridge, MA: The MIT Press.

Brown, A. L., & Day, J. D. (1983). Macrorules for summarizing texts: The development of expertise. *Journal of Verbal Learning and Verbal Behavior, 22,* 1-14.

Moore, P. (1995). Information problem solving: A wider view of library skills. *Contemporary Educational Psychology, 20,* 1-31.

Moore, P. A., & St. George, A. (1991). Children as information seekers: The cognitive demands of books and library systems. *School Library Media Quarterly, 19,* 161-168.

Scardamalia, M., & Bereiter, C. (1996). Computer support for knowledge-building communities. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 249-268). Mahwah, NJ: Lawrence Erlbaum Associates.

Scardamalia, M., Bereiter, C., & Lamon, M. (1994). The CSILE project: Trying to bring the classroom into world 3. In K. McGilly (Ed.), *Classroom lessons: Cognitive theory and classroom practice* (pp. 201-228). Cambridge, MA: The MIT Press.

Teasley, S. D., & Roschelle, J. (1993). Constructing a joint problem space: The computer as a tool for sharing knowledge. In S. Lajoie & S. Derry (Eds.), *The computer as a cognitive tool* (pp. 229-258). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wallace, R., & Kupperman, J. (1997, March). On-line search in the science classroom: Benefits and possibilities. Paper presented at the AERA, Chicago.

Wineburg, S. S. (1991). Historical problem solving: A study of the cognitive processes used in the evaluation of documentary and pictorial evidence. *Journal of Educational Psychology, 83,* 73-87.

Authors' Addresses

Jeff Kupperman, Raven Wallace, and Nathan Bos:
School of Education, University of Michigan, 610 E. University, Rm. 1323, Ann Arbor, MI, 48109, USA
jkupp@umich.edu
ravenmw@umich.edu
serp@umich.edu