Information and Communications Technology and Literacy Development

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Abstract. This paper reports an investigation of how students' literacy improved through on-line discourse. Two English literature classes in an inner city multicultural secondary school participated. The teacher taught both classes-an experimental and a control class. The experimental group was a class of Grade 9 students with access to the discourse space, Knowledge Forum®, for writing narrative and expository texts, critiquing others' texts, and exploring ideas. The control class did not have access to Knowledge Forum. Overall, discourse in the database resulted in improved literacy, a positive correlation between database activity and final grades, and to a more harmonious classroom culture.

Keywords: literacy, dialogue, knowledge building

INTRODUCTION

In North America, 25 percent of students are reading at "below basic" levels meaning that they are unable to understand or comprehend advanced material (OECD-OCDE, 2000). Fewer than 5% of the adolescents in the American NAEP 1998 assessment could extend or elaborate the meanings of the materials they read. The NAEP writing assessments also indicated that few adolescents could write effective pieces with sufficient details to support main points (Donahue, Voelkl, Campbell, & Mazzeo, 1999; Moore, Bean, Birdyshaw, Rycik, 1999). This is an appalling finding given that students have been reading and writing in school for many years before these assessments. The increasing complexity of knowledge in every domain increasingly demands sophisticated abilities for composing and comprehending written text (NICHD, 2000). Clearly, adolescents' literacy skills are not keeping pace with the societal demands of living in a rapidly changing knowledge age (Senge, 2000). Research indicates several reasons for low literacy all centering on the nature of classroom discourse. Discourse is central to knowledge creation because it is the means through which knowledge is formed, criticized, and amended (Scardamalia, Bereiter & Lamon, 1994).

Although several studies have indicated that meaningful discourse is the most relevant classroom variable for increasing literacy, this practice is not pervasive in schools (Applebee, 1996; Greenleaf, Jimenez & Roller, 2002). Unlike conventional conversation or dialogue in professional communities, classroom discourse typically conforms to a participation structure controlled by the teacher. Teachers ask most of the questions, call on students to answer and allocate turns (Greenleaf & Freedman, 1993). The discourse between teacher and students is then limited to an IRE (inquire, respond, evaluate) structure for the purpose of transmitting information (Cazden, 1988) where the teacher already knows the answer. Additionally, adolescents' evolving expertise in coping with routine school literacy tasks with the least amount of time or effort (Scardamalia et al, 1994) suggests the need to involve students in higher level thinking about what they read and write than is possible within a transmission model of teaching, with its emphasis on skill and drill, teacher-centered instruction, and passive learning. However, this 'knowledge transmission' model has had a very strong hold in classrooms for decades (Cuban, 1993). In these environments, students have little chance of becoming heard or recognized as contributing participants. As the NAEP and other results indicate student achievement with this kind of discourse does not promote reading for comprehension or writing for communication.

Bereiter and Scardamalia (1987) distinguished two types of discourse: knowledge telling and knowledge transforming. Knowledge telling is a traditional discourse used to support teaching-learning interactions, such as the IRE structure. A knowledge transforming strategy treats discourse as problem solving, an active reworking of thoughts. Bereiter and Scardamalia (1987) were reporting on the process of writing, which is also a form of discourse and one central to assessments of reading comprehension[1]. Carbonaro and Gamoran (1999) found that the more teachers emphasized both literature and analytical writing, the higher the average achievement growth of their students; conversely, students tended to gain the least when their teachers

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1 For example, The NAEP reading assessments require written responses from students.

emphasized grammar. Nystrand (1997) showed that greater levels of coherence among reading, writing, and classroom discourse promoted higher achievement.

Knowledge building communities (Scardamalia et al, 1994), and learning communities (Brown & Campione, 1996) approaches to teaching and learning provide ways to integrate reading, writing, and dialogue as often as possible across all subject domains since each of these activities reinforces the other. These participatory methods actively engage students in their own learning and provide opportunities for substantive interaction among students as well as with the teacher. In these classrooms, learners focus on cognitive goals, structural features of a problem and use a knowledge transforming strategy (e.g., Lamon, Chan, Scardamalia, Burtis, & Brett, 1992). That is, they are intentional in how they approach learning. Unlike Brown and Campione's learning communities approach, knowledge building communities make use of information and communications technology that affords communication without restrictions of time and space, and encourages dynamic, democratic, and creative dialogue.

Technology affordances

A recognition that students need to actively construct their own knowledge by their bootstraps (Scardamalia & Bereiter, 1987) led to the development of a multimedia communal database application called Knowledge Forum® (formerly Computer Supported Intentional Learning Environments/CSILE). Knowledge Forum is an online environment where participants contribute ideas, ask questions, read what others have written, challenge ideas, and build upon them to advance their community's knowledge. Like other asynchronous conference systems, participants can interact at any time and from any place. Unlike other systems, Knowledge Forum provides views or working spaces enabling people to see and adjust the structure of their discourse making thinking visible. The software also provides customizable scaffold supports; external prompts that support cognition while the learner is in the process of creating increasingly complex structures (Bruner, 1983). Scaffold supports encourage students to reflect on their cognitive processes as they are thinking, reading and writing (Chan & Van Aalst, 2004).

The software also supports student-to-student dialogue that is not directly mediated by the teacher thus averting the problem of teacher-centred dialogue prevalent in traditional classrooms. Peers provide much of the procedural facilitation in their database by making connections between their understanding and others' ideas, with what is known in other disciplines, and with world knowledge. Confrontation with a variety of ideas and arguments promotes deeper reflection and enhances coherent explanations, because of the increased visibility of different ideas and how they change (Bereiter & Scardamalia, 1993). Since students must communicate through reading and writing improved literacy is a by-product of working with ideas (Lamon, Andrews & Scardamalia, 2004).

Teacher and classroom affordances

As Owston (1997) has noted the potential of new technologies for learning is likely to be found not in the technologies themselves but in the way in which these technologies are used as tools for learning. In classrooms where database discourse is supported by knowledge building pedagogy: "the teacher's role shifts from standing outside the learning process and guiding it to participating actively in the learning process and leading by virtue of being a more expert learner" (Bereiter & Scardamalia, 1993, p. 211). In these classrooms, the teacher turns more and more responsibility for learning over to students. Students define what needs to be learned, monitor their own progress and decide what to do when progress isn't being made.

Mr. K., the teacher, had used the software in the previous year for writing projects; but students in that class used the database as an informal chat space (Klonsky, 2001). In his second year using the database, Mr. K.'s goal was to use the database to foster students' ability to move beyond chats to online collaboration and as a mechanism for formative assessment. Collins (1992) has suggested that assessment should shift from an emphasis on traditional summative evaluation (in which data is acquired at the end of an activity) to include more formative design approaches (which are informed by data acquired during the planning and development of the activity). For example, providing adolescents who are experiencing reading difficulties with clear goals and then giving feedback on the progress they are making can lead to increased self-efficacy and greater use of comprehension strategies (Schunk & Rice, 1993).

It is important to note that the software is designed to support knowledge building communities. A knowledge building community is similar to a research community where members share responsibility for creating new knowledge. Participants set out their theories and ideas approaching information from various viewpoints; they consider how well diverse theories account for information; whether one theory provides a better account than another; whether complexity and parsimony are dealt with and so through discourse progressively improve their understanding. In this way, the community produces cultural artifacts (Bereiter, 2002) of value to themselves and others; success then is a result of contributions distributed across all members rather than being

concentrated in a leader. A knowledge building community is guided by a system of 12 knowledge building principles shown in Table 1 below. Teachers' adotpion and appropriation of a knowledge building philosophy shows a developmental trajectory (Lamon, 2005); and will be explored in this paper.

Knowledge building principles	Definitions
Real ideas and authentic problems	Real knowledge problems arise from efforts to understand the world; creative work with ideas supports faster and more reliable learning, whereas learning alone seldom leads to knowledge innovation
Idea diversity	Different ideas create a dynamic environment in which contrasts, competition, and complementarity of ideas is evident, creating a rich environment for ideas to evolve into new and more refined forms
Improvable ideas	All ideas are treated as improvable; participants aim to mirror the work of great thinkers in gathering and weighing evidence, and ensuring that explanations cohere with all available evidence
Knowledge building discourse	Discourse serves to identify shared problems and gaps in understanding and to advance understanding beyond the level of the most knowledgeable individual.
Epistemic agency	Participants mobilize personal strengths to set forth their ideas and to negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them
Democratizing knowledge	All participants are legitimate contributors to the shared goals of the community; all have a sense of ownership of knowledge advances achieved by the group
Collective knowledge, community responsibility	Participants take responsibility for the overall advancement of knowledge in the community.
Embedded transformative assessment	The community engages in its own internal assessment, which is both more fine-tuned and rigorous than external assessment, and serves to ensure that the community's work will exceed the expectations of external assessors
Constructive use of authoritative sources	Participants use authoritative sources, along with other information sources as data for their own knowledge building and idea-improving processes.
Rise – above	The conditions to which people change because of the successes of other people in the environment. Adapting means adapting to a progressive set of conditions that keep raising standards.
Pervasive knowledge building	Creative work with ideas is integral to all knowledge work.
Symmetric knowledge advances	Interleaved communities provide successively more demanding contexts for knowledge work, and set into motion inner-outer community dynamics that serve to embed ideas in a broader social context.

Table 1: Knowledge Building Principles

Effects of technology on student self-concept and attitudes about literacy

Desktop publishing, web publishing, and e-mail have made it possible for students to write for real and extended audiences. According to numerous reports, this is a great motivator and encourages students to take greater care with their writing. Technology environments heighten students' motivation to become independent readers and writers and thereby increase their sense of competency (Kamil, Intrator, & Kim, 2000). Working in a technology supported classroom increases motivation. Beach and Lundell (1998) found that the information and communications technology encourages participation from students who tend to shy away from participating in face-to-face discussions, and can facilitate the free expression of alternate views. They noted how these social contexts require adolescents to contribute in ways that call on them to infer social meanings, respond in ways that are socially appropriate, and accurately communicate their ideas to an audience. This seems particularly important for students coming from other cultures (NRP, 2000). As a Jamaican student new to Canada who participated in this study said:

> Sometimes when I'm at home with nothing to do ideas will be running through my head and I'll say I'm just going to put it on Knowledge Forum. Because sometimes when I'm at home I can get really bored so I just go on the forum. It has changed my writing because at the beginning of the year I knew for sure that I wasn't a good writer because my marks weren't good as Mr. Mr. K. explained and now I'm up there with the rest of the class getting 80's and so it's good.

The hypothesis for this study was that students who engaged in online collaborative discourse would improve their literacy skills compared to a class that did not have the opportunity for online discussions. A specific focus on classroom processes and the teacher's role are highlighted.

METHOD

Participants

Thirty-eight secondary students in two Grade 9 literature classes in an inner-city multicultural school participated. A one-year literature course with students who were generally not going to university was the domain. Students were randomly assigned to courses by school administration. Researchers arbitrarily assigned one class access to Knowledge Forum. Mr. K. taught both classes on alternate days at the same time in the morning.

Materials for Assessment

The reading comprehension assessments used for this study were adapted from Campbell and Brokop's (2000) Canadian Adult Reading Assessment because they had been validated with students across Canada using the Fry (1977) and Chall (1995) readability indices (cited in Campbell & Brokop, 2000). Additionally, passage topics had been chosen by a wide array of adult students who reflected diversity in terms of race, class and gender. Finally, the focus of the tool is comprehension not word recognition-a lower level skill. The texts are grouped into levels, with each level increasing in difficulty-based on factors such as number of questions, length and readability. For this study, two 500 - word texts at a Grade 9 readability level were selected. Texts were counterbalanced so that students did not read the same text in the fall and spring.

PROCEDURE

At the beginning and end of the year, researchers administered pre and post reading assessments to students in both classrooms. Researchers and the teacher introduced the software to students in a one-hour session. Throughout the year-long course, students went to a computer lab twice a week and most logged in from home. Towards the end of the course, researchers interviewed five randomly selected students in the experimental classroom and the teacher. Beyond that, there was little communication between researchers and Mr. K. or between researchers and students.

For the experimental class, students began with an empty database. The first task was to contribute his/her autobiography to a View[2], called "Personal Autobiography". The activity, designed to be non-threatening, allowed students to familiarize themselves with the software while getting to know a little about one another's background, interests and so on. Initially, students collaborated to teach each other aspects of html, an activity that did not involve the teacher. Two out of three classes per week were carried out in the school's computer laboratory where students and their teacher used the software alone or in pairs to compose and revise their writing and to offer feedback on other's work. Occasionally, students and sometimes the teacher gathered to discuss an idea posted in the database. An analysis showed that most students also logged in outside class time. All writing from first draft to final paper was public in the database as were the teacher 's formative assessments in the form of annotations. Mr. K. also encouraged students to annotate and build onto each other's drafts.

Mr. K.'s control class typically worked in small groups; and thus the entire class could not review all exchanges regularly. These face-to-face conversations were transitory, and unlike database communication which preserves discourse, allowing students to return to their ideas and study them from a variety of perspectives (Hewitt, 2004).

Occasionally, in both classes, there were whole class discussions on the writing topic, reading a text or discussing what the teacher called "dangerous ideas". These were ideas contributed by the teacher or students to a literal snake basket. These included ideas such as morals are relative, religion is dangerous, or different cultures can't coexist as well as quotations from writers. The curricular content for both secondary classes was the same: creative writing, research and research reports, and personal essays. As the year progressed, there was a noticeable shift in the experimental class as students began to assume some ownership for discourse in the database. As one example, early in the year, students had written creation myths and their last assignment was

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[2] A View in a Knowledge forum database allows participants to organize their discourse according to problems or issues graphically. Notes, the basic way to contribute to a discussion, can be copied from one view to another.

to write a science fiction story. Noticing that the first assignment was to write a creation myth from long ago and a science fiction story to take place in the future, one student wondered about the concept of time. He created a view for discussion and the rest of the class joined. Their ideas were diverse: time is man made, time is universal, or time is a cycle. A section of their discussion is shown in Figure 1 below.
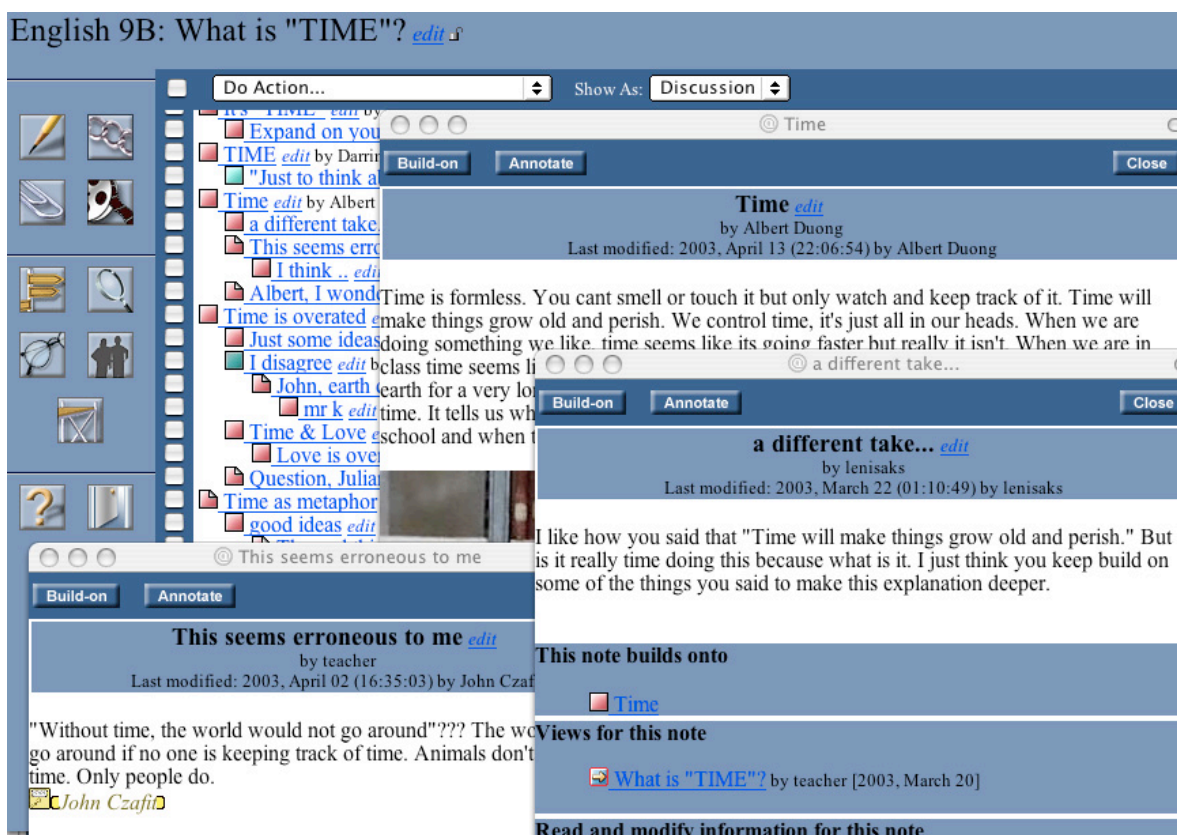

Figure 1: A Knowledge Forum View with Sections of a Note Thread.

RESULTS

As well as the Canadian Adult Reading Assessment, final grades for experimental and control groups were examined. For the experimental group, Knowledge Forum's Analytic Toolkit was used to assess quantitative activities (i.e., expressing ideas in writing, building onto other's ideas, reading) as was the teacher's database activity. Towards the end of the academic year, video interviews were conducted with the teacher and five students in the experimental class.

Classroom Culture

Mr. K. reported that students in the experimental class had higher attendance and assignment completion rates than students in the control group. For example, the first assignment saw a completion rate of 100% for the experimental class versus a 30% completion rate for the control class; and according to the teacher this pattern continued. This result convinced Mr. K. that the database had a profound effect (Klonsky, 2003). He stated that he had never seen a group of students so supportive of each other:

> I wish you could see this from day to day because it is really impressive and so important. To me it is a revolutionary change. I just do not see the same thing going on in the other class. Now, once again, one might attribute it to the unique dynamic of that group but I don't think so. All of them are Grade nine students and these kids happened to have come into a situation where they really feel comfortable and they've been very successful and it's working.

In the interviews with five randomly selected students, four enjoyed interactions in the database and believed that their thinking, writing and reading had advanced through feedback from others. One student, learning English as a second language and without Internet access from home, was not comfortable discussing her ideas in the database. As one of the other four students summarized:

I would say it is a pretty interactive program that allows a person to develop their skills based on what other people might suggest and it is a pretty open system because you don't necessarily have to follow or to please anyone who annotates your work or builds onto your work. You can choose exactly what you want to do and it builds on your independent level of study and thinking as well. Your analytic skills develop by using this program itself.

Both the teacher and four of the five interviewed students believed that working in the database developed communication skills and literacy skills as well as more collaborative classroom culture. They also agreed that formative assessments by the teacher and other students provided more opportunities to improve their writing. A sample of students' discussions shown below in Table 2 illustrates their online discourse:

My Ideas on TIME
by Lennie L.
Last modified: 2003, April 09 (09:26:36) by Lennie L.

My theory:[3] Time is only what we make of it. It is something in which we use as a guideline so the whole world can run smoothly. Now if no one if calculating time, does it still exist? My answer to this is no.

New information : This is because if you have two clocks both set exactly to the same time and then you bring one into space and come back say a week later the time on the clock that went into space will be different than the clock that was on earth.Because time never existed we only created it, it is not universal. Without time the world maybe would not have advanced. Without recording days and hours that have gone by everything and everyone would be out of sync. If time were to actually exist when would it exist? In the past, present, or future even? In everyone's mind it appears that the past had existed but the only thing that really exists that you can control is the present and the future. Now some people say that you do not have control over your future but I believe you do. So if time does not really exist can we bend it? The answer to this in my head is yes. You can only bend the near future. In your head you can make time go as fast or as slow as you desire. Now time is only calculated as a mathematical equation so we can change this. Could we use the laws of mathematics to reverse time or speed it up? Anything is possible.

I sometimes feel the hands of time closing in on me. When I am trapped within its limits. It almost feels like an impenetrable barrier that is set on two speeds, slow and fast. You want to pass the barrier because you want to desperately know what is beyond it but you know you can't. It is when we break this barrier, this barrier that is time, that we will be able to go anywhere beyond this universe. So what is this barrier? Well if I knew I am positive that I would't be spending my time (get the irony!) at VRA. Though, I do know that time is physics and we have bound ourselves to these laws of physics because we are ignorant people and we want to live lives that have meaning and in the end will wrap up into a perfect package as time passes by our gravestones.

Build-On Notes

To Lenny, Somehow sensible comments
by john c.
Last modified: 2003, April 07 (16:14:58) by john c.

So then if the gravity is higher , on a watch, the gravity will push the hands down? What does that have to do with gravity then? If you have a clock that works on the sun, then where does gravity come into play? People measure time using clocks and sundials, but taking your clock out into space isnt the reason you will age quicker or slower outside of earth. Time acts upon us whether or not we have clocks. Clocks don't mean we created time.

Somehow Sensible Comments
by Lennie L.
Last modified: 2003, April 07 (22:24:47) by Lennie L.

John, in response to your comments it has been proven that clocks tick at different speeds on Earth and in Space. You see there is something called gravity which puts pressure on different objects forcing them to do certain things. In space there is less pressure than on Earth because there is no gravity. Now with less pressure on a clock in space it would either move faster or slower. Regardless which one the point is it will move FASTER OR SLOWER than the one on Earth.

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[3] This is a scaffold support in the software.

You see this is how I came back to the idea we invented time. Because it is a worldly measurement and does not prove to be the same outside the earth how can it really fully exist.

John you say "It is true that people age quicker on earth than in space, but that has nothing to do with clocks and peoples' measure of time." I ask you then what is aging if it has nothing to do with our measurements of time? Who is to say that our lives start when we are born? Maybe they start when we end. Time is a way to bring stability to havoc. We need time to understand ourselves and what is happening around us.

TIME
by naguib s.
Last modified: 2003, April 09 (09:30:37) by naguib s.

I need to understand To me I find it quite incomphrensible to believe that time actually repeats itself. For example, if looking at a solar calendar, the 365 days repats itself but how do we know exactly that it is repeating itself if time is only exsistant for a fraction of a second. To an even further extent I wonder if time really exsists? We can not consider the futur time. The past is time that has already passed. The present is only there for only a mere instance. the matter is quite large and is quite hard to answer with only my understanding. To prove the complexity of this subject, the moment you finish reading this it will already be the past and that moment in time has passed and will never exsist again.

Table 1: Students' online discourse

Quantitative Results: The Canadian Adult Reading Assessment (CARA)

Students in both classes were asked to read an expository text ("The Halifax Explosion" concerning events that occurred during WWI. "Why Birds Fly" that focused on anatomical and physiological characteristics of birds affording flight.). Texts were counterbalanced so that student who read about Halifax in the fall read about birds in the spring. After students had read the text, it was removed and students were asked to (1) retell the story and (2) to answer 10 questions that required a factual or an inferential response (e.g., "Who was to blame for the Halifax explosion?" Answers were not explicitly provided in the text.

CARA MEASURES				
Questions				
Group	Pretest Mean	SD	Post-test Mean	SD
Experimental (N=16)	9.63	3.89	22.25	8.01
Control (N=14)	8.57	3.97	15.46	5.93
Recall				
Group	Pretest Mean	SD	Post-test Mean	SD
Experimental (N=16)	8.94	2.35	11.31	2.50
Control (N=14)	9.07	3.11	10.36	3.34

Table 3: Mean Pretest and Post-test Question and Recall Scores for Experimental and Control Classes.

A multivariate analysis was conducted[4]. Pretest scores for the question section of the assessment did not vary between groups. They were used as a covariate for the post-test scores. Post test scores revealed that the experimental class performed significantly better than the control class $F_{(1,26)} = 34.44$, $p < .0001$ for answering questions. There was also an interaction between group and questions $F_{(1,26)} = 5.66$ $p < .04$. Pretest scores for the recall section of the assessment for the experimental and control groups did not differ and were used as a covariate for the post-test recall scores which did differ $F_{(1,26)} = 77.84$, $p < .001$. There was no interaction between group and recall $F_{(1,26)} = 2.76$, $p > .1$. There was an interaction between questions and recall scores $F_{(1, 26)} = 27.72$, $p < .001$. There was no group by question by recall interaction. Clearly, the experimental group outperformed the control group on both measures. It is also not surprising that there was a question by recall interaction since both were related to the text. The one noticeable difference was that there was no group by recall interaction. There are two possible explanations: the first is that there was a ceiling effect for the recall test; and the second was that recall may be a measure of knowledge telling where the task for students was to use a copy delete strategy that might not be expected to differ between groups.

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[4] Thanks to an anonymous reviewer who suggested this analysis. This led the author to include only those students who had competed the pretest, post-test and for whom there was a final grade.

Final Grades

Final grades (not including database activities) for the two classes were examined. They revealed a significant difference between classes $F(1,26) = 6.13$, $p < .03$. Additionally, four students in the control class did not achieve a grade of 50% and one student in the experimental class did not.

Group	Mean Grade	SD	Median
Experimental (N=16)	66.31	12.67	64
Control (N=14)	53.07	16.59	52

Table 4: Mean final grades for experimental and control classes.

Knowledge Forum's Analytic Toolkit

The analytic toolkit underlying Knowledge Forum affords a detailed examination of database activity (See http://analysis.ikit.org/atk/atkdoc.html for details) and was used for the same exprimental participants.

Measure	Mean	SD	Median
# Notes created	16.18	8.54	11
Percent of notes read	40%	23%	35.8%
# Revisions	57.41	52.48	33

Table 5: Analytic Toolkit Results for the Students

Previous research (Lamon & Power, 1997) showed that reading in the database was correlated with advance placement course results but writing was not. In the present study, both writing, reading and number of revisions were significantly correlated with final grades as can be seen in Table 4. It is now possible to examine the number of build-on notes and number of annotations: both of which are sensitive to collaboration in the database. However, in the database these students used, neither measure was available in the ATK; nor could they be calculated in a conversion of the database to a later version. This was a limitation in understanding effects of student collaboration on literacy development.

	# Notes Created	% Notes Read	# Views worked in	# Revisions	Final Grades
# Notes created		0.89††	0.58†	0.80††	0.66††
Proportion Notes Read			0.44	0.56†	0.61††
# Revisions					0.47

Table 6: Correlation Matrix for ATK measures and Course Grades (†† $p < 0.01$, † $p < 0.05$).

Teacher Analytic Toolkit Results

As well as examining student results in terms of database activity, it was of interest to examine the teacher's behaviour in the database. This revealed a pattern characteristic of teachers with some experience in using Knowledge Forum but who are not experts in developing and sustaining knowledge building communities in their classrooms (Lamon, 2005). As the results demonstrate, Mr. K made 172 annotations and 45 build-on notes. He did not provide students with opportunities to create their own views since the teacher created 12 of the 13 views.

# Notes Created	% Notes Linked	% Notes Read	# Notes in Build-Ons	# Views Created	# Annotations
61	75.4%	76.4%	45	12	172

Table 7. Analytic Toolkit Results for the Teacher

DISCUSSION

Results indicated that computer supported collaborative learning affected literacy development in terms of a task that required a knowledge transforming strategy (answering factual and inferential questions) and in terms of tasks requiring a knowledge telling strategy (recall of texts). Experimental students outperformed control students - an indication that students even when working individually are able to work critically with ideas. Additionally, final grades correlated with database activity suggesting that students' individual work (number of notes written, revisions) and collaborative work (proportion of notes read) is related to course outcomes. That the Analytic Toolkit measures that could not determine effects of collaboration (number of annotations; number of build-on notes) was a serious limitation. Unlike many educational interventions this effect isn't compromised by teacher intervention, a criticism frequently directed at educational reforms that are, in part, dependent on teacher differences. Participating teachers in reform efforts are early adopters of information and communications

technology; but teachers in control classes may not be (see Doubler, Laferriere, Lamon, & Rose, 1993) for a discussion on early adopters and ICT).

When students were given the freedom to express ideas, in their discussion of time, the nature of online discourse changed from a task focus to idea centered. What the electronic database did allow was the emergence of students' discourse as the primary medium for understanding what they were reading and writing. Mr. K. read many notes in the database and his responses provided students with constructive feedback for improving their writing. He also asked for a reconsideration of ideas, and alluded to other literary sources. Finally, the database afforded opportunities for three of NRP's (2000) recommendations for reading comprehension: comprehension monitoring, cooperative learning, and answering questions with feedback.

Students of all ages construct scripts for school. Based on years of similar experiences, they develop scripts that include listening to lectures, predicting what will be on texts, using copy delete strategies for summarizing texts and memorizing facts. Although, Mr. K. released agency to students in terms of assessment literacy, he did not overtly encourage students to view the knowledge of the collective as the focus. If the goal is to advance the knowledge of the group, students must first understand how their knowledge is limited and then seek to improve it. New contributions by one person will influence subsequent investigations by others and so individual understanding is driven forward by the dual need to be familiar with the knowledge of the collective, and the desire to advance that knowledge. Implicitly, Mr. K. may have realized this in his comment:

> The idea that many heads are better than one that you may be the expert or may have learned more or have a better education but on a specific matter of work that does not mean that there isn't a sufficient amount of knowledge and thought in that classroom that you can't advance further than the teacher. My philosophy is that there is more out there in the classroom by way of resources than the teacher knows.

Nonetheless, the fact that all students were assigned the same set of tasks argued against a knowledge building philosophy. Even though students' took some control of the curriculum the teacher assigned most of the content: that is, all students were required to do the same thing at the same time. Reconciling the inevitable tension between mandated curricula and knowledge building community development – that is, the trade off between depth and breadth was a challenge in this classroom.

The teacher's many online contributions suggested that he may have been more involved in the discourse than is common in classrooms led by expert knowledge building teachers (Lamon, 2005). Expert knowledge building teachers organize their classrooms so that problems of understanding and knowledge advances in the database are made public beyond the database. Beginning knowledge building teachers intervene very little in the database but when they do they are more directive in terms of the curriculum. At the intermediate stage on a developmental trajectory in appropriating a knowledge building philosophy, teachers intervene frequently in the database not so much to direct students but to offer constructive feedback. A goal for further research is to examine the role of teachers' online discourse in blended learning environments; and how teachers' professional development might foster teachers' adoption and appropriation of computer supported collaborative learning.

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