

Collaborative Learning using MIND BRIDGES: An Asian Experience

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Abstract

There is increasing interest in and appreciation of the potential benefits of collaborative learning in educational circles today. This paper reports on our efforts to introduce computer-based collaborative learning technology into local schools and the experiences that we have gained.

The paper has five main parts. The introduction explains the notion of social constructivism as it constitutes the theoretical bedrock of the work reported here. The second part describes the system MIND BRIDGES that we developed to support meaning negotiation and critical thinking processes between students. MIND BRIDGES is a multimedia messaging system that allows students to engage in media-rich articulations. Our intention is that, through the use of MIND BRIDGES, students will acquire the skills that allow them to propose ideas, engage in critical discussion and debate, justify approaches and views, and rebut criticisms. The third part sets out the background and context in which the reported empirical work was carried out. The fourth part describes empirical research using MIND BRIDGES with 15-year-olds in the domain of English Literature over a one year period. We outline the way in which MIND BRIDGES was employed, some of our observations in introducing a technology-based independent thinking project into the curriculum, some of the successes that we achieved, and the lessons that we learnt. In the conclusion, we briefly reflect on what we have achieved and look ahead to what the future portends in the local education context.

Introduction

Educational research has increasingly focused on collaborative forms of co-learning between students. The attention now given to collaborative learning is in large part due to greater appreciation and acceptance of a social constructivist perspective on the nature of human knowledge.

Social constructivism is a theoretical standpoint that views all human knowledge as a social construction. We can identify three distinct ideas to this assertion. The first idea revolves around the process of conceptualization as we attempt to describe our experiences in words. This process of conceptualizing and naming is bounded only by our (human) ability to invent concepts to describe human experience. It typically occurs in a broader social context. Einstein, for instance, has said that physical concepts are free creations of the human mind, and Gregory (1988) demonstrates compellingly how physicists *invent* a physical world—a story that closely fits the facts they create in experimental apparatus using words.

The second idea revolves around the process of meaning negotiation as we attempt to interpret what we read or hear spoken. This process of ascribing meaning is one that involves language-based thinking. It typically involves the use of inner thought (talking to oneself “in one’s own head”) or conversing with others on the subject of interest and, in so doing, fleshing out *a* meaning for the idea. An excellent example of such a meaning negotiation process can be found in Brown & Campione (1990). The example illustrates

how a group of children negotiate the meaning of the word “camouflage” in the context of a reciprocal teaching session.

The third idea revolves around the imputation of truth to any claim, assertion, or theory. Such an imputation is always dependent on broad social acceptance. Consider, for example, the transition in our understanding of the physical world from a Newtonian basis to an Einsteinian basis. The planets surely did not modify their behavior to accommodate mankind’s revised “scientific laws”. Instead, it was society that revised its notion of what was true and *imputed* the Einsteinian description as a true description of the behavior of the planets. This imputation of truth succeeded because society at large was persuaded of the validity of Einstein’s theory. (Coincidentally, at the time of writing this paper, a newspaper article reports that, contrary to Einstein’s Theory of Relativity, space may not be uniform after all. Recent findings suggest that the universe may have an ‘up’ an ‘down’ because there is a mysterious axis that orients the universe.) We see then that what is accepted as true is relative to what is known and socially accepted at any point in time. Social acceptance is, in turn, dependent on the norms and discipline practices that are upheld in the (socially) established conduct of scientific inquiry and what leading experts in a field say. Hence, human knowledge, the product of scientific inquiry, is socially constructed and always susceptible to change.

From a social constructivist perspective, the goal of instruction is to nurture the processes by which learners come to understand the world in which they live. The role of teaching shifts from seeking to maximize the communication of fixed content or skills to one in which students are led to construct interpretations, appreciate multiple perspectives, develop and defend their own positions while recognizing the views of others, and to become aware of and be able to manipulate the social process of knowledge construction itself (Knuth & Cunningham, 1993). These processes of human learning inherently entail social couplings based in language. Individuals come to see the world by representing it socially through conventional means such as language (Jost, 1995).

As we know, scientists conduct empirical research and make their findings known and open to scrutiny, criticism, and debate through conference presentations, panel discussions, and journal publications. In so doing, they participate in a process of socially-grounded knowledge construction that entails stating and defending positions, critiquing viewpoints, justifying assertions, and rebutting criticisms. These processes invariably engage the participants in independent and critical thinking. Our goal as educators is to engage students in a similar knowledge construction process. As part of this process, students will learn to seek out information, filter and evaluate it, apply information to support a stance, and critique, defend, and rebut points of view. These activities help to nurture their independent and critical thinking skills.

MIND BRIDGES

Given the above theoretical predisposition, our aim is to create learning contexts in which students can engage in meaning negotiation and knowledge construction and, as part of this process, develop their independent and critical thinking skills. To this end, we developed the system MIND BRIDGES. This system was inspired by CSILE (Scardamalia & Bereiter, 1989).

MIND BRIDGES is a distributed, multimedia learning environment designed to support media-rich student co-articulations in the context of collaborative knowledge construction. The learning environment allows students to express their thoughts on any subject matter in a threaded form of discussion. Students can make use of text, pictures, animations, sounds, and digital movies to express their ideas. The multimedia elements enhance the representational power of the ideas that students can express. All multimedia elements in a message play back *in situ*.

Figure 1 illustrates what the MIND BRIDGES interface looks like when a student is in the Read Message mode. Notice that messages are classified into Thematic Spaces and Environments. The Thematic Space denotes the domain area of the message while the Environment denotes the meta-level knowledge type(s) of the message content. In addition, students are encouraged to index their messages with appropriate keywords to facilitate keyword-indexed message search.

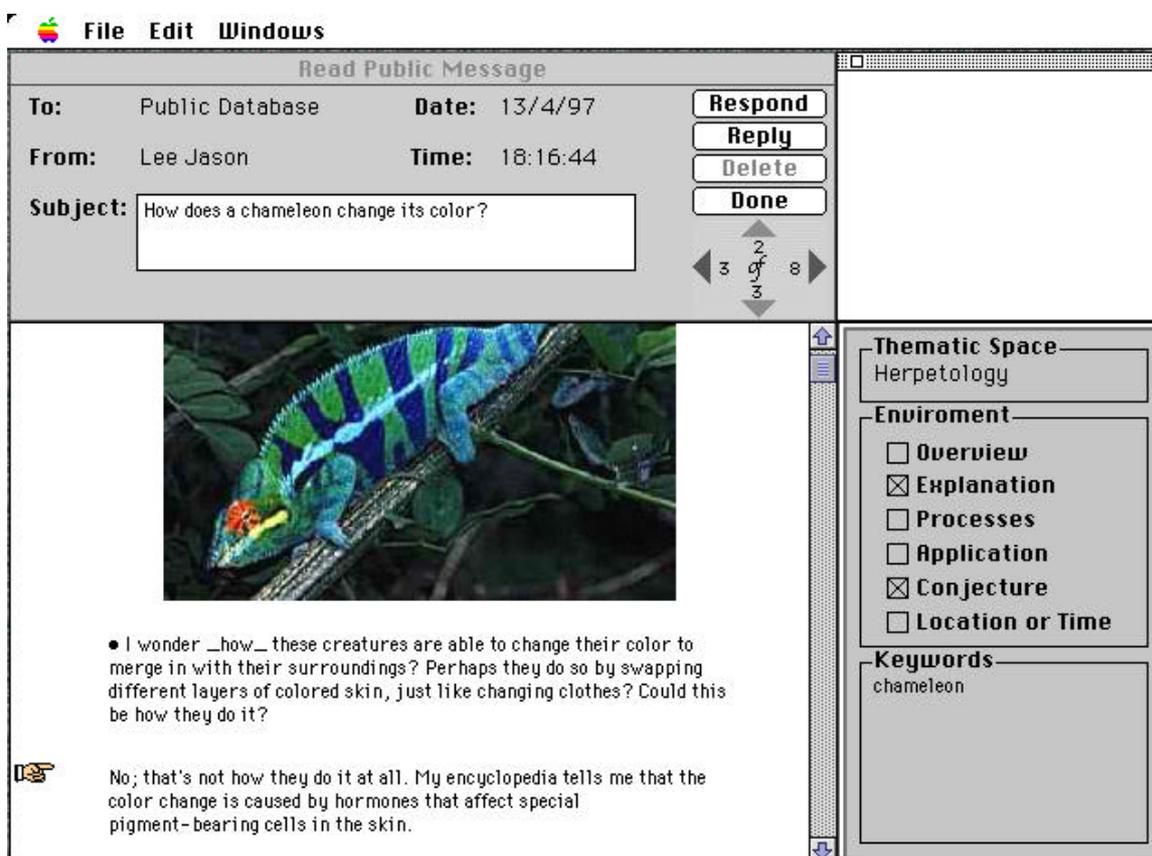


Figure 1. MIND BRIDGES: Read Message interface

The substance of the (hypothetical) message shown illustrates how a student has conjectured about how a chameleon changes its color (the original bulleted message) while a second student (Jason Lee) has disagreed and offered an alternative explanation based on what he has found in his encyclopedia. This message forms part of a threaded list of messages. The vertically-oriented arrows in the top-left pane indicate that we are viewing the second message in a thread comprising three messages. The horizontally-oriented arrows indicate which message we are currently at for the given Thematic Space and selected Environment(s). Note how the disagreement in the message can easily spawn an extended discussion dealing with the way a chameleon camouflages itself to hide from its enemies.

Figure 2, on the other hand, illustrates the Compose Message interface of MIND BRIDGES. It shows a student, Edwin Chan, soliciting information on how to feed and maintain a chameleon as a pet. The interface is similar to the one for reading messages. However, the Compose Message interface contains an extra toolbar used for creating, editing, and importing media elements including movies, sounds, pictures, and text. Note that the interface also supports the recording of sounds through the microphone of the Macintosh as well as the recording of digital videos (this can be done directly on an AV model

Macintosh or using a video capture board on a non-AV model). The pane shown on the top-right is the MIND BRIDGES clipboard.

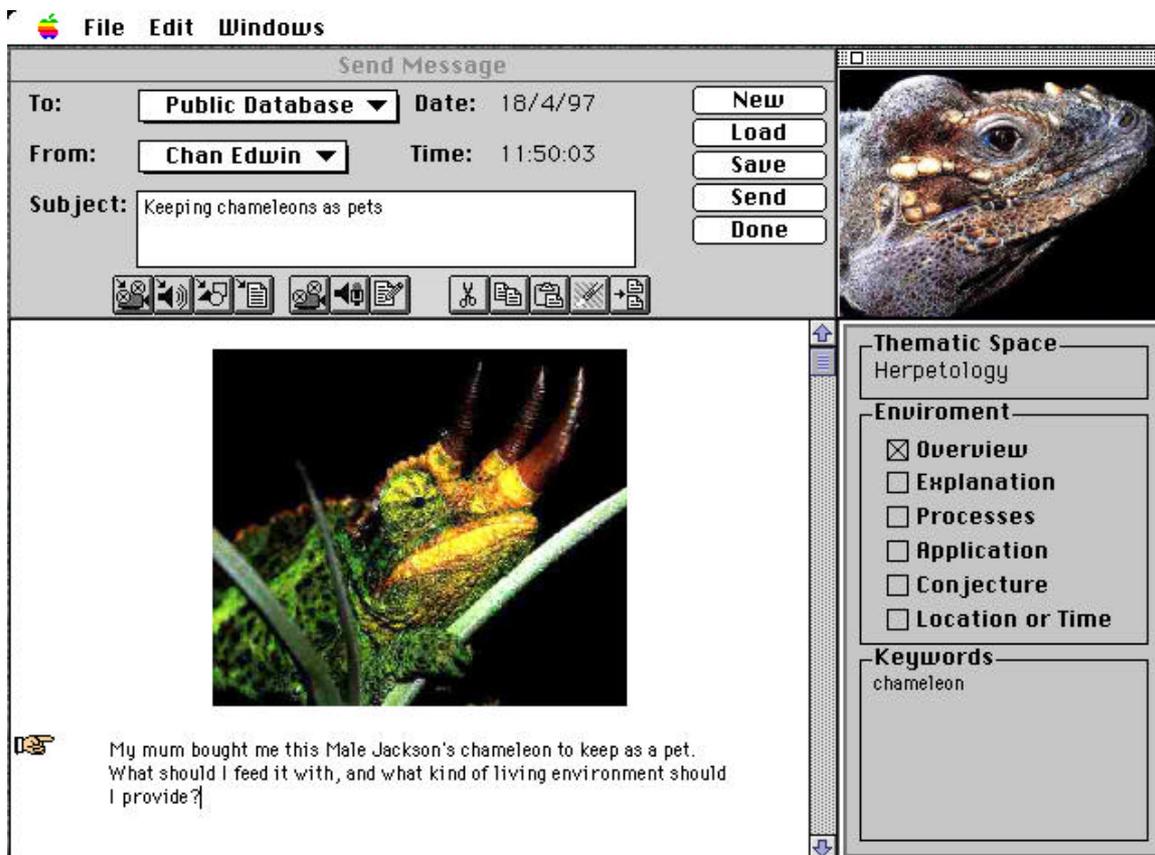


Figure 2. MIND BRIDGES: Compose Message interface

MIND BRIDGES is a client-server system. Communication between students takes place in an asynchronous fashion. In addition to browsing and responding to threaded discussions, students can also perform keyword-based search to find messages of interest. For a more complete description of MIND BRIDGES, see Chee (1996).

To summarize, the purpose of MIND BRIDGES is to provide an environment that will help nurture students' independent and critical thinking skills. As part of the discussion and co-articulation process, students will learn to express ideas effectively, take and argue positions on issues, build up cases to justify adopted positions, and rebut claims. Engaged in this process of learning, students will naturally learn to seek out relevant information, filter it, and adapt it for use in their specific context and based on their specific needs.

Background and context

Our attempts to introduce learning processes of the kind described here date back to around 1995. At this time, it was difficult to find schools that could support a system such as MIND BRIDGES as few schools had computing resources that would adequately support network-based learning with multimedia. Typical problems faced were that there were too few computers, the computers available were too slow, they did not have sufficient memory, or they had no network card and could not be connected to a network. In addition, given that our system was developed for the Macintosh (chosen because of its superior multimedia-

handling capability at the time), we needed to find schools which owned Macintosh computers. Finding such schools proved to be difficult given that PCs, in general, were cheaper.

However, the greater problem we faced concerned the culture of learning found in our schools. Until very recently, rote-oriented learning was very much the order of the day. Our education system has traditionally been very examination-oriented. Good examination results obtained at the Cambridge University-linked Ordinary and Advanced Level examinations provide entry to the local Universities and, ultimately, to better educational qualifications and better jobs. Not surprisingly, students sought to get all the “right” answers to examination questions so as to score top marks. Inevitably their world of knowledge became dichotomized into “right” versus “wrong”: a gross oversimplification of reality. Against this backdrop, a system of school rankings was introduced, and the struggle to be ranked amongst the elite schools led to even greater emphasis being placed on academic achievement. (This emphasis has since been tempered marginally with the inclusion of performance in students’ extra-curricular activities being included in the ranking computation.)

The overemphasis on a “right” versus “wrong” answer approach to learning had an unfortunate side effect: students were always seeking after the “right” answers which they were all too ready to accept without critical evaluation. Amid this background, attempts to introduce a style of learning oriented toward independent and critical thinking proved rather difficult. Our attempts to introduce MIND BRIDGES into the school learning context were by no means successful over the first two years. However, the experience of these years proved valuable in helping us to design improved contexts for collaborative learning.

In the next part of this paper, we deal with some of our experiences during 1996. While the use of distributed learning in a social constructivist mould is still a difficult enterprise in practice, we have begun to make some progress.

Empirical research

Overview

In the 1996 school year, we involved two classes of 15-year-olds in the use of MIND BRIDGES at a secondary school. Given the declining enrolment in English Literature for the Cambridge ‘O’ level examinations, it was felt that the study of English Literature might be made more interesting with the introduction of IT (information technology). We used a text-only version of the MIND BRIDGES software because the Macintosh models then available in the school were not very powerful: the school only had five Macintosh LC575s and two LCIIIIs that students could use.

In the first half of the year, we attempted to run an inter-school study using a TCP/IP version of MIND BRIDGES. However, problems with the software forced us eventually to copy the contents of the knowledge base from one school to another on a periodic basis. This state of affairs was unsatisfactory as the turnaround time for student contributions was intolerably lengthened. MIND BRIDGES activity was eventually concentrated at one school as contributions from the other school dwindled away. The school that continued made use of a somewhat weak class of students.

A motivating context was created for the project, which revolved around the study of Shakespeare’s text, *Macbeth*. Students were divided into two groups: the prosecution and the defence. The two groups would cross swords at an event to be held around the middle of the year: a courtroom trial of *Macbeth*. The role of the prosecution was to prove that *Macbeth* was guilty of killing King Duncan and deserved the death sentence. The role of the

defence was to raise mitigating factors (eg. the role of his wife; the effect of supernatural elements) that would save Macbeth from the death sentence.

In the second half of the year, a second class of students at the same school was brought in to interact with the original Macbeth class. The new class comprised very capable students. It was hoped that the standard of the weak students would improve as a result of interacting with the good ones. For this second phase, students were again divided into two groups—called Mulder and Scully—where the composition of each group included boys from both the good and weak classes. The task of the “Mulderites” was to demonstrate that Lady Macbeth was a fiend-like queen and part of a supernatural conspiracy responsible for Macbeth’s killing of King Duncan. The task of the “Scullies,” on the other hand, was to demonstrate that the supernatural had nothing to do with the murder of King Duncan; rather it was Lady Macbeth who, as a warm and loving wife, supported Macbeth all the way, even to the extent of obtaining the crown of Scotland for himself. Toward the end of the school year, the two teams met in a live debate to present their respective cases, and their presentation was judged by a panel of teachers from the school.

Phase I of Study

When we first launched the project, we found that the students initially resisted the use of MIND BRIDGES. While they felt positively about the objectives of the project, they were not so easily convinced about the potential benefits of doing things “through the computer.” Typing out thoughts was a cumbersome affair and all too slow as most students had not learned to type; speaking face to face seemed a good deal easier. We did our best to explain to the students how a permanent record of messages provides a useful historical trace of thoughts that can later be reflected upon. This explanation was accepted somewhat grudgingly. In truth, the students did raise a valid concern. MIND BRIDGES was conceived and designed for distributed learning. As an asynchronous messaging system, students would ideally be able to use it from anywhere at any time, including from homes. But, due to their not having suitable computers at home as well as not having the needed network connectivity to the server in the school, the students found themselves doing their computer-based work *during* class time where everyone else was co-present. In light of this, their reservations about using MIND BRIDGES were quite understandable.

Our data reveal that, in the early days of the study, there was much muddled thinking amongst the students. In one instance, P1 (student #1 from the prosecution) said:

Refer to lines 24 & 25 of Act 1 Scene 3.

*[Though his bark cannot be lost,
Yet it shall be tempest-tossed.]*

It indicates that the witches do not have total power over Macbeth. He was the one who had hidden desires. He was the one who made his own choice to kill King Duncan.

P2 responded:

It's the bloody witches fault. They instigated Macbeth to assassinate King Duncan. There is nothing to debate about. They are BAD!! Without the witches' interference, Macbeth would not have uncovered his hidden ambition to usurp the throne.

The extract above reveals two problems. First, P2 did not seem to realize that he was supposed to be prosecuting Macbeth instead of defending him. Second, we see an attempt to foreclose any further discussion: “There is nothing to debate about.”

We also found that many students’ contributions tended to be short (no more than five lines of text) and somewhat opinionated. In a further response to the above two messages, student P3 said:

I personally think that Macbeth had evil desires before he spoke to the witches. The witches just brought it out in the open.

In general, we found that students were well able to express their own opinion on some subject or theme. However, they seemed unable or unwilling (or perhaps they thought it unnecessary) to substantiate their opinions with facts and evidence from the play.

More critically, an important feature of the threads of discussion was that they did not lead to any firm outcomes or conclusions. The prosecution was supposed to use MIND BRIDGES as a vehicle through which they would build up their case for prosecuting Macbeth. But, although good and sensible opinions were voiced, the discussion meandered because no leader emerged to help focus the discussion and summarize the prosecution's case over time. In general, the students seemed too engrossed with their own task as prosecutors that they did not see their task in relation to arguments that the defence might raise and how the defence might respond to some of the prosecution attacks. In short, the prosecution adopted an isolated and narrow mindset; they failed to appreciate the broader context of their role. It was therefore refreshing to observe a rare instance in which a student, P4, said:

What could the defence say? They could say that since Macbeth starts and seems to fear (Act 1 Scene 3), that could mean that Macbeth is NOT ambitious as he is appalled [appalled] at the thought of being king.

An example of a better-quality contribution came from student P5 whose message stated:

Act 1 Scene 4, lines 49-53

Macbeth is totally aware of what he is doing. He tells himself that the Prince of Cumberland is an obstacle to his rise to power. He strives to remove all his threats, and this indicates that he is deliberately choosing to be evil. True, the witches aroused his curiosity. BUT, after that, the murders which he commits are of his own design. What more, he chooses to seek the witches out later. This proves that he is already dependent upon the Devil's minions. He could have chosen to stay good, and not let his ambition take hold of him. This ambition, however, drives him to his doom later.

During the course of the Phase 1 study, there were intermittent occasions when the Literature teacher contributed comments to scaffold the students' efforts. For example, when student P6 stated:

To a certain extent, Macbeth was ambitious and did have hidden desires for power. However, it was the witches' prophecy which aroused his intention to be the King of Scotland and he was further provoked by Lady Macbeth as can be seen in the line, "When you durst do it, then you were a man." From here, we can see that there are many factors which influenced his decision so it wasn't completely his choice.

The teacher responded:

What are some of these 'many factors'? Are your above reasons adequate? What other info do we need?

Unfortunately, the student never followed up on the teacher's comments.

Contributions from the defence students were, on the whole, weaker. Just as we found prosecution students arguing for the defence, so too we found some defence students arguing for the prosecution. Furthermore, the ability of the students to make a clear and strong case for their position was also generally weak. Consider what student D1 said in relation to the supernatural exerting an influence on Macbeth to kill King Duncan:

Witches possess supernatural powers:

"When the hurlyburly's done

When the battle's lost and won."

This shows that the witches knew about the war, even though they did not take part in it. They also know about Macbeth and about his hidden desires.

They also knew where and how to meet with Macbeth. This is shown when the third witch said, "There to meet with Macbeth."

The witches also have powers to communicate with animals. This is shown when the first witch says, “I come, Graymalkin,” and when the second witch says, “Paddock calls.”

From all these evidence, we can assume that the witches have powers to influence Macbeth’s actions, and in this case, influence Macbeth to kill King Duncan.

The above message reveals poor logical reasoning. There is a quantum leap between the evidence put forward and the inference drawn. Fortunately, a good student from the cooperating school countered:

I don’t really agree with the part about the witches being able to influence Macbeth’s actions because they were merely predicting his actions. They knew where and when he would appear because it is believed that witches have the supernatural powers of predicting the future. In any case, Macbeth killed Duncan because of his ambitions and not because the witches influenced him. However, they did tell him that he was going to become king, thus causing him to be ambitious. [etc.]

While the counter-statement is entirely appropriate, we find, again, a defence student adopting a prosecution position. More significantly, the earlier observation that the prosecution students seemed unable to self-organize and build a systematic prosecution case was equally true of the defence students. While there was evidence of some good discussion and statements of opinion, students engaged mainly in airing their views on whether Macbeth was to blame for King Duncan’s murder.

Phase II of Study

The domain objective in Phase II was to explore the theme of the supernatural in the play Macbeth and, in particular, to demonstrate that, as part of the broader supernatural context in which the play is embedded, to debate whether Lady Macbeth is a “fiend-like queen.”

In this study, good students from a top class were brought in to engage with the weak students from Phase I of the study. The Mulder and Scully groups each contained good as well as weak students. We received some excellent contributions from the good students. They typically showed a clear awareness of their contention with the opposing team, a significant advance over the Phase I students. An extract from a Mulder student reads:

The “Scullies” say that Lady Macbeth is a warm, supporting and loving wife. It is unbelievable that they can make such a hideous lie.

Firstly, Lady Macbeth, if she is as warm as the “Scullies” claim, she must be a warm person with a cold heart; someone who has no reservations about killing her own baby, who at that point was “bonding” with its mother—suckling her for milk. In fact, Lady Macbeth sends shivers down my spine with all her evil deeds. How can she be called warm? Is the definition of a warm person to the “Scullies” mean a person who talks about a cold “keen” knife”, “direst cruelty”, “thick night”, “blanket of the dark” and “raven . . . croaks the fatal entrance”? These are images of death and darkness, which in turn reflect on the evilness and coldness of Lady Macbeth.

What was most gratifying to see, however, was some of the weaker students beginning to manifest some degree of metacognitive awareness. For example, student P1, now part of the Mulder group, said:

Lady Macbeth is a fiend-like queen (that is what we are trying to prove.) Her first appearance in the letter scene . . . [etc.]

In contrast to the situation in Phase I, this extract reveals that P1 had overcome his narrow mindset and was aware of his task in relation to the larger purpose (what his team was trying to prove). At the same time, student P4, now also part of the Mulder team, responded to the question “Why didn’t she [Lady Macbeth] just go ahead and murder Duncan when she had the chance?” as follows:

OK, so he reminded her of Dad . . . Big deal . . . The Scully people will argue that this shows how compassionate she really is.

*@ We CAN say that she wanted to initiate Macbeth into REAL evil (ie. The Supernatural—not the weak stuff that Macbeth was playing about with at the start of the play.) Ya’know, kinda *blood* him, get him started on the path of evil. Sooo . . she’s evil!!!*

Recall that student P4 was the only weak student in Phase I that made mention of what the opposing team might say. In the extract above, we see that he goes one step further. Not only does he anticipate what the Scully team might say, he also plans a suitable response to what they might say.

Finally, we share a short extract, three months into the project, where a good student from the Mulder group stated:

Hi, this is David. Let’s just take things in their proper perspective and hold on for a minute. Before we start accusing the other side of vile deeds and deceitful words, why not take the time to consider what we’re supposed to do in the first place.

1. We have to prove beyond reasonable doubt that Lady Macbeth is a FIEND-LIKE QUEEN.

[etc.]

The extract above reveals clear evidence of the student engaging in reflection, a type of metacognitive activity. This observation was most gratifying.

Lessons, limitations, and successes

Based on the experiences that we gained in attempting to introduce a collaborative knowledge building project in our schools, we now share some important lessons that we learned. The obvious lessons were:

- Adequate student access to computing resources is essential for a project of this nature to succeed. The lack of adequate resources in the school at which we conducted our empirical work made it difficult to operationalize the study.
- Teacher commitment to the project is paramount. Teachers need to be willing to commit time and effort to participate in the ongoing dialog between students and providing them with modeling and scaffolding support.
- Ample technical support for maintaining the networked computer system is essential. Technical problems inevitably arise, and they need to be resolved efficaciously.

Some less-obvious lessons that we learned were:

- Good project design by teachers is crucial to the success of collaborative knowledge building projects. Teachers need to create and instantiate a meaningful context in which the collaborative learning activity can naturally unfold. Left to talk about things over the computer, students will do just that. However, their discussions are likely to be meandering, unfocused, and ultimately unproductive. The design of a competitive context in which the learning took place in our study went a long way in keeping the students engaged in the project.
- Students need tangible motivators and rewards to encourage them to contribute their best to the project. Sustaining a learning project over a period of five to six months can be quite a challenge for 15-year-olds. One of the motivators that we provided was official Certificates of Participation. In our experience, intrinsic motivation alone could not make the students sustain their project effort.

- Teachers need to drive the project and press students to sustain their project efforts. If our 15-year-olds had been left to maintain the project momentum on their own, they would not have succeeded in bringing the project to a satisfactory conclusion.
- The benefits of matching students of different abilities can be difficult to realize. Too great a gap between the ability levels of good versus weak students is likely to result in the two groups being unable to engage each other successfully in productive discussion. A judicious assessment by the teacher is necessary.
- Getting students to engage in directed discussion can be difficult as it requires an important change in mindset. Our students took quite a long time to move from a “put information into the system” mindset to a “let’s discuss the issues” mindset.

Our data suffers from two basic limitations. First, the quality of the data is rather coarse. This coarseness is partly the result of other classroom and non-classroom interactions not captured by MIND BRIDGES (a leakage effect) and partly the result of students finding it cumbersome (difficulty with typing) and inconvenient (inadequate access) to use the system. Second, the level of participation by the students did not occur evenly over the study phases. There were often other classroom or school-related exigencies that took students away from their scheduled MIND BRIDGES sessions. This problem made it difficult to capture a smooth evolution in students’ thinking.

What has been achieved to date needs to be viewed in the context of the background to our study described earlier. Despite the difficulties faced, we are pleased to report that the Mulder—Scully debate at the end of the school year was a big success. We are also pleased to have observed some measure of metacognitive development on the part of some of the weaker students toward the end of the year while the good students made full use of the intellectual space afforded to them in their study of Macbeth.

Conclusion

In this paper, we have laid out the position of social constructivism as a basis for our work and used it to motivate the design of our collaborative learning tool, MIND BRIDGES. We described the context in which our research efforts have been embedded and illustrated some of our observations using data captured in MIND BRIDGES. We also listed some of the important lessons that we learned through engaging in this enterprise, stated some of the limitations of the data collected, and detailed what we feel to be some successes.

One of our disappointments is that we were unable to make use of the multimedia support in MIND BRIDGES during the 1996 studies due to lack of hardware as well as some software problems. We are currently running a new study that attempts to make use of multimedia elements in MIND BRIDGES, in the context of the subjects Physics and English Language.

All told, it should be evident that introducing social constructivist-oriented learning in a system with a traditional bent is a rather difficult enterprise. Fortunately, it appears that our education system is about to be put through a major revamp with the goal of transforming the rote-oriented learning system to one that emphasizes independent and creative thinking with extensive use of information technology thrown in. We anticipate that this transformation will be in place in three to five years. It will provide a positive boost to the kind of work that we have been doing and facilitate the learning processes that we have been encouraging amongst our school students.

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