The Journal of Interactive Online Learning Volume 3, Number 1, Summer 2004
www.ncolr.org ISSN: 1541-4914

# Using an Electronic Bulletin Board in Science Teacher Education: Issues and Trade-offs

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University professors increasingly are expected to infuse computer technology in teaching. Many universities are aggressively promoting the delivery of entire courses and programs using computers and the Internet as vehicles for instruction. There is also a movement to align university teaching with the national standards for K-12 teaching. National and state standards call for K-12 teachers to integrate computer technology in teaching. One way to encourage prospective or experienced teachers to do that is to provide opportunities to experience success using computer technology during preservice and in-service courses. Computer-mediated communication (CMC), or any form of communication that takes place with the use of a personal computer, can be an effective tool for not only infusing technology in an education course, but also for fostering the creation of a community of learners within which the social interaction supporting meaningful learning occurs (Fussell & Benimoff, 1995; Herring, 1996; Nonis, Bronack, & Haton, 1998).

As a result of integrating Web-based structures into multiple sections of graduate and undergraduate teacher education courses, we are convinced the best education for all students is a combination of weekly face-to-face class meetings and the use of the Web for CMC and delivery of a resource collection tailored to a specific course. However, the time commitments for this configuration can be outrageous. It often requires not only the usual time invested in a face-to face course, but also time invested to design and execute the Web-based course structures. The time invested in CMC can be an ongoing burden beyond the instructor's comprehension or the university's compensation. We propose choices in CMC design format that can mitigate the time requirements for the instructor while providing productive learning opportunities for students.

The expression "bulletin board" (BB) describes an asynchronous electronic space where "text or graphics-based communication takes place over time with participants posting messages that receive responses later in time" (Burkett, 2002). All members of the group are able to post messages made public to all others in the group. In courseware packages such as WebCT and Blackboard, messages and responses can be displayed in threads of related messages facilitating the flow of the conversations.

## What are the Format Choices?

### *The All-in-One Discussion*

The structure of the BB depends on the intended outcome for the discussion. For instance, instructors might use a BB with no divisions; all messages on all topics are posted in the same area. Announcements and clarification of assignments are posted for all students at the same time. This quickly and easily disseminates information to the entire class. All discussions are begun here. Diversions into tangential topics are continued in the one discussion. Classroom discussions cut short by the limitations of class schedules can be continued on the BB. This format choice has several drawbacks for a semester-long course: (a) the intrusion of announcements and personal challenges interrupt the flow of continued discussions; (b) as the semester progresses, the length of the discussion complicates finding previously discussed information; and (c) the tangents can become the focus of the discussion. One plan for mitigating these drawbacks includes monitoring the discussion for inappropriate social or tangential issues. Often the instructor feels compelled to serve as monitor, but the use of rotating student monitors relieves the instructor's time commitment. Students are assigned monitoring duties for a week or more. This activity provides a sense of ownership in the discussion and gives students practice that can be useful in their future teaching assignments. The awarding of grade points for this function seems to be a necessary incentive for full participation.

### *Multiple Discussion Areas*

A second format choice mitigates the problem of excessively long discussions. In this format the instructor divides the BB into several areas, each dedicated to a particular discussion purpose. Separating the discussion into areas creates smaller blocks of related information making it easier for those trying to follow the flow of information. A trade-off to the limiting of discussion to a single topic can be an inhibition of the natural flow of discourse. The structuring of the discussion without overlapping topics can lead to artificial divisions in the discussion. Another issue in this format is the decision about what areas to include in the BB. In a course structured as an open-ended, student-centered inquiry where students select the order and time to read course materials, the BB is used as a place to record and discuss thinking and learning on each article. These multiple articles can require the addition of a discussion topic for each reading or group of readings. Three divisions with which we have experimented are (a) social interaction, (b) class housekeeping functions and technical assistance, and (c) course subject matter.

***Social interaction.*** Social interaction is a discussion area where students communicate on topics not specifically related to the course material, but necessary in the formation of a social support network for the community of learners. Members may share personal events, events in the news, controversies on campus or other topics of interest to them, including their feelings and interpretations of the class. Instructor involvement in this area may range from no participation in what is considered a student-owned social forum to full participation as the dominant person in charge. Between these two extremes are the "lurker" who reads to learn about her or his students and the instructor-as-peer participant. The position one takes in this discussion depends on the instructor's goals for the kind of community one wishes to develop. It is important to create a balance between

a trusting environment, where students may speak what is on their minds, and anarchy. Students, feeling that this is an "anything-goes" arena, are free to say whatever they want and, using the computer as an intermediary and shield, may write things that would be inappropriate, or even rude, topics in the face-to-face environment. Just as with a face-to-face class, the social area can be dominated by one or two students commenting on a variety of personal or class issues. These students can be a positive influence, generating feelings of camaraderie and community, or negative personalities lacking skills for appropriate social interaction. This can lead to the discussion area becoming a "gripe session." The prevention of these behaviors involves setting at the outset rules for the discussion and providing for the monitoring of the discussion.

***Housekeeping and technical assistance.*** The housekeeping and technical assistance section provides a space for announcements, discussions clarifying students' varying interpretations of course procedures and assignments, and the sharing of technical information about hardware and software. A trade-off to providing a separate area for these issues is that students may fail to access this topic and miss relevant information, important announcements, or information pertinent to problems they may have experienced. As with the social interaction discussion area, there is always the issue of inappropriate remarks and public airing of remarks better addressed privately in e-mail. To ensure accurate and timely information, the instructor should monitor for this discussion.

***Course subject matter.*** The third area of the BB, course subject matter, includes reflections on and discussion of course materials and products. The written discussion helps students create meaning and develop cognitive frameworks. Each student must actively read, interpret, and question others' works in order to dialog. Writing becomes a vehicle for learning with reading and interpretation incorporated in this process.

Writing as a way to learn has been well documented (Graves, 1978; Murray, 1996; Nelson, 1991). The process of committing words to keyboard and screen obliges students to clarify the meaning they are making in order to articulate their ideas. They have to organize thoughts and select the language that represents their thinking. This reflective process of selecting and structuring appropriate language triggers reorganization of cognitive frameworks and establishment of new connections leading to richer understanding. The asynchronous nature of the BB is an aide to developing understanding. The delay between messages provides opportunities for students to research other data sources, create new ideas, and clarify their own thinking to develop more complete understanding.

An issue that surfaces in online discussion is misinterpretation. This is a problem in face-to face conversation, but can be exacerbated in CMC by the loss of inflection and emotion inherent in face-to-face communication. Sarcasm, interpreted literally, can lead to unpleasant and unintended meanings. Another area in which misunderstanding arises is the use of distinct operational definitions for common words and phrases, for instance, using "opinion" to mean one's own unsubstantiated belief rather than a statement of understanding supported by relevant research and data. Especially at the beginning of a course, the instructor needs to be aware of these possibilities and remind students of the need for supporting evidence for a stated opinion or join the conversation to ask for clarification.

## Other Issues

### *Reflection*

Reflective journals, where students record, in writing, their thoughts and ideas about course materials, are enhanced by the discussive nature of the BB. In order to develop understanding, information must be assimilated into one's cognitive framework (Ausubel, 1976). Social interaction and subsequent multiple perspectives inherent in a group of learners where each individual is building on his or her idiosyncratic prior knowledge, or cognitive framework, contributes to this assimilation. Understanding, or the assimilation of ideas and information to construct meaning, is evidenced by students' ability to generate statements of application, interpretation, perspective, empathy, and self-knowledge (Wiggins & McTighe, 1998). The social interaction contributing to assimilation is an iterative process. Individuals make sense of course materials and experiences and record their thinking in a written record on the BB. This reflective journaling makes public the cognitive processes that each person uses and becomes a source of ideas for others to add, delete or rearrange connections in their own thinking. The new postings reflect community feedback and individual amended thinking. This iterative process encourages and supports scientific discourse, or the evaluation of evidence and the reasoning presented, the challenge of conceptions and the provision of alternative explanations.

A more structured approach to reflective journals requires the posting, at specified time intervals throughout the course, of higher level (Bloom, 1956) questions on a specific course topic. These questions may be formulated either by the instructor or by individual students taking turns as student moderators. In the later case, the student moderator is required to study the topic in advance of the discussion and to then respond to others as they participate in the BB discussion. At the end of the allotted time for a particular discussion, the student moderator must then post a summary of the discussion (Harasim, Calvert, & Greeneboer, 1989)

Ideally, each student should have a turn as moderator; however, university classes have more students than weeks of class. A way to accommodate this is to divide the larger class into smaller groups. Each week a different student moderator summarizes the discussion, posting the summary to a main discussion area. All students and the instructor read the summaries. In some cases the instructor may not participate in the group discussions except to read and comment on the summary.

In addition to the written-word form of communication, the BB can also incorporate graphic interpretations of how students are making meaning of the course material.

### *Graphic Interpretations*

Building a series of concept maps several times during the semester and posting them on the BB can be an effective strategy for helping students articulate connections they are making among concepts. Students create the concept map using software tools such as Inspiration (Helfgott & Westhaver, 1999), MindManager (2002) or Microsoft Office. Using the software gives students the option of making changes to the c-map as the course progresses. As the c-maps incorporate more ideas and linkages, they become

large images that must be scrolled across the screen to view the entire map. When students post their maps on the BB, the maps serve as triggers for others to test different connections. This assignment helps students to (a) think through the many ways concepts can be connected to each other to construct meaning, (b) see that cognitive frameworks are idiosyncratic, and (c) develop multiple perspectives on various aspects of the interactions between science, technology, and society. Once again, if policing assignments is an issue, the maps can first be posted to the professor in private before posting to the entire class.

Creating concept maps as a group is another use of the BB. People can add or rearrange parts of the map and write their explanations for the changes they post if they are not obvious. The process of reaching consensus fosters consideration of multiple perspectives and subsequently enriches meaning and understanding.

### *Product Development*

The BB can be a place for student products to be displayed for all to read, comment and save. For instance, in a science methods class for elementary teachers, the students are required to search the Internet for a prepared science activity. These activities are posted to the BB for small-group feedback. Each group selects one activity for class presentation. This use of the BB creates a collection of annotated activities on a variety of subjects and at varying grade levels. Preservice and in-service teachers alike appreciate that these have been screened and evaluated by classmates. They can be reasonably assured that these are appropriate resources for use in the classroom.

### *Developing the Community of Learners*

In the university classroom, conversations are often two-way, back and forth between student and teacher. In that setting it can be difficult to convince students that they need to question and respond to each other creating a network of responses. With the BB, creating this network is much easier. There is no one "dressed for success" standing in the front of the room. This absence of visual cues telling who is in charge results in a leveling of the playing field. Students question and respond to each other rather than waiting for the instructor to give the "correct" answer. This helps to develop the community of learners in a way that cannot be done by the instructor and contributes to student ownership with a more positive attitude toward the course.

The division of the BB into the three sections, social interaction, housekeeping and technical issues, and course material, is but one of the decisions an instructor may make when designing the Web-based portion of a course. There are other advantages and challenges that may emerge when using the BB. The following section is a discussion of some of these issues.

### *Assessment and Evaluation*

The electronic discussion provides a record of who is or is not participating, increasing the accuracy of the instructor's perceptions about class participation. It also provides a check on the quality of that participation. In a vigorous class discussion, statements can be either misconstrued or altogether forgotten. In a large class, side

conversations may take place and the instructor has no way to listen or evaluate these. If the class is broken into small groups for discussion, then only bits and pieces of the conversations will be observed. With the BB, all conversations are recorded and content can be evaluated.

***Diagnostic tool.*** The written record provided by the electronic BB can also be a useful diagnostic tool. It provides a record of students' thinking, how their ideas change and what misconceptions, or alternative conceptions, they may hold. The asynchronous nature of the BB provides built-in wait time, allowing the instructor to monitor discussions of and challenges to the alternative conceptions or to provide resources for students to research the facts. Revised concepts are then posted in the BB.

***Monitoring assignments.*** The instructor can monitor the BB written record, checking assignments for on-time completion by simply viewing the assignments with the time/date notations. This can be done at the instructor's convenience or assigned to a student.

The BB not only provides a permanent written record of assignments but is versatile enough to accommodate assignments that are often the basis of assessment in face-to-face classrooms as well. Both product- and process-driven assignments can be monitored.

The trade-offs in using the BB to post product-driven assignments include the fact that when assignments are posted electronically, then others have the opportunity to piggyback on someone else's work. The instructor will need to have creative ways to check for accountability. One way to encourage accountability is to announce to students that the first to post an idea will receive maximum credit for the idea. Another idea is to have students post products first to the instructor and when all have posted or the deadline has passed, the products are displayed for all to view. If the instructor is interested in process-oriented assignments such as journaling, scientific discourse, and feedback, then other types of monitoring are appropriate. For instance, students can be required to include in their posting a question to which another student must respond. Another instance is requiring students to note in their responses information posted in another's journal.

### *Issues of Time*

Time management is a quagmire for both students and instructors. The BB offers several features that can help mitigate time constraints. Some of the most notable advantages are the following:

- Overcoming constraints of class time periods: Discussions are not limited to the class period and can continue over a period of days, if necessary. Instructors often remember the best examples after class is dismissed. The BB gives instructors and students time to pull together the best resources.
- Overcoming those who monopolize the conversation: In the classroom, time limits make monopolizing conversation a problem. On the electronic BB, several conversations may, in fact, be taking place at the same time with all posted for comment. If one student tries to monopolize the conversation, others may either ignore the statements of the dominant discussant or choose to start a new conversation.

- Saving repetition: When students ask similar questions, the instructor refers the student to the message containing that information. If students are assigned to separate private discussion groups, the repeated message may be copied and pasted into a separate message for each group. When posted by students, messages containing particularly useful insights may be copied to the other small groups or simply moved to a main discussion area so all may read and comment. When copying, moving or deleting student messages, the instructor should post a message indicating that this has been done.
- 24/7 availability: One is not constrained to be in a particular classroom, on a designated day, at the designated hour. Travel time is eliminated and dress code is not an issue. Participants are able to jump online and comment when they are available. One can work at any hour, day or night. This availability does, however, require disciplined regular participation on the part of both instructor and students.
- Just-in-time delivery of information: Another feature of asynchronous BB discussion is the ability to add relevant information to a discussion when and where it is needed (just-in-time learning). The instructor can observe teachable moments and use those to provide new information or new angles on old information. The advantage is that providing the information in the discussion meets a student's need to know in a timely fashion and is, therefore, more likely to be meaningful and to be incorporated into a student's lexicon for decision-making and acted upon. Additionally, there is no need to stop the class with the phrase, "I don't know. Let me look it up and I'll get back to you." In the asynchronous format, both instructors and students have time to research information and either incorporate their information into a new message or provide links for others to read articles online.

***Additional Trade-offs***

Students often lack time management skills and have difficulty allocating the necessary time to think and respond appropriately. The large class cannot be expected to participate as one group reading and responding to everyone's postings. In this case the requirements must state that students are only expected to read a portion of the postings and respond to a limited number during each discussion period. The other option is to divide the class into smaller discussion groups and the students in each small group are expected to read all responses from all members and respond to either all or a limited number. The pitfall here is that some groups work better than others. This can be a problem for the instructor. Requiring the less able students to visit other groups and read postings can be interpreted as indicating that the ideas expressed were unacceptable. It is also a violation of the trust built among members of the host group. They may regard the visitors as spies violating the trust agreement in their group. An attempt should be made by the instructor to create a more constructive atmosphere so that the group heals within itself without disrupting others.

The instructor's time in the BB may be less than students expected, creating frustration and alienation. The instructor may have underestimated the amount of time needed to read and respond to students' postings or set too high a standard for the amount

of interchange with students, leading to an inability to read and reply to most of the postings. Students want to know that the instructor is at least reading their work. They long for feedback, although some may not recognize non-evaluative feedback. They only see as feedback comments indicating "good" or "bad." They are used to having instructors tell them they have done well or they have done poorly, usually in the form of a grade. Without the positive strokes and the "warm fuzzies," they feel as if they are not getting feedback and may become resentful.

Many instructors have faced time challenges. The best education always takes the most time—whether it is fully online using Web-based courseware, fully face-to-face, or some combination of these. The most contact is provided in the Web-enhanced course; however, the time demanded to do this combination design can be outrageous. It not only requires the original time invested to design and execute the course materials, but using CMC threatens to become an ongoing burden beyond the university's compensation.

## In Closing

As with any course design, there are advantages and disadvantages to incorporating the electronic BB in a course. The process is time-consuming and laced with challenges. Each aspect of BB use must be subjected to a cost-benefit analysis weighing the cost in instructor time against the gains in student understanding. Each instructor must decide whether the use of an electronic BB tips the balance toward advantage or challenge.

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