

## A Comparison of Computer-Mediated and Face-to-Face Discussions of a Multimedia Case Study of Mathematics Teaching

A survey of the literature indicates that educators possess a large amount of interest in online environments for teaching. As yet, however, little systematic research is available that compares online communication with face-to-face communication in educational settings. Since Internet use has become widespread in teaching and learning contexts, it is essential to examine how computer mediated communication (CMC) influences human learning with respect to face-to-face communication. Key questions that need to be examined include, “Is CMC an effective tool in teaching and learning?”, “Does CMC affect equality of participation among individuals?” and “Does CMC, in as much as it provides more time for reflection, enhance the sophistication of language used in educational settings?”.

The research proposed here examines how four cultures with a common interest in mathematics teaching and learning -- pre-service secondary mathematics teachers, in-service secondary mathematics teachers, mathematicians, and mathematics teacher educators -- communicate about a multimedia case study, Making Weighty Decisions (Bowers, Doerr, Masingile & McClain, 2000). Since each of these groups of people share similar problems, use similar words to identify concepts, play [similar] roles in teaching and mathematics and work in similar physical environments, we refer to them as cultures. These cultures met both on-line and face-to-face to discuss the multimedia CD. Our basic goal, in this session, is to examine how the computer-mediated discussion differs from the face-to-face discussion, making use of computer mediated discourse analysis (CMDA).

### *Setting the stage*

This research was carried out as part of a project entitled Collaboration for Enhancing Mathematics Instruction (CEMI), funded by Lucent Technologies Foundation. CEMI is a new partnership between Indiana University (IU) and Monroe County Community School Corporation (MCCSC), involving middle and high school mathematics teachers of MCCSC, the Department of Mathematics of Indiana University, and the Indiana University School of Education (SOE). An important goal of CEMI is that all members of the collaboration develop richer and deeper understandings of mathematics teaching and learning.

The purpose of the CEMI project is to engage the four cultures (in-service secondary mathematics teachers, in-service secondary mathematics teachers, university mathematicians and university mathematics educators) in Lesson Study Groups (LSGs) similar to those commonly found in Japan (Lewis & Tsuchida, 1998). Prior to engaging in the multimedia case study, Lesson Study Group (LSG) members engaged in activities designed to acquaint them with various perspectives on mathematics teaching and learning and professional development. Foci included the National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics (NCTM, 2000), Japanese lesson study groups, and the mathematical task framework (Stein, Grover, & Henningsen, 1996). Each LSG member was asked to view the multimedia case study CD and related materials individually and then to respond to on-line discussion

prompts. Discussion prompts were designed to encourage participants to reflect on the teacher's role in planning for and facilitating classroom activities, the mathematical content of the lesson, and the level of student thinking throughout the lesson. On-line discussion that took place within the Inquiry Learning Forum (ILF) (<http://ilf.crlt.indiana.edu>) proceeded for approximately four weeks. The ILF, hosted at Indiana University, "is a web-based professional development tool designed to support a community of in-service and pre-service mathematics and science teachers creating, sharing, and improving inquiry-based pedagogical practices" (Barab, Makinster, Moore, Cunningham & the ILF Design Team, in press, p. 3). LSGs also met face to face to discuss the case study twice during these four weeks. Post-interviews were conducted approximately two weeks after the conclusion of on-line discussions.

### *Research Questions*

Specifically, this study seeks to determine the following:

- What are diverse members of a professional community (in-service secondary mathematics teachers, in-service secondary mathematics teachers, university mathematicians and university mathematics educators) doing as they talk about mathematics teaching and learning?
- What role and power structures are influential among the participants?
- How does computer-mediated communication (CMC) differ from face-to-face communication with respect to the above questions?

### *Data Sources*

In this study, we used transcripts of on-line and face-to-face discussions of the multimedia case study by the six Lesson Study Groups and interviews of the 38 participants as data sources. Our primary goal in selecting data was to hold the topic and the participants constant, while varying the mode of communication: Computer mediated communication (CMC) versus face-to-face communication.

### *Methods / Theoretical Approach*

Computer mediated discourse analysis (CMDA) (Herring, in press) guided the data analysis phase of [the investigation]. Specifically, we obtained descriptive statistics on language complexity and participation by role and gender, and conducted pragmatic analysis of speech acts. We interpret our findings through a Critical Discourse Analysis (CDA) (Fairclough, 1992) lens that is sensitive to participant relations and power dynamics.

We analyzed participation for each discussion and for each type of communication mode, CMC and face-to-face communication. This involved counting the number of messages and number of words contributed by each participant as a means of determining whether the project members participated in the discussions equally. In addition, we examined whether some individuals or groups dominated other individuals or groups.

We also used the exchange structure of Francis and Hunston (1992), originally developed by Sinclair and Coulthard (1975) for the analysis of classroom discourse, to analyze the transcripts of the discussions. Exchange structures are sequences of speech acts (agree, inquire, inform, react, etc.) produced when individuals are engaging in

conversation. The model was developed for face-to-face conversation, but has been applied to educational CMC by Herring and Nix (1997). The goal of the present analysis is to understand what kind of speech acts take place in CMC and face-to-face communication in discussing the multimedia CD. Additionally, we compared the speech act usage of groups and individuals within the groups.

### *Preliminary findings*

#### Participation

##### Overall

Descriptive statistics reveal that 19 participants posted 87 messages during a five-week period. The average number of messages per day is 2.43 and the average number of words that the participants posted daily is 254.25. These values suggest that the participation rate is relatively high. In addition, the average message length is 102 words, indicating that the participants posted long messages. Since the participants are highly educated people, this finding makes sense. Finally, the statistics indicate that the computer-mediated discussion is active.

##### Group Differences (number and length of messages for each group)

The data show that 10 females posted 47 messages and 9 males posted 40 messages. This result does not show a significant gender difference; however, the average length of messages posted by males is 128.7 which is larger than 79.6 of females. This finding suggests that females present their ideas briefly, but males write more. Probably, males focus on more details which could be an interesting observation because traditionally, it is believed that females focus on details more than males.

Also, it is revealed that there are significant differences among the cultural groups participated in this study. For example, the average message length is 91.2 words for pre-service teachers; however, this value is 140 words for mathematicians and 153.3 words for teachers. These findings seem meaningful because pre-service teachers may know about teaching less than mathematicians and teachers. A surprising finding is that the average message length is 74.2 for teacher educators. A reasonable explanation can be that the teacher educators did not want to dominate the discussion, so they post relatively short messages.

#### Language Complexity

##### Overall

Initial results for the computer-mediated discussion suggest that language use is relatively complex, as measured by word and sentence length. The average word length posted by the participants is 4.54 characters and the average sentence length is 21.68 words, consistent with previous findings for edited written discourse. These findings suggest that CMC in educational settings may help the participants construct complex ideas, in as much as longer sentences encode complex thoughts. We also calculated the type-token ratio, the ratio of the number of word types to the number of word tokens in the text, as a measure of range of vocabulary used. In the present study, the type-token ratio was calculated as 0.16, a rather low value, suggesting either that participants'

vocabulary was limited, or that they were focusing narrowly on a particular topic of discussion in which the same words were repeated often.

### Group Differences

The findings indicate that mathematics educators used longer words and shorter sentences, in contrast to in-service teachers who used shorter words and longer sentences. This suggests a strategy whereby mathematics educators expressed their opinions concisely using more complex words. Similarly, females used longer words and shorter sentences than males. Also, it is shown that the preservice teachers used less complex sentences than other populations. This result makes sense because pre-service teachers have the lowest education level.

### Speech Acts

#### Overall

The speech act analyses indicate that generally the participants are informing each other, sharing their observations, inquiring and commenting on their own statements as they discuss the multimedia case study. These results are consistent with the findings of Herring and Nix (1997) for a distance education course. However, unlike in Herring and Nix's study, the participants use very few directive speech acts, suggesting a relatively polite and egalitarian environment.

#### Group Differences

Initial results for the computer-mediated discussion indicate that males share their observations more than females, while females ask more open-ended questions. Moreover, the teacher educators usually ask the questions and the pre-service teachers answer. Thus the traditional roles of teacher-student are preserved, even in the computer-mediated environment. It should be noted that in some cases, the pre-service students ask questions, presumably to learn more about teaching and learning mathematics.

Thus far we have completed the preliminary analysis for the computer-mediated discussions. These findings will be compared with the results of a similar analysis of the face-to-face discussions of the multimedia CD by the same participants.

### *Conclusions/Implications*

The basic goal of this study is to examine how CMC differs from face-to-face communication through computer mediated discourse analysis (CMDA). CMDA helps us understand teacher education phenomena better. The analysis reveals empirical evidences of individual and group differences with respect to participation in CMC. Revealing such differences can help teacher educators and instructional designers build online communities in teacher education settings. Participation statistics also provide evidence that helps us to understand power dynamics within the online or face-to-face community. In our study, power structures are potentially always an issue because instructors and students share the same context. Since teachers have more authority than students, in our research, we expect to see teacher educators and teachers participate more. In addition, we observed that members of different groups use some speech acts more than others, indicating that participants have diverse intentions. If teachers, teacher educators,

mathematicians and pre-service teachers have diverse goals in a shared context, they may not understand each other well.

The findings of this study thus make contributions to various fields, including information technology, teacher education and CMC.

### References:

- Barab, S. A., Makinster, J. G., Moore, J. A., Cunningham, D. J., & the ILF Design Team (In press). Designing and building an online community: The struggle to support sociability in the Inquiry Learning Forum. *Educational Technology Research and Development*.
- Bowers, J. S., Doerr, H. M., Masingila, J. O., & McClain, K. (2000). *Multimedia case studies for teacher development: Case II: Making weighty decisions* [CD-ROM]. San Diego, CA: San Diego State University, Syracuse University & Vanderbilt University.
- Fairclough, N. (1992). *Discourse and Social Change*. Cambridge: Polity Press.
- Francis, G. & Hunston, S. (1992). Analysing everyday conversation. In M. Coulthard (Ed.), *Advances in Spoken Discourse Analysis*. London: Routledge.
- Herring, S. (In press). Computer-mediated discourse. In *Handbook of Discourse Analysis*, ed. by D. Tannen, D. Schiffrin, & H. Hamilton. Oxford: Blackwell
- Herring, S. & Nix, C. (1997). Is "serious chat" an oxymoron? Pedagogical vs. social uses of Internet Relay Chat. Paper presented at *the American Association of Applied Linguistics*, Orlando, FL, March 11.
- Lewis, C. C. & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: How research lessons improve Japanese education. *American Educator*, 22 (4), 12-17 and 50-51.
- National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Authors.
- Sinclair, J. & Coulthard, M. (1975). *Towards an analysis of Discourse: the English used by Teachers and Pupils*. Oxford: Oxford University Press.
- Stein, M. K., Grover, B. W. & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning: An analysis of mathematical tasks used in reform classrooms. *American Education Research Journal*, 33, 455-488.