Teaching Mathematics Using Mediated and Mixed-MediMediated Communication Models

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ABSTRACT

The study examined the perception of instructors of mathematics in computer-mediated communication (CMC) versus mixed-mediated communication settings (MMC). The instructors for this study were drawn from a large private university; the instructors were trained and certified in the teaching of their subject field. The instructors were real-time instructors, some using a combination of in-class instruction and computer-mediated instruction, termed mixed-mediated communication (MMC) instruction and the remainder of the instructors using virtual instruction that consisted entirely of online instruction with no face-to-face contact. This model is termed computer mediated communication (CMC).

Keywords: Mathematics, Education, Online Education, Virtual Communication

1. INTRODUCTION

The importance of improving math education is evident from the results of a study comparing 15-year-old math students across 30 countries. The results show that math students in the United States rank 25th out of the 30 countries in math literacy and problem solving [8]. These findings suggest a need to search for tools, methods, and teaching techniques that might improve how students learn math.

This research examines the differences in math instruction between computer-mediated communication (CMC) and mixed-media communication (MMC). The MMC model is a departure from the more normal unmediated communication model (UMC), and can be examined with regard to its effectiveness for math learning outcomes. MMC refers to a communication model that blends face-to-face in class teaching with an online component. Clearly, MMC is a new teaching tool that will need to be understood to achieve the best chances for success with the model.

2. LITERATURE REVIEW

The research into the differences between computer-mediated communication (CMC) and unmediated communication (UMC) is extensive [1] [2] [5] [7] [11] [12]. The comparison between CMC and a mixed-media communication is not extensive. There are significant questions to be asked when making the MMC and CMC comparisons.

Certain lines of inquiry are pertinent when addressing the behavior of teaching using MMC and CMC. The failure to establish shared knowledge [2] [12] or common purpose [1] has been determined to be important determinants to group performance in CMC. Shared knowledge in a task-based group is knowledge the group shares, and importantly, knows they share [7]. The structure in a mathematics class using either MMC or CMC thus becomes crucial. Does the curriculum establish a means whereby such knowledge and awareness of shared information is readily available?

Studies have shown there are major differences in effective communication styles between CMC and unmediated communication (UMC). Such differences [11] make it reasonable to assume similar differences will be found when comparing CMC to MMC. Student preferences have been found to differ among UMC, CMC, and MMC [5]. Research on whether such preferences exist among instructors has not been well established.

The question of whether teaching mathematics differs from other types of course content is relevant to this study. The work that establishes such differences [6] in teaching statistics gives preliminary support to the idea that learning style preferences among students is an important factor in student success. The preference for non-traditional classes [6] is a finding that contradicts certain earlier findings, and may be an indicator that certain important factors affecting learning are emerging as students become more accustomed to new course-content modalities. Not only do students show a preference for non-traditional learning, but a 2009 meta-analysis by the Department of Education found that, on average, students in online educational environments outperformed those receiving only face-to-face education. The difference in learning outcomes was even larger for those students participating in a blended or MMC environments when compared to face-to-face instruction only. The study findings show that blended learning incorporates more learning time and different instructional components than those received in traditional learning environments [10].

In a mathematics teaching situation, feedback is essential, and the research on feedback comparing CMC and UMC is pertinent. The comparison between CMC and UMC groups have found that there is less positive and more negative feedback with CMC [12]. If true, then teams may be more negatively influenced by feedback from an instructor or a fellow-student in a CMC setting compared to a MMC model. The element of psychological distance also influences our acceptance or rejection of negative feedback [14], and the potentially greater psychological distance in a CMC versus a MMC modality might be reasonably assumed. After all, a MMC setting does have a face-to-face contact. The resistance to feedback in a CMC [16] might play a role in teacher-to-student communication, as well as the student-to-student communication. Such resistance would differ from UMC, and the composite model of MMC might reasonably differ on this factor.

In addition, the state of research with respect to CMC and the type of task being mediated has largely remain unchanged since
the elements of team and task were addressed by Hollingshead and & McGath [5]. In 2010, evolving technology justifies further study of task and team relationships in both CMC and MMC settings.

3. SIGNIFICANCE OF STUDY

The two most important delivery tools for course content at many major universities are on-ground courses, which combine mediated and unmediated communication, and on-line courses, which use mediated communication. Understanding how instructors perceive these two delivery methods may well provide suggestions of how to maximize the performance of the instructors, and thus how to improve the likelihood of the success for their students.

4. METHODOLOGY

This study is a quantitative descriptive study examining the perceptions of math instructors with regard to feedback, class success, student performance in teams, and student learning outcomes within CMC, and MMC learning environments.

Population and Sample

The population was university math instructors at a large private university. The sample size was 300 math instructors with differing levels of teaching experience in online and on-ground modalities. The sample represented a convenience sample.

Research Questions

RQ1: Is the MMC model seen as more effective than the CMC model by mathematics instructors.
RQ2: Is student teamwork seen as more effective with MMC compared to CMC by mathematics instructors.
RQ3: Is there a difference between MMC and CMC in the perception of student response to instructor feedback.
RQ4: Do instructors perceive students are more supportive in MMC compared to CMC.

Measurement

The study compared several measures of instructor perceptions while teaching in a MMC or CMC environment. Measurements of instructors’ perceptions were obtained using Likert type scales designed to measure instructors’ perceptions of classroom success, students’ ability to work in teams, instructors’ ability to provide adequate feedback, and whether students were supportive of each other. In addition, an open-ended question was obtained from the instructors using a content analysis methodology. This qualitative measurement was used to supplement the quantitative measures and was intended to allow the instructors to voice any concerns they have that are not captured by the Likert scales.

The initial reliability analysis provided a Cronbach’s Alpha of .302. Upon examination of the scales, one scale was found which contributed significantly to the lower than expected reliability assessment. This was a scale measuring the reluctance to use tools available to the students. This scale was thus eliminated from the final analysis. The resulting Cronbach’s Alpha was a more reasonable .612. In addition, the Corrected Item-Total Correlations were in the acceptable range with the revised scale[3].

The issues of validity are, of course, present, but at least some assumptions seem warranted. The issue of criterion validity is affected by the authenticity of the sample. The subjects were actual instructors teaching actual students from a syllabus that was relatively standard across the university from which the sample was gathered. The syllabi for a MMC class and for a CMC class will differ, but that difference may well be a part of the comparison that should be present to draw meaningful conclusions.

Analysis

The analyses of the data employed correlation and a set of difference measures between the four sets of Likert scales obtained from the MMC and the CMC instructors. The differences were evaluated using Anova to assess the significance of the differences. The sample was adequate to make comparisons, and variances were appropriately using robust adjustment for unequal variances. A content analysis was used to evaluate open-ended responses to a question asked on the questionnaire.

5. RESULTS

Respondents consisted of instructors that in general taught in three modalities: teach online only, teach both face-to-face and online, and teach on-ground only. The participant breakout into these groups is shown in Table 1.

Table 1. Participants by teaching modality

<table>
<thead>
<tr>
<th></th>
<th>CMC</th>
<th>CMC MMC</th>
<th>MMC</th>
<th>TOTALS</th>
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The instructors were asked to respond regarding a current class that they were teaching and the instructors that in general taught both on-ground and online, were, for this study, currently teaching online. So 24 participants responded with regard to an on-ground course teaching experience, and 36 participants responded with regard to an online course teaching experience.

The detection of relationships among the six independent variables was assessed using Pearson product-moment correlation. The correlation coefficients provide a description of the linear relationship between two variables. The size of the relationship indicates the strength of the relationships. An examination of the correlations between independent variables indicates numerous linear relationships that exceed chance expectations. The size of the sample suggests these are valid relationships and not artifacts that can occur with large sample sizes.

The results of the Likert Scale survey are shown in Table 2. Comparisons between instructor perceptions in mixed-mediated instruction, and computer-mediated instruction for class success, student supportiveness, feedback, teams, and asking content questions showed no significant differences (p > .05). Using Cohen’s [15] approach, eta squared was calculated and demonstrated the effect sizes were small(<.01). Based upon these findings, no further examination of mean differences was conducted.
Table 2. Likert Scale Survey Results

<table>
<thead>
<tr>
<th>Dep Variables</th>
<th>Mode</th>
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<th>Std. Deviation</th>
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</table>

The content analysis conducted upon the open-ended questions found several categories that provided useful information. The four categories extracted were improved student preparation, too much material to cover, the use of Aleks (an on-line tool to aid in mathematics learning), and finally, good student progress. Thirteen percent of instructors said students needed better preparation prior to starting class. Eleven percent of instructors noted that there was too much material to cover in a course. Thirteen percent of instructors remarked that Aleks was an important tool for the success of the students. Finally, thirty-eight per cent of instructors remarked that the students made good progress.

6. DISCUSSION AND FUTURE RESEARCH

In general, the results of this study support the findings of the exhaustive meta-analysis conducted by the United States Department of Education [10]. That is, on-line students perform at least as well, and in some cases superior to a blended instructional method when measured using instructors’ perceptions. The question, of whether there is a difference between CMC and MMC, has received a preliminary answer: there is no significant difference between the two modalities from an instructor’s point of view with regard to class success, feedback acceptance, student teamwork, and student supportiveness.

The question that now needs to be examined calls for another study, asking essentially the same questions, of students’ perceptions of the effectiveness of using the two teaching modalities. Additionally, asking instructors who teach both MMC and CMC to compare their experiences in each modality could reveal differences not revealed in this study. Finally, a rigorous before and after comparison of learning outcomes using MMC and CMC would be highly desirable.

7. CONCLUSION

With the educational landscape changing with new technologies, new formats, and new student needs, universities, schools, instructors, and accrediting agencies should be reassured that experienced mathematics’ instructors feel they can function well and that their students can succeed in a variety of learning environments provided by modern educational institutions.

8. REFERENCES