Investigating Relationships between Attitudes toward the use of Web 2.0 Technologies and Mathematical Achievement

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Abstract: This paper discusses the current state of mathematics education in the United States and describes the results of a study to determine if relationships exist between achievement in a college Euclidean Geometry class and student attitudes toward and their perceived efficacy of a blogging activity that was a component of the course. The study which included a 12-week blogging activity was conducted at a university in the western United States. The use of powerful Web 2.0 technologies such as blogs is suggested as a possible means of strengthening the mathematics achievement of students of all levels, regardless of their relative strength in mathematics problem solving, reasoning, and understanding skills.

Introduction

Technology has been a powerful tool in the United States' mathematics classrooms for several decades. Technology is one of the six principles included in the NCTM (2000) Principles and Standards of School Mathematics. The NCTM (2000) Principles and Standards suggests that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (p. 24). It also advocates for the appropriate and integrated use of technology in every aspect of mathematics education from what is taught in mathematics; how mathematics is taught and learned; and how mathematics is assessed (Powers & Blubaugh, 2005).

However, current progress in science, technology, and mathematics education in the U.S. is not satisfactory as evaluated by educators and legislators (Hossain & Robinson, 2011; Leshner, 2009). Although many U.S. students excel in mathematics, as a whole, U.S. performance on international mathematics tests consistently remains between the second and third quartile (Leshner, 2009). There are wide disparities in mathematics achievement among various ethnic groups. Too many U.S. students and parents think that mathematics is a difficult and uninteresting subject. The result is that mathematics education in the U.S. is failing to instill students with sufficient skills and knowledge necessary to meet the century's challenging economy and leadership (Leshner, 2009).

Moreover, information technology has not reached its full potential in mathematics education programs across the United States (Gunter, 2001; Kurz & Middleton, 2006). Many prospective mathematics teachers' views on the role of information technology in mathematics education are not satisfactory (Habre & Grunmeier, 2007). Studies also show that information technology is integrated inappropriately in many teacher education programs (Mistretta, 2005; Watts-Taffe, Gwinn, Johnson, & Horn, 2003). The preparation of preservice teachers to use information and communication technology is one of the critical challenges teacher education programs face (Powers & Blubaugh, 2005). Another study found that many teacher education programs use the computer as a teacher-centered tool rather than as a student-centered tool (Wang, 2002). Many information technology courses that are part of teacher preparation programs emphasize preservice teachers' learning with technology rather than the integration of technology into their classroom teaching (Lederman & Neiss, 2000). Another study to measure preservice teachers' technology beliefs, skills, and barriers to the use of information technology reports that many teacher education programs prepare preservice teachers with lower or outdated information and communication technology skills that do not provide preservice teachers adequate knowledge to provide sufficient information technology-based instruction in their classrooms (Brush, Glazewski, & Hew, 2008). Without adequate knowledge, these teachers get little opportunity to integrate information technology into their actual classrooms (Brush et al., 2008).

Objective and Procedure

The premise of this study is that mathematics education in the United States not only needs improvement but also often fails to take advantage of new technologies that could serve to enhance mathematics instruction and ultimately student learning. To initiate this line of investigation, this study sought to determine if relationships exist between student performance in mathematics and their perceptions of a blogging activity included as a regular component of the class. Specifically, the two research questions were: (1) Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class?; and, (2) Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?

To answer these research questions, a 12-week blogging activity was conducted as a standard component of a college Euclidean Geometry course offered for preservice secondary mathematics at a university in the western United States. The blog can be visited at: http://edsc353fall2011.wordpress.com/. At the end of the 12-week activity, preservice mathematics teachers' attitudes toward the blogging activity and perceived effectiveness of using the blogging activity were measured using an instrument developed by the researcher. Validity and reliability of the instrument were measured through appropriate procedures and were found to be authentic and consistent. A copy of the survey instrument can be seen at: http://edsc353fall2011.files.wordpress.com/2012/10/survey_instrument.pdf

The first research question sought to determine if a relationship exists between participants' median attitude scores regarding the blogging activity with their cumulative quiz total attained on the eight in-class quizzes. The second research question sought to determine if a relationship exists between participants' median perceived effectiveness scores of the blogging activity. Participants' attitude toward the blogging activity was measured by calculating the median response to 16 Likert-type scale items measured on a six-point scale, while participants' perceived effectiveness of the blog for the learning of Euclidean Geometry was measured by calculating the median response on another 18 Likert-type scale items measured on a six-point scale. Due to the ordinal nature of the Likert-type scale data, a Spearman correlation r was used for these analyses

Prior to collecting data, permission was sought from the Institutional Review Board (IRB) of the university where the study was conducted. At the conclusion of the blogging activity, a survey was administered to collect data regarding preservice mathematics teachers' perceptions of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course.

Participants and Data

The study was conducted in a college Euclidean Geometry course offered at a university in the western United States in the fall 2011 semester. There were 28 students who enrolled in and completed the class, all of whom participated in the study and survey. Descriptive statistics on the demographic information of study participants showed that twelve (42.86%) of the participants were male, and 16 (57.14%) were female. The participants ranged in age from 20 to 61 years old with a mean, median, and range of 26.43, 22.0, and 41 years respectively, and a standard deviation of 10.15 years. The participants reported their approximate average total time spent on the Internet per week in hours for all purposes that had mean, median, and range were 22.43, 20.50, and 55 hours respectively, with a standard deviation of 10.823 hours.

Participants were asked to respond to 16 specific questions (#s 8 to 23) designed to measure their attitudes toward the blogging activity in a college Euclidean Geometry course. These questions included a 6-point Likert-type scale allowing participants to indicate whether they Very Strongly Agree (VSA), Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD), or Very Strongly Disagree (VSD) to each item. These sixteen 6-point Likert-type scale items were combined to attain a median attitude score toward the blogging activity in the college Euclidean Geometry course for each participant. The possible attitude score for each item was 1 to 6 with a higher number representing a more positive attitude toward the blogging activity for the learning of college Euclidean Geometry. For positively worded items, 1 indicated Very Strongly Disagree (VSD) and 6 indicated Very Strongly Agree (VSA). There were 6 negatively worded Likert-type scale items (items numbers 9, 11, 13, 16, 19, and 23) in this section. The same Likert scale options were given for the six negatively worded Likert-type scale items; however, those items were coded in reverse order. The median score on the 16-question attitude survey was determined for each participant.

The participants also responded to 18 specific questions (#s 24 to 41) pertaining to the perceived effectiveness of the blog for the learning of Euclidean Geometry. These questions included a 6-point Likert-type scale allowing participants to indicate whether they Very Strongly Agree (VSA), Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD), or Very Strongly Disagree (VSD) to each item. These eighteen 6-point Likert-type scale items were combined to attain a median perceived effectiveness score of using the blog for the learning of Euclidean Geometry for each participant. Each item had a possible range of 1 to 6; where 1 indicated Very Strongly Disagree (VSD) and 6 indicated Very Strongly Agree (VSA). All items in this section were worded positively. The possible range for the perceived effectiveness score for each item was 1 to 6 with a higher number representing a more positive perceived effectiveness of the blog for the learning of Euclidean Geometry. The median score on the 18-question perceived effectiveness survey was determined for each participant.

Table 1
Descriptive Statistics of Median Attitude and Median Perceived Effectiveness Scores

	Median Attitude Scores	Median Perceived Effectiveness
Valid N	28	28
Mean	4.1786	4.1250
Median	4.0000	4.0000
Mode	4.00	4.00
Std. Deviation	.95466	.92921

Table 1 shows an overall measure of the median attitude and median perceived effectiveness scores. Descriptive statistics of the median attitude scores yielded a mean, median, and mode of 4.18, 4.0, and 4.0, respectively, with a standard deviation of 0.95. This indicates that the typical response of participants corresponds to slightly more than agreement that they held a positive attitude toward the blogging activity in the College Euclidean Geometry course. Similarly, descriptive statistics of the median perceived effectiveness scores yielded a mean, median, and mode of 4.13, 4.0, and 4.0, respectively, with a standard deviation of 0.93, indicating that the typical response of participants corresponds to slightly more than agreement that the blogging activity was an effective means of teaching and learning Euclidean Geometry.

Findings and Discussion

Use and Impact of a Blogging Activity on Students' Mathematics Achievement
The first research question was: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class? The data (Table 4) for this research question were analyzed by calculating a non-parametric Spearman correlation r on cumulative quiz scores and median attitude scores.

Table 5
Spearman Correlation Test Results on Median Attitude Scores

Spearman's rho		Cumulative Quiz Score	r_s
Cumulative Quiz Score	Correlation Coefficient	1.000	-.145
	Sig. (2-tailed)	.	.461
	N	28	28
Median Attitudes	Correlation Coefficient	-.145	1.000
	Sig. (2-tailed)	.461	.
	N	28	28

Table 4
Cumulative Quiz Scores vs. Median Attitude and Perceived Effectiveness Scores

Cumulative Quiz Scores	Median Attitude Scores	Median Perceived Effectiveness Scores
74.5	6.0	4.0
77.5	6.0	4.0
73.0	4.0	5.0
80.0	4.0	4.0
76.0	3.0	3.0
66.5	4.0	4.0
70.0	5.0	5.0
49.0	5.0	6.0
64.0	4.0	4.0
33.0	5.0	4.0
58.5	4.0	4.0
78.0	3.0	3.0
72.5	4.0	5.0
70.5	4.0	4.0
69.5	3.0	4.0
65.0	3.0	3.0
58.5	4.5	5.0
64.5	6.0	6.0
65.5	4.0	3.5
73.5	5.0	5.0
67.5	4.0	5.0
73.0	5.0	5.0
77.0	3.5	3.5
60.5	4.0	4.0
68.5	4.0	3.0
72.5	4.0	3.5
70.5	2.0	2.0
72.0	4.0	4.0
N = 28	N = 28	

The Spearman correlation test result (Table 5) indicated a non-significant correlation (N = 28, r_s = -0.145, p >.05) that failed to reject the null hypothesis that there is no relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class. This means that the study did not find a significant correlation between attitudes toward the blog and total quiz score measured by eight in-class quizzes.

The second research question was: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry? The data (Table 4) for this research question were analyzed by calculating a non-parametric Spearman correlation r on cumulative quiz scores and median perceived effectiveness scores.

The Spearman correlation test result (Table 6) indicated a non-significant correlation (N = 28, r_s = -0.232, p >.05) that failed to reject the null hypothesis that there is no relationship between the cumulative quiz scores attained

by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry. This means that the study did not find a significant correlation between perceived effectiveness of the blog and total quiz score measured by eight in-class quizzes.

Table 6
Spearman Correlation Test Results on Median Perceived Effectiveness Scores

Spearman's rho		Cumulative Quiz Score	r_s
Cumulative Quiz Score	Correlation Coefficient	1.000	-.232
	Sig. (2-tailed)	.	.235
	N	28	28
Median Effectiveness	Correlation Coefficient	-.232	1.000
	Sig. (2-tailed)	.235	.
	N	28	28

Discussion and Implication of the Study

Analysis of the first research question: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class?, did not indicate a significant correlation (N = 28, r_s = -0.145, p >.05) between the participants cumulative quiz scores and their median attitude scores toward the blogging activity. Similarly, analysis of the second research question: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?, did not indicate a significant correlation (N = 28, r_s = -0.232, p >.05) between the participants cumulative quiz scores and their median perceived effectiveness scores toward the blogging activity. These finding coincide with Cash's (2010) doctoral dissertation research that found that Web 2.0 usage level did not have a significant relationship with high school students' letter grade (performance) in mathematics, science, and social studies.

Although in many instances, non-significant results aren't particularly useful with regard to informing practice, in this study, combining the non-significant results with the descriptive statistics is quite revealing. The descriptive statistics gathered in this study indicate that participants considered the blogging activity to be enjoyable and perceived it to be effective with regard to the teaching and learning of Geometry. Combining these strong descriptive findings with the non-significant results to the two research questions suggest that all participants, regardless of their relative performance on the quizzes, enjoyed and perceived benefits from participating in the blogging activity. Thus, we can conclude that relative strength in mathematical problem-solving, reasoning, and understanding skills should not be considered as a determining factor with regard to the benefits of using a blogging activity.

Thus, we can conclude that the level of mathematical content knowledge and/or problem-solving skills are not determining factors regarding whether or not a blogging activity will be enjoyed by and perceived to be effective by students in a mathematics class. This conclusion suggests that teachers should implement blogging activities in their low level classes as well as their upper level classes, as all students are equally likely to benefit. Unfortunately, we have all heard stories of upper level classes being provided with interesting activities while lower level classes are often relegated to completing boring worksheets under the guise that these students couldn't handle the more interesting activities. This study directly refutes this idea and provides a strong justification for implementing blogging activities with classes of all levels.

Conclusions

This study has revealed some important and notable results regarding the use of blogs in teaching-learning Geometry and other mathematics courses. As most of the participants in this study were preservice mathematics teachers, their perceptions were related to both teaching and learning perspectives. Quantitative measures of

participants' attitudes toward and perceived effectiveness revealed that the use of a blog is both enjoyable, and perceived to be effective in a college Euclidean Geometry course.

The study, also, revealed that students' mathematical content knowledge, problem solving, and understanding skills are not a significant factor with regard to using a blog as a supportive teaching-learning tool in a Euclidean Geometry course. This means that mathematics teachers who want to use a blogging activity in their courses should not be concerned about whether the participants have a strong or weak background in mathematics. Through active collaboration and increased engagement both strong and weak students will enjoy and potentially benefit from the use of a blog as a supportive learning tool.

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