 Available online at <http://fsuoj01a.uncfsu.edu/> and <http://digitalcommons.uncfsu.edu/jri/>

**JRI**

Journal of Research Initiatives (2013) 1(1): 54-71

Pre-Service Mathematics Teachers’ Perceptions of Using Web 2.0 Technology for Instruction and Achievement in a College Euclidean Geometry Course

Md Mokter Hossain and Robert J. Quinn

**ABSTRACT**

The purpose of this study was to investigate the nature of pre-service mathematics teachers attitudes toward and perceived effectiveness of a blogging activity included as a regular component of a college Euclidean Geometry course. Descriptive statistics regarding participants’ attitudes toward and perceived effectiveness of the blogging activity were gathered using a researcher developed instrument. Additionally, an inferential statistical test was performed to determine if a relationship exists between pre-service teachers’ attitude toward the blogging activity and their performance in the course as measured by the eight in-class quizzes administered throughout the semester. Similarly, an inferential statistical test was performed to determine if a relationship exists between pre-service teachers’ perceived effectiveness of the blogging activity and their performance in the course as measured by the eight in-class quizzes. The study was in a Euclidean Geometry class designed for preservice mathematics teachers enrolled in a land grant university located in the western part of the United States. The results revealed that preservice mathematics teachers tended to enjoy participating in the blogging activity and perceived that the blogging activity was effective. Additionally, the results indicated that no relationships existed between performance in the course and either attitude toward the blogging activity or the perceived effectiveness of the blogging activity. These non-significant results suggest that mathematics teachers who want to incorporate a blogging activity in their courses should not be concerned about whether the students have a strong or weak background in mathematics, as both strong and weak students seem to enjoy and potentially benefit from the use of a blogging activity as a supportive teaching and learning tool.

*Keywords****-*** *Blog; collaborative model; Euclidean geometry; mathematics education; pre-service teachers; Web 2.0 technology*

**Introduction**

Technology has been a powerful tool in mathematics classrooms for several decades, and is one of six principles stated by the National Council of Teachers of Mathematics (NCTM) in Principles and Standards for School Mathematics (NCTM, 2000). In this document, NCTM (2000) suggests that “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning” (p. 24). NCTM further 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 is not considered to be satisfactory by educators and legislators (Hossain & Robinson, 2011; Leshner, 2009). Although, many U. S. students excel in mathematics, as a whole, their performance on international mathematics tests consistently remains between the second and third quartile (Leshner, 2009). Far too many students and parents think that mathematics is a difficult and uninteresting subject. Such beliefs result in a wide disparity in mathematics achievement among various ethnic groups. According to Leshner (2009) mathematics education is failing to instruct students sufficiently in the skills and knowledge necessary to meet the leadership and economic challenges of the 21st century.

Although, essential to addressing 21st century skills, , information technology has not reached its full potential in mathematics education programs (Gunter, 2001; Kurz & Middleton, 2006). Many mathematics teachers view the current role of information technology in mathematics education as unsatisfactory (Habre & Grunmeier, 2007). Habre and Grunmeier (2007) found that prospective mathematics teachers believe that they should use information technology to help teach mathematics to students; but that mathematics and not information technology should remain the focus of instruction in mathematics classrooms. However, many pre-service teachers believe that in mathematics classrooms, information technology is used improperly in ways that focus more on the technology than on mathematical understanding or calculation (Habre & Grunmeier, 2007). For instance, in an experiment, if students are shown tessellations of a plane, using a web-based Java applet, many participants may skip the mathematical knowledge behind the tessellation, since a Java applet may not show the actual mathematical calculation (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). In regards to the preparation of pre-service teachers, it is important that they be exposed to communication technology, as this 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 teacher preparation programs utilizing information technology tend to emphasize learning with technology rather than integrating technology into into their classroom teaching (Lederman & Neiss, 2000). Another study measuring pre-service teachers’ technology beliefs, skills, and barriers to the use of information technology, reports that many teacher education programs use outdated information and lack adequate communication and technology skills to impact instruction in the classroom (Brush, Glazewski, & Hew, 2008). Without adequate knowledge, pre-service teachers are not given the opportunity of learning how to integrate information technology into their actual classrooms (Brush et al., 2008).

Although Blogs, Podcasts, YouTube, wikis, Facebook, and similar interactive Web 2.0 tools are currently used in the fields of information technology, engineering, business, language, journalism, and the medical sciences (Lemley & Burnham, 2009; Malhiwsky, 2010; Thomas & Li, 2008), the utilization of these tools are rarely infused in the teaching and learning of mathematics. Moreover, research on the effectiveness of Blogs and other standard Web 2.0 technologies in the teaching and learning of mathematics is limited. Therefore, the researchers aimed to investigate whether there was a significant relationship between pre-service teachers’ perceptions of the use of a Blog, a simple Web 2.0 technology, and their achievement in a college Euclidean Geometry class. The rationale for conducting the present study in this specific college Euclidean Geometry class was that the majority of the students enrolled were pre-service secondary mathematics teachers. This provided the researchers with an opportunity to gather and investigate the participants’ perceptions of using the Blogging activity both as students and as teachers.

**Current state of Mathematics Education in the United States**

According to the report of the National Assessment of Educational Progress in 2007, 70% of U. S. eighth-grade students performed at or above the basic level in mathematics and 31% performed at or above the proficient level (National Center for Educational Statistics, 2008). Even the eighth graders in the highest-performing states such as Massachusetts rank significantly lower than the average eighth graders in the highest-achieving countries such as South Korea, Singapore, and Taiwan (Kuenzi, 2008). Compared to other industrialized nations, mathematics achievement of U. S. students appears inconsistent with a nation considered to be the world leader in scientific innovation (Hossain & Robinson, 2011).

Trends in International Mathematics and Science Study (TIMSS) results show that U. S. students’ progress and performance in mathematics is not satisfactory. The TIMSS report showed that in 1995 fourth-grade and eighth-grade students in the U. S. achieved an average score of 518 and 492 points respectively (TIMSS, 1995a, 1995b). In 1999, only eighth graders were tested, the average mathematics scores of U. S. eighth-graders was 502 (TIMSS, 1999); in 2003, the average mathematics scores of U. S. fourth-graders and eighth-graders were 518 and 504 respectively (TIMSS, 2003); and in 2007, these scores were 529 and 508 points respectively (TIMSS, 2007). In each year for each grade level those scores can be compared with an international average that was normed at 500 points with a standard deviation of 100 points. It should be noted that TIMSS study is conducted in 4-year time spans. A closer look at the results of past TIMSS studies is shown in Table 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 1  UNITED STATES Students’ Mathematics Performance Recorded in TIMSS 1995 – 2007 | | | | | |
| Assessment  Year | Participating Countries | UNITED STATES Fourth-graders Score | Average Score | | UNITED STATES Eighth-graders Score |
| M | SD |
| 1995 | 41 | 518 | 500 | 100 | 492 |
| 1999\* | 38 | − | 500 | 100 | 502 |
| 2003 | 46 | 518 | 500 | 100 | 504 |
| 2007 | 48 | 529 | 500 | 100 | 508 |
| \*In TIMSS 1999 only eighth graders were tested. | | | | | |

A superficial look at this table might mislead the reader into believing that the United States is doing well in mathematics. However, this would be a mistake as the improvement from 1995 to 2007 was not measureable. Although, both U. S. fourth- and eighth-graders improved in mathematics in 2007 compared to 1995, no measurable change was found in the percentage of either U. S. fourth- or eighth-graders performing at or above the advanced international benchmark in mathematics between 1995 and 2007 (grade four: 9 vs. 10 percent; grade eight: 4 vs. 6 percent) (TIMSS, 2007). Compared with the average score of 500 points in each grade with a standard deviation of 100 points, the U. S. fourth-graders’ average mathematics achievement on these tests was slightly higher; however, eighth-graders’ average achievement was close to the average level. In 2007, compared to the mathematics achievement of fourth-graders among the 36 participating countries, the average mathematics score of U. S. fourth-graders was higher than 23 out of the 35 other countries, lower than eight countries, and not measurably different from the average scores of students in the remaining four countries; the average mathematics score of U. S. eighth-graders was higher than 37 of the 47 other countries, lower than five countries, and not measurably different from the average scores of students in the remaining five countries (TIMSS, 2007).

Moreover, according to the Program for International Student Assessment (PISA), which is a system of international assessments that focus on 15-year-old students’ scholastic performance in mathematics, science, and reading among the 35 Organization for Economic Co-operation and Development (OECD) member nations and some other non-member nations, in 2003, 2006, and 2009, U. S. 15-year-old students’ combined mathematics scores were below the overall average score of 500 with a standard deviation of 100 in each of the assessments. A closer look at U. S. 15-year-old students’ mathematics performance in past PISA studies is shown in Table 2.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 2  UNITED STATES 15-year-old Students’ Mathematics Performance in PISA 2003 – 2009 | | | | | | |
| Assessment  Year | UNITED STATES  Score | Average Score | | | Participating Countries | UNITED STATES  Position | |
| M | SD | |
| 2003 | 483 | 500 | | 100 | 41 | 24th | |
| 2006 | 474 | 500 | | 100 | 57 | 32nd | |
| 2009 | 496 | 500 | | 100 | 67 | 24th | |

In PISA 2003, the average mathematixs score of 15-year-old U. S. students was 483 compared to the overall average score of 500 with a standard deviation of 100. These U. S. students ranked 24th in average mathematics score among the 41 participating countries (Lemke et al., 2004). In PISA 2006, 15-year-old U. S. students’ average mathematics score was 474 compared to the OECD average mathematics score of 498, placing them in 32nd position among 57 participating countries (Baldi et al., 2007). In PISA 2009, U. S. 15-year-old students’ average mathematics score was 487 compared to the OECD average score of 496 ranking them in 24th position among 67 participating countries (Fleischman, Hopstock, Pelczar, & Shelley, 2010).

Although U. S. 15-year-old students’ average mathematics score in 2009 was higher than their average mathematics score in 2006, it was not measurably different from their average mathematics score in 2003. The U. S. 15-year-old students’ average mathematics scores were lower than the OECD average scores in each of the assessment years from 2003 to 2009. Only 27% scored at or above proficiency level four in mathematics – that was lower than the 32% of 15-year-old students in the OECD countries on average that scored at or above level four (Fleischman et al., 2010).

**Objectives and Method**

The premise of this study was to discuss how 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 pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class?

(2) Is there a relationship between the cumulative quiz scores attained by pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blogging activity 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 pre-service secondary mathematics students at a land grant university located in the western part of the United States. The blog can be visited at: http://edsc353fall2011.wordpress.com/.

**Survey Instrument**

At the end of the 12-week activity, pre-service mathematics teachers’ attitudes toward the blogging activity and their perceived effectiveness of the blogging activity, were measured using an instrument (Appendix A) developed by the researchers. An electronic copy of the survey instrument can be seen at:

<http://edsc353fall2011.files.wordpress.com/2012/10/survey_instrument.pdf.>

The validity and reliability of the instrument were measured through appropriate procedures and were found to be authentic and consistent. Validity was achieved by having five experts in the field of mathematics education review a preliminary version of the instrument to determine if each item covered the area it was purported to cover. Items which did not achieve significant agreement among these reviewers were eliminated. With regard to reliability, the Reliability Calculator developed by Siegle (2002) was used. This measure indicated a value of 0.97 for Cronbach's alpha, while a split-half reliability was calculated as 0.97. In both cases, the reliability coefficients were found to be consistent; and thus, the value of Cronbach's alpha was considered to be greater than 0.9, suggesting the reliability of this instrument was excellent.

**Nature of Euclidean Geometry Course**

The Secondary Education class (EDSC) 353 - Teaching Secondary Geometry course in which the blogging activity was conducted is an undergraduate level course designed to help prepare secondary mathematics education majors for the teaching of Euclidean Geometry at the high school level. This class is typically taken by junior or senior mathematics education majors. Most of the students in this class had already decided that they want to be high school mathematics teachers, while a couple took this course to help them decide if they want to pursue the goal of becoming a high school mathematics teacher.

Some specific goals of the course were to: (1) solve problems appropriate to a Euclidean Geometry course using multiple strategies; (2) rigorously prove theorems typically included in Euclidean Geometry; (3) explain the nature of proof and consider its role in a Euclidean Geometry course; (4) explain the role of technology in the teaching of Euclidean Geometry; (5) describe the different experiences that must occur to facilitate the learning of High School Geometry; (6) explain instructional strategies appropriate for teaching Euclidean Geometry; (7) communicate geometric concepts effectively, both orally and in writing; and (8) define and discuss the teacher's role in the Geometry classroom, including responsibility to the diversity of students and their various learning styles.

The first research question sought to determine if a relationship exists between participants’ attitude toward the blogging activity and their cumulative quiz total attained on the eight in-class quizzes. The second research question sought to determine if a relationship exists between participants’ perceived effectiveness of the blogging activity and their cumulative quiz total. 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 blogging activity 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.

**Participants**

The study was conducted in a college Euclidean Geometry course offered at a land grant institution located in the western part of the 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 Participant data indicated that their approximate average total time spent on the Internet per week in hours for all purposes had a mean, median, and range of 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, see Appendix-A) 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, see Appendix-A) 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, therefore larger numbers correspond to a higher 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.

An overview of participants’ scores for attitude toward and perceived effectiveness of the blogging activity are shown in Table BA and Table BB in Appendix B, respectively. Table 3 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.

**Results**

The first research question was: *Is there a relationship between the cumulative quiz scores attained by pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity in a college Euclidean Geometry class?* The data (see Table 4) for this research question were analyzed by calculating a non-parametric Spearman correlation r on cumulative quiz scores and median attitude scores.

The Spearman correlation test result (see 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 pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their attitudes toward the blogging activity. This means that the study did not find a significant correlation between attitudes toward the blog and total quiz score measured by the eight in-class quizzes.

The second research question was: *Is there a relationship between the cumulative quiz scores attained by pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blogging activity 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 (see 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 pre-service 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 the eight in-class quizzes.

**Discussion and Implications**

Analysis of the first research question: *Is there a relationship between the cumulative quiz scores attained by pre-service 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, rs = −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 pre-service mathematics teachers enrolled in a college Euclidean Geometry class and their perceptions of the effectiveness of the blogging activity for the learning of Euclidean Geometry?*, did not indicate a significant correlation (N = 28, rs = −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 as a supportive tool for teaching and learning in a Euclidean Geometry course as well as other typical mathematics courses.

One implication of these results might be that mathematical content knowledge and problem-solving skills are not determining factors of whether or not a blogging activity should be included in a particular course. The results also suggest that teachers should implement blogging activities in their low level courses as well as their upper level courses. Unfortunately, we have probably all heard stories of upper level courses being provided with interesting activities, while lower level courses 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 courses of all levels.

Another implication of these results might be that, since undergraduate college students and pre-service mathematics teachers responded positively to this activity and perceived it to be effective, there is a good chance that middle school and high school students and/or in-service mathematics teachers might, also, find it positive and effective. Thus, middle or high school teachers should consider implementing activities similar to those used in this study in their own classrooms. Further teacher educators could provide instruction to pre-service teachers regarding the implementation of blogging activities and encourage these pre-service teachers to use these strategies in the future. Additionally, curriculum developers and policy makers could use their influence to encourage the inclusion of blogs and/or other Web 2.0 technologies in the middle school, high school, and teacher education mathematics curricula.

## Conclusions

This empirical study has revealed some important and notable results regarding the use of blogs in the teaching and learning of Euclidean Geometry and other mathematics courses. As most of the participants in this study were pre-service mathematics teachers, their perceptions were related to both teaching and learning perspectives. Quantitative analysis of the data collected in this study indicate that these pre-service teachers enjoyed participating in the blogging activity and perceived that it was effective for the teaching and learning of Euclidean Geometry.

While the study did not find a significant correlation between the participants’ achievement in the college Euclidean Geometry course and either their attitude toward or the perceived effectiveness of the blogging activity, this non-result in and of itself can be considered noteworthy. In particular, teachers should take this as a sign that blogging activities like the one inplemented in this course can be enjoyed by and perceived effective by mathematics students at all levels of ability. This means that mathematics teachers who want to incorporate 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 seem to enjoy and potentially benefit from the use of a blogging activity as a supportive teaching and learning tool.

**References**

Baldi, S., Jin, Y., Skemer, M., Green, P., Herget, D., & Xie, H. (2007). *Highlights from PISA 2006: Performance of US 15-year old students in science and mathematics literacy in an international context*. Washington, DC: National Center for Education Statistics, US Department of Education.

Brush, T., Glazewski, K. D., & Hew, K. F. (2008). Development of an Instrument to Measure Pre-service Teachers’ Technology Skills, Technology Beliefs, and Technology Barriers. *Computers in the Schools, 25*(1), 112-125.

Cash, J. C. (2010). *Web 2.0 and self-reported student performance among high school students in rural schools.* (Doctoral Dissertation. UMI #3416273), The University of Southern Mississippi, Mississippi - United States. Retrieved from http://proquest.umi.com/ pqdweb?did=2100301511&Fmt=7&clientId=1846&RQT=309&VName=PQD

Fleischman, H. L., Hopstock, P. J., Pelczar, M. P., & Shelley, B. E. (2010). *Highlights From PISA 2009: Performance of UNITED STATES 15-year-old students in reading, mathematics, and science literacy in an international context*. Retrieved August 18, 2011, from http://nces.ed.gov/pubs2011/2011004.pdf

Gunter, G. (2001). Making a difference: Using emerging technologies and teaching strategies to restructure an undergraduate technology course for pre-service teachers. *Education Media International, 38*(1), 13–20.

Habre, S., & Grunmeier, T. A. (2007). Prospective Mathematics Teachers’ Views on the Role of Technology in Mathematics Education. *IUMPST: The Journal, 3*(Technology), Retrieved August 31, 2011, from http://www.k-2012prep.math.ttu.edu/journal/technology/ habre2001/article.pdf.

Hossain, M. M., & Robinson, M. G. (2011). Is the UNITED STATES Plan to Improve its Current Situation in Science, Mathematics, and Technology Achievable? *US-China Education Review, 1*(1), 1-9.

Kuenzi, J. J. (2008). Science, Technology, Engineering, and Mathematics (STEM) Education: Background, Federal Policy, and Legislative Action. *CRS report for Congress.* Retrieved October 20, 2009, from http://www.fas.org/sgp/crs/misc/RL33434.pdf

Kurz, T. L., & Middleton, J. A. (2006). Using a Functional Approach to Change Pre-service Teachers' Understanding of Mathematics Software. *Journal of Research on Technology in Education, 39*(1), 45-65.

Lemley, T., & Burnham, J. F. (2009). Web 2.0 tools in medical and nursing school curricula. *Journal of the Medical Library Association, 97*(1), 50-52.

Lederman, N., & Neiss, L. (2000). Technology for technology’s sake or for the improvement of teaching and learning? *School Science and Mathematics, 100*(7), 345–348.

Lemke, M., Sen, A., Pahlke, E., Partelow, L., Miller, D., Williams, T., . . . Jocelyn, L. (2004). *International Outcomes of Learning in Mathematics Literacy and Problem Solving: PISA 2003 results from the UNITED STATES perspective*. Washington, DC: UNITED STATES Department of Education, National Center for Education Statistics, Institute of Education Sciences.

Leshner, A. (2009). A wake-up call for science education. *The Boston Globe. January 12, 2009.* Retrieved March 11, 2009, from http://www.boston.com/bostonglobe/editorial\_opinion/ oped/articles/2009/01/12/a\_wake\_up\_call\_for\_science\_education/

Malhiwsky, D. R. (2010). *Student Achievement Using Web 2.0 Technologies: A Mixed Methods Study.* (Doctoral Dissertation), University of Nebraska, Lincoln, Nebraska. Retrieved from http://digitalcommons.unl.edu/cgi/ viewcontent.cgi?article=1057&context=cehsdiss

Mistretta, R. M. (2005). Integrating technology into the mathematics classroom: The role of teacher preparation programs. *The Mathematics Educator, 15*(1), 18-24.

National Center for Educational Statistics. (2008). *Digest from Education Statistics: 2007.* Retrieved March 18, 2009, from http://www.nces.ed.gov/programs/digest/d07/

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Powers, R., & Blubaugh, W. (2005). Technology in Mathematics Education: Preparing teachers for the future. *Contemporary Issues in Technology and Teacher Education, 5*(3/4), 254-270.

Siegle, D. (2002). *Reliability*. Retrieved October 4, 2011, from http://www.gifted.uconn.edu/ siegle/research/Instrument%20Reliability%20and%20Validity/Reliability.htm

Thomas, D. A., & Li, Q. (2008). From Web 2.0 to Teacher 2.0. *Computers in the Schools, 25*(3-4), 199-210.

TIMSS. (1995a). *Highlights of Results: The middle school years.* Retrieved December 12, 2008, from http://pirls.bc.edu/timss1995i/HiLightB.html

TIMSS. (1995b). *Highlights of Results: The primary school years.* Retrieved December 12, 2008, from http://pirls.bc.edu/timss1995i/HiLightA.html

TIMSS. (1999). *International Student Achievement in Mathematics.* Retrieved 12, 2008, from http://timss.bc.edu/timss1999i/pdf/T99i\_Math\_01.pdf

TIMSS. (2003). *International Student Achievement in Mathematics.* Retrieved December 12, 2008, from http://timss.bc.edu/PDF/t03\_download/T03\_M\_Chap1.pdf

TIMSS. (2007). *Average Mathematics Scores of Fourth- and Eighth-grade Students, by Country: 2007.* Retrieved December 12, 2008, from: http://nces.ed.gov/timss/table07\_1.asp

Wang, Y. (2002). When Technology Meets Beliefs: Pre-service teachers’ perception of the teacher’s role inthe classroom with computers. *Journal of Research on Computing in Education, 35*(1).

Watts-Taffe, S., Gwinn, C., Johnson, J. R., & Horn, M. (2003). Preparing pre-service teachers to integrate technology with the elementary literacy program: The experiences of three beginning teachers raise important issues for teacher educators. *The Reading Teacher, 57*(2), 130-139.

| Table 3  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 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 |  |

| Table 5  Spearman Correlation Test Results on Median Attitude Scores | | | |
| --- | --- | --- | --- |
| Spearman's rho |  | Cumulative Quiz Score | rs |
| 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 6  Spearman Correlation Test Results on Median Perceived Effectiveness Scores | | | | |
| --- | --- | --- | --- | --- |
| Spearman's rho |  | Cumulative Quiz Score | rs | |
| 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 |

APPENDICES

## Appendix A: Survey Instrument

Please fill out this questionnaire based on your perceptions of the blogging activity in the course, EDSC 353: Teaching Secondary Geometry, in the fall semester of 2011.

## I. Demographic Information

1. Please indicate your gender: 􀂆 Male 􀂆 Female

2. Please state your age: \_\_\_\_\_\_\_\_\_\_\_ years.

**II. Experience in using Internet and Web 2.0 Application**

3. Do you use a Smartphone or Internet connected cell handheld device to get access to the Internet?

􀂆 Yes 􀂆 No 􀂆 I do not use a cell phone

4. How much total time do you spend per week on the Internet for all purposes? \_\_\_\_\_\_\_\_\_\_ hours.

5. How do you rate your skills in using the Internet in terms of sending or receiving emails, browsing webpages, searching information, reading news on the Internet, etc.?

􀂆 Excellent 􀂆 Good 􀂆 Fair

6. How do you rate your interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc.?

􀂆 Very Much 􀂆 Average 􀂆 Very Little

7. Before participating in this activity how much experience in blogging did you have?

􀂆 Very Much 􀂆 Average 􀂆 Very Little

**III. Attitudes toward the Blogging Activity**

In this section, please express your response in **only one** of the following options:

*VSA* = Very Strongly Agree *SA* = Strongly Agree

*A* = Agree *D* = Disagree

*SD* = Strongly Disagree V*SD* = Very Strongly Disagree

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **#** | **Question** | **Response** | | | | | |
| 8. | Participating in this blogging activity peaked my interest to learn how to conduct such an activity | VSA | SA | A | D | SD | VSD |
| 9. | The blogging activity made me irritable | VSA | SA | A | D | SD | VSD |
| 10. | After participating in this blogging activity I hope to see blogging activities in other mathematics courses I take in future | VSA | SA | A | D | SD | VSD |
| 11. | I did not like participating in the blogging activity | VSA | SA | A | D | SD | VSD |
| 12. | I enjoyed spending time online for this blogging activity | VSA | SA | A | D | SD | VSD |
| 13. | The blogging activity was not worth the time and effort it involved | VSA | SA | A | D | SD | VSD |
| 14. | I enjoyed reading solutions that my classmates posted on the blog | VSA | SA | A | D | SD | VSD |
| 15. | I enjoyed posting topics or issueson the discussion board of the blog | VSA | SA | A | D | SD | VSD |
| 16. | I felt uncomfortable participating in the blogging activity | VSA | SA | A | D | SD | VSD |
| 17. | I enjoyed commenting on my classmates’ contributions to the blog | VSA | SA | A | D | SD | VSD |
| 18. | The blogging activity was interesting | VSA | SA | A | D | SD | VSD |
| 19. | The blogging activity did not fulfill my initial expectations about it | VSA | SA | A | D | SD | VSD |
| 20. | Blogging activities should be incorporated into other courses in the teacher education program | VSA | SA | A | D | SD | VSD |
| 21. | I enjoyed posting solutions to the blog | VSA | SA | A | D | SD | VSD |
| 22. | I felt comfortable with the blogging activity | VSA | SA | A | D | SD | VSD |
| 23. | The blogging activity was boring | VSA | SA | A | D | SD | VSD |

**IV. Effectiveness of the Blogging Activity for Learning Euclidean Geometry**

In this section, please express your response in **only one** of the following options:

*VSA* = Very Strongly Agree *SA* = Strongly Agree

*A* = Agree *D* = Disagree

*SD* = Strongly Disagree V*SD* = Very Strongly Disagree

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **#** | **Question** | **Response** | | | | | |
| 24. | The blog provided me with an interactive tool for online learning | VSA | SA | A | D | SD | VSD |
| 25. | The blogging activity encouraged me to share my ideas with other students in the course | VSA | SA | A | D | SD | VSD |
| 26. | The blogging activity helped me understand difficult problems in easier ways | VSA | SA | A | D | SD | VSD |
| 27. | The online discussion on the blog was more effective for learning Euclidean Geometry than in class discussion | VSA | SA | A | D | SD | VSD |
| 28. | The blogging activity helped me get better scores on the quizzes | VSA | SA | A | D | SD | VSD |
| 29. | My contributions to the blog increased the learning experience of other students in the course | VSA | SA | A | D | SD | VSD |
| 30. | Writing a substantive comment to someone’s solution on the blog encouraged me to think of an alternative solution to a problem | VSA | SA | A | D | SD | VSD |
| 31. | The blogging activity helped me figure out how a specific problem could be solved in different ways | VSA | SA | A | D | SD | VSD |
| 32. | Solving a problem on the blog was more effective for learning Euclidean Geometry than solving a problem face-to-face in class | VSA | SA | A | D | SD | VSD |
| 33. | The blogging activity encouraged me to try other Web 2.0 technologies for teaching and learning Euclidean Geometry | VSA | SA | A | D | SD | VSD |
| 34. | The contributions of my classmates to the blog helped me learn something new about Euclidean Geometry | VSA | SA | A | D | SD | VSD |
| 35. | The blogging activity helped me better understand some concepts of Euclidean Geometry | VSA | SA | A | D | SD | VSD |
| 36. | My contributions to the blog helped other students in the class learn something new about Euclidean Geometry | VSA | SA | A | D | SD | VSD |
| 37. | The blogging activity helped me better utilize my leisure time for learning purposes | VSA | SA | A | D | SD | VSD |
| 38. | The blogging activity encouraged me to collaborate with other students in the class | VSA | SA | A | D | SD | VSD |
| 39. | The blogging activity provided me with some lifelong understanding of Euclidean Geometry | VSA | SA | A | D | SD | VSD |
| 40. | The blogging activity created a collaborative learning environment in the Euclidean Geometry course | VSA | SA | A | D | SD | VSD |
| 41. | The blogging activity was more effective for learning Euclidean Geometry than writing reflection papers on class readings | VSA | SA | A | D | SD | VSD |

*Thank you for your participation.*

Appendix B:*An Overview of Participants’ Perception Scores Obtained by the Survey*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Table BA: *An Overview of Participants’ Attitude Scores toward the Blogging Activity* | | | | | | | | | | | | | | | | | | |
| Participants | |  | Items in the Survey Instrument Pertaining to the Measurement of Attitude | | | | | | | | | | | | | | | | Median |
| No. | Gender | Time | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 1 | M | >=21 | 5 | 6 | 6 | 6 | 5 | 6 | 6 | 5 | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 |
| 2 | M | >=21 | 3 | 5 | 4 | 6 | 5 | 6 | 6 | 6 | 5 | 6 | 6 | 5 | 6 | 6 | 6 | 6 | 6 |
| 3 | F | <21 | 4 | 3 | 5 | 6 | 5 | 4 | 4 | 4 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 6 | 4 |
| 4 | F | <21 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | F | <21 | 4 | 3 | 2 | 3 | 3 | 4 | 3 | 2 | 2 | 2 | 4 | 4 | 3 | 4 | 4 | 4 | 3 |
| 6 | F | <21 | 4 | 4 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 7 | M | <21 | 6 | 6 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 |
| 8 | M | >=21 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 5 |
| 9 | M | >=21 | 5 | 4 | 4 | 4 | 4 | 5 | 3 | 3 | 4 | 3 | 5 | 5 | 5 | 4 | 5 | 4 | 4 |
| 10 | M | <21 | 1 | 6 | 1 | 5 | 6 | 5 | 5 | 6 | 6 | 4 | 1 | 6 | 4 | 1 | 6 | 1 | 5 |
| 11 | M | <21 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 4 | 5 | 4 | 4 | 4 | 3 | 4 | 5 | 3 | 4 |
| 12 | F | <21 | 3 | 3 | 2 | 3 | 3 | 5 | 3 | 4 | 4 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 |
| 13 | F | >=21 | 3 | 4 | 3 | 5 | 3 | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 3 | 4 |
| 14 | M | <21 | 6 | 4 | 3 | 4 | 5 | 3 | 4 | 4 | 3 | 5 | 3 | 4 | 5 | 4 | 5 | 3 | 4 |
| 15 | F | >=21 | 2 | 2 | 2 | 1 | 3 | 2 | 5 | 1 | 3 | 3 | 4 | 6 | 3 | 4 | 4 | 5 | 3 |
| 16 | F | <21 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 3 | 2 | 3 |
| 17 | M | >=21 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 4 | 6 | 5 | 4 | 4 | 5 | 4 | 6 | 5 | 4.5 |
| 18 | F | >=21 | 6 | 6 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 19 | M | <21 | 3 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 3 | 4 | 5 | 3 | 4 |
| 20 | F | >=21 | 5 | 6 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 5 | 6 | 4 | 4 | 6 | 6 | 6 | 5 |
| 21 | F | >=21 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| 22 | F | >=21 | 4 | 4 | 4 | 6 | 4 | 5 | 6 | 4 | 5 | 5 | 6 | 4 | 5 | 5 | 6 | 6 | 5 |
| 23 | M | <21 | 3 | 4 | 4 | 5 | 3 | 4 | 2 | 2 | 4 | 2 | 3 | 4 | 3 | 2 | 5 | 5 | 3.5 |
| 24 | F | <21 | 4 | 3 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 25 | F | <21 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 26 | F | >=21 | 3 | 5 | 3 | 5 | 4 | 4 | 4 | 3 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| 27 | M | >=21 | 2 | 1 | 5 | 1 | 2 | 1 | 2 | 4 | 6 | 4 | 2 | 5 | 6 | 2 | 6 | 1 | 2 |
| 28 | F | >=21 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Table BB: *An Overview of Perceived Effectiveness Scores of the Blogging Activity* | | | | | | | | | | | | | | | | | | | | |
| Participants | | | Items in the Survey Instrument Pertaining to the Measurement of Perceived Effectiveness | | | | | | | | | | | | | | | | | | Median |
| No. | Gender | Time | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 |
| 1 | M | >=21 | 5 | 6 | 4 | 3 | 3 | 4 | 5 | 5 | 3 | 4 | 5 | 5 | 4 | 4 | 5 | 4 | 5 | 3 | 4 |
| 2 | M | >=21 | 6 | 6 | 4 | 3 | 4 | 6 | 5 | 5 | 3 | 4 | 4 | 5 | 6 | 3 | 4 | 4 | 6 | 4 | 4 |
| 3 | F | <21 | 4 | 5 | 5 | 3 | 4 | 6 | 6 | 4 | 3 | 5 | 5 | 5 | 4 | 6 | 6 | 5 | 4 | 3 | 5 |
| 4 | F | <21 | 4 | 4 | 4 | 3 | 4 | 4 | 5 | 5 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | F | <21 | 4 | 3 | 4 | 1 | 2 | 3 | 4 | 4 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 4 | 4 | 3 |
| 6 | F | <21 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 2 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 |
| 7 | M | <21 | 5 | 6 | 4 | 3 | 4 | 6 | 6 | 5 | 2 | 5 | 5 | 4 | 4 | 5 | 6 | 5 | 6 | 4 | 5 |
| 8 | M | >=21 | 6 | 6 | 6 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 6 | 5 | 6 |
| 9 | M | >=21 | 5 | 5 | 4 | 3 | 3 | 4 | 4 | 5 | 3 | 4 | 2 | 5 | 4 | 3 | 4 | 5 | 5 | 5 | 4 |
| 10 | M | <21 | 3 | 6 | 3 | 3 | 3 | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 6 | 3 | 6 | 3 | 4 |
| 11 | M | <21 | 5 | 5 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 4 |
| 12 | F | <21 | 3 | 4 | 4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 3 |
| 13 | F | >=21 | 6 | 6 | 5 | 4 | 5 | 6 | 6 | 4 | 4 | 6 | 6 | 5 | 6 | 5 | 5 | 5 | 6 | 5 | 5 |
| 14 | M | <21 | 5 | 5 | 4 | 2 | 3 | 5 | 6 | 4 | 2 | 3 | 4 | 4 | 3 | 2 | 5 | 3 | 5 | 2 | 4 |
| 15 | F | >=21 | 4 | 4 | 5 | 1 | 4 | 5 | 5 | 4 | 3 | 2 | 4 | 4 | 4 | 1 | 2 | 4 | 4 | 5 | 4 |
| 16 | F | <21 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 17 | M | >=21 | 5 | 5 | 5 | 3 | 4 | 6 | 4 | 4 | 3 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 5 | 6 | 5 |
| 18 | F | >=21 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 | 5 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 6 | 6 |
| 19 | M | <21 | 4 | 4 | 4 | 2 | 3 | 4 | 4 | 5 | 3 | 3 | 4 | 3 | 3 | 2 | 2 | 3 | 4 | 4 | 3.5 |
| 20 | F | >=21 | 6 | 5 | 5 | 5 | 5 | 6 | 5 | 6 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 5 | 6 | 5 | 5 |
| 21 | F | >=21 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 4 | 5 | 6 | 6 | 5 | 5 | 5 | 5 | 6 | 5 |
| 22 | F | >=21 | 4 | 4 | 5 | 3 | 4 | 6 | 5 | 6 | 4 | 6 | 5 | 5 | 6 | 5 | 6 | 5 | 6 | 6 | 5 |
| 23 | M | <21 | 6 | 3 | 3 | 4 | 3 | 4 | 2 | 4 | 3 | 3 | 3 | 4 | 4 | 2 | 5 | 3 | 4 | 5 | 3.5 |
| 24 | F | <21 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 6 | 4 |
| 25 | F | <21 | 3 | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 3 | 3 |
| 26 | F | >=21 | 4 | 4 | 3 | 1 | 3 | 4 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 4 | 6 | 3.5 |
| 27 | M | >=21 | 4 | 4 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 4 | 2 | 2 | 4 | 5 | 1 | 1 | 2 | 1 | 2 |
| 28 | F | >=21 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

**About the Authors**

**Md Mokter Hossain** is in the Department of Computer Science at the University of Alabama.

E-mail: [mokter@gmail.com](mailto:mokter@gmail.com)

**Robert J. Quinn** is a Professor of Mathematics Education in the College of Education at the

University of Nevada, Reno. E-mail: [quinn@unr.edu](mailto:quinn@unr.edu)