EXPERIENCE FROM THE IMPLEMENTATION OF A WEB 2.0-BASED COLLABORATIVE MODEL IN A COLLEGE EUCLIDEAN GEOMETRY COURSE

Md. Mokter Hossain
Department of Computer Science
The University of Alabama, Tuscaloosa, USA
Email: mokter@gmail.com

Robert J. Quinn
Professor of Mathematics Education
College of Education
University of Nevada, Reno, USA
Email: quinn@unr.edu

CITATION: Hossain, M. M. & Quinn, R.J. (2013). Experience from the implementation of a web 2.0-based collaborative model in a college euclidean geometry course. *European Journal of Educational Sciences, 1 (3),* 124-135.

ABSTRACT

Due to the rapid growth of the Internet and mobile web usage, costs of mathematics teaching-learning software, and the challenges of traditional and Web-based online classes, free and available Web 2.0 applications may provide a means for improving the teaching and learning of mathematics. This paper presents authors experience of the implementation of a Web 2.0-based collaborative model implemented in a College Euclidean Geometry Course conducted at a university in the western United States. The study found that the implementation of a blogging activity in the Euclidean Geometry class to be collaborative, convenient, effective, enjoyable, and applicable in other mathematics classes. Despite some difficulties and limitations of the free blog service used, the study suggests that blogs and other Web 2.0 technologies could provide an important avenue for fostering improved mathematics in today's technologically advanced society.

Keywords: *Blog, Euclidean Geometry, Blended, Mobile, and Online Learning, Mathematics Education, Web 2.0 Technology*

INTRODUCTION

Web 2.0 is a collaborative Web development platform (O'Reilly & Battelle, 2004) that fosters the development of participatory Web applications. These applications allow the user to add, control, and share information interactively, simultaneously, and interoperably, through a browser from anywhere with an Internet connection (O'Reilly, 2005). *The advancement of* Web 2.0 technologies and their accessibility using computers and handheld cellular devices has led to a radical change in the lifestyles of young students in the United States and worldwide. Young students spend more time using computer, Internet, and mobile devices than any other age group. Most of that time is spent on social network sites (Clark, Logan, Luckin, Mee, & Oliver, 2009; Lenhart & Madden, 2009; Selouani & Hamam, 2007). Text messaging, blogging, online discussion groups, social networking sites, and other Web 2.0 tools and applications have become integral parts of their lives (Baker, Wentz, & Woods, 2010). These students are arriving in high schools, colleges, and universities having multitasking operation skills in blogging, podcasting, tweeting, and other Web 2.0 applications. Due to their inclination to the Web 2.0 technologies, mathematics instruction in the traditional static mode might not be sufficient to meet their needs (Hossain & Wiest, 2011a, 2011b).

Since Web 2.0 tools allow end users to create visual web content from text based web pages and online journals, Web 2.0 could provide the ability to create appropriate multiuser virtual environments. As Web 2.0 facilitates a relatively quick communicative exchange between individuals who are geographically or temporally distant (Hodson, 2008) it could establish new dimensions to enhance mathematics education.

Moreover, due to the free accessibility of online resources, traditional and authoritative printed material may no longer serve as the standard means of resource sharing (Thomas & Li, 2008). These online resources may better meet the demand of the new generation of students. Hossain and Wiest (2011a, 2011b) support idea, adding that due to the inclination of the new generation, both students and teachers, to use Web 2.0 technologies in their personal lives, mathematics instruction in the traditional static mode might not be sufficient to meet the needs of today's students. Open, free, and easily accessible Web 2.0 tools and technologies could be capable of meeting the increasing demand of new generation students and teachers. The interactive features of Web 2.0 technologies can be utilized by mathematics students, teachers, and educators to develop many online platforms in which students can participate and contribute to developing and extending web-based mathematical repositories.

Collaboration, constructivism, and motivation are the fundamental features of Web 2.0 technologies (Anderson, 2007; Cash, 2010; Kamel Boulos & Wheeler, 2007). Collaborative activities lead to improved knowledge acquisition compared to instruction delivered through non-collaborative activities (Bonk & Wisher, 2000). In an online classroom, collaborative learning can take the form of discussion among the whole class or within smaller groups (Brindley, Blaschke, & Walti, 2009). Constructivism offers promising new approaches to teaching (Bruner, 1990). Constructivism and socioculturalism (Vygotsky, 1978) are the elements of the two most dominant cognition theories that have been applied to mathematics teaching (Crowe & Zand, 2000). Motivation affects student performance and learning, particularly in online learning (Cole, Field, & Harris, 2004; Papastergiou, 2009; Ryan, 2001; Tuzun, Yilmaz-Soylu, Karakus, Inal, & Kizilkaya, 2009). According to Butler and Butler (2008), "One method of motivation is to use technology to engage students inside and outside of the classroom" (p. 1). In Web 2.0-based collaborative environments students and teachers become self-motivated to engage themselves inside and outside the classroom. Interactive features of Web 2.0 tools motivate participants to spend more time online, and share their creativity to a broader audience than might be possible in a regular classroom (Malhiwsky, 2010).

Given the emphasis on these features, many educational commentators argue that Web 2.0 technologies can offer great potential for supporting students' learning in online mathematics education (Alexander, 2006; McLoughlin & Lee, 2008; Waycott et al., 2010). Thus, it has become a recent quest to understand what young learners do with the emerging features of Web 2.0 technologies, and how information technology use and Web 2.0 activities can be incorporated into classroom instruction for the teaching and learning of mathematics.

Moreover, a blog is a standard example of Web 2.0 applications (Maddux, Liu, & Johnson, 2008) that is free, fast and relatively easy, requiring only basic computing knowledge (Solomon & Schrum, 2007). Thus, a blog could be an appropriate tool to evaluate the potential of other Web 2.0 technologies. Therefore, the basic rationale of this paper is to present a Web 2.0-based

collaborative model that could be used to promote teaching and learning of Euclidean Geometry and other mathematics courses.

OBJECTIVE OF THE STUDY

Blog is one of the easiest tools of Web 2.0 technologies that can offer unlimited possibilities for building collaborative teaching-learning environments in mathematics education. According to International Data Corporation (IDC)'s expectation, over the next few years, creating blogs will be one of the fastest growing applications for mobile Internet users (Kairer, 2009). Blogs promote reflective practice as well as collaboration and social interaction among users (B. B. Ray & Hocutt, 2006). As a collaboration and communication tool, educators can use blogs to post announcements for students and parents; students can build portfolios and digital diaries, share their reflections with others, and plan for new projects (J. Ray, 2006). This may benefit students by allowing them to become "engaged as subject matter experts, motivated as owners of their own learning, involved in a community of practice, and exposed to diverse perspectives" (Norton & Hathaway, 2008). Blogs can become a means of obtaining or outsourcing solutions of quizzes, fallacies, and various mathematical problems students need to know to be prepared for competitive tests.

To initiate a new blog, teachers could first form small groups of students to work together on specific topics. For instance, a high school geometry teacher might form several study groups for discussing important or sophisticated topics that he or she wants students to explore more extensively to clarify and deepen their understanding. Hossain and Aydin (2011) call these iGroups to reflect the interactive and dynamic nature of working together using Web 2.0 technologies such as blogs, wikis, and podcasts. An iGroup may continue to discuss a topic long after the semester has ended. Students may be more motivated to join and study in an iGroup if they are using a blog or other new technology instead of simply writing on paper (Solomon & Schrum, 2007). If someone outside the class requests to be a member of an iGroup, the teacher can add or reject the request based on the nature of the activity.

THE MODEL AND PROCEDURE

In a previous paper (Hossain & Quinn, 2012) we proposed a Web 2.0-based collaborative model to be implemented in a secondary mathematics class. In the model we discussed a means of building a collaborative environment in teaching-learning mathematics under the supervision of the class teacher who initiates the process and supervises the entire activity. In this study we implemented the model with some modifications in a college Euclidean Geometry class, EDSC 353 Teaching Secondary Geometry, during fall 2010 and 2011 semesters at a university in the western United States. The fall 2010 and fall 2011 blogs can be visited at: http://webactivities.wordpress.com/ and http://edsc353fall2011.wordpress.com/, respectively.

There were 22 students enrolled in the fall 2010 class and all of them participated in the blogging activity. In 2011, there were 29 students initially enrolled in the class and all of them agreed to participate in the blogging activity. One student, who attended only two class sessions, did not complete the course and did not participate in this study. The 28 remaining students participated

in the blogging activity and were included in the study. It should be noted that in both years, the students were given the option of participating in the blog or completing an alternate assignment. Nobody refused to participate in the blogging activity during wither year. Most of the students enrolled in these classes were secondary mathematics education majors but a few were majoring in other areas.

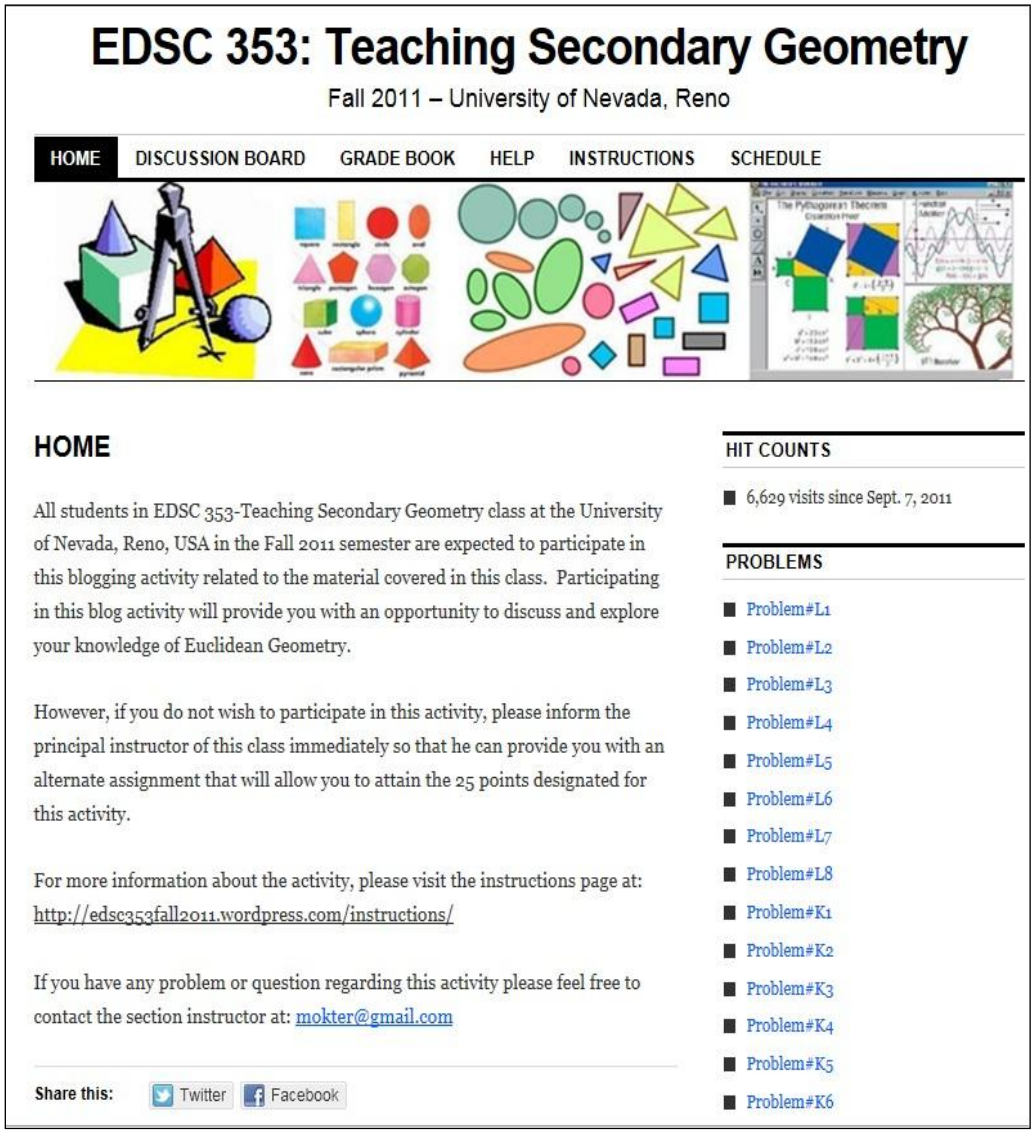

FIGURE 1: A Screenshot of the Homepage of the Fall 2011 Blogging Activity

During both years, the blogging activities were almost identical, except that an additional online discussion board was added in 2011 to allow participants to raise and discuss issues and topics related to the blogging activity and to the teaching-learning mathematics. Thus, in this limited scope implementation the fall 2011 semester blog will only be briefly discussed hereafter in this paper. Figure 1 shows a screenshot of the homepage of the fall 2011 blogging activity. By the end of the 12-week activity, there had been more than 6,500 visits to the blog.

The blogging activity was designed to run for twelve weeks and was a regular component of the course. Students were divided into six groups with five students in five of the groups and three in the remaining group. Each week the researchers uploaded a new problem set. The six groups were randomly assigned to one of the following pairs of weeks, 1st and 7th, 2nd and 8th, 3rd and 9th, 4th and 10th, 5th and 11th, or 6th and 12th. During the weeks in which their group was assigned, group members were responsible for solving problems and leading the discussion board activity on the blog. The schedule was purposely set so that each group was assigned one week during the first half of the activity and another week in the second half. Each student created a pseudonym to maintain confidentiality throughout the activity.

Each group member was responsible for submitting a complete solution to one of the eight problems posted during the weeks assigned to their group. Additionally, during the assigned week, at least one group member was responsible for initiating a new discussion thread and the other group members were expected to contribute to the thread. Throughout the semester each class member was required to post at least five substantive comments to solutions posted by other students and to actively participate in the online discussion. Substantive comments included verifying a solution posted by someone else, fixing an incorrect or partially correct solution, or providing an alternative solution. In the online discussion board, a student could raise a discussion topic such as a contemporary issue related to the topics taught in the class or comment on threads that had been started by other class members. http://edsc353fall2011.wordpress.com/discussion-board/ was the address of the online discussion board. During the 12-week activity, there were 174 responses with 66 threads on the discussion board.

After the 12 week activity had concluded each of the participants was asked to complete a survey that gathered information regarding preservice mathematics teachers' perceptions of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. In particular, each participant was asked about his or her attitude toward the blog and his or her perception of its effectiveness. Prior to collecting data, permission was sought from the Institutional Review Board (IRB) of the university where the study was conducted. An electronic copy of the survey instrument is available at:
http://edsc353fall2011.files.wordpress.com/2012/10/survey_instrument.pdf

FINDINGS AND DISCUSSION

This study examined preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a college Euclidean Geometry course using both quantitative and qualitative methods. Due to the limited scope of this paper only the key procedures and major findings are briefly presented and discussed in this section. Description of data analysis is not presented here. Participants' perceptions were measured by two dependent variables: (1) participants' attitudes toward the blogging activity in the college Euclidean Geometry course – measured by calculating the median response to the 16 Likert-type scale items (#s 8 to 23) measured on a six-point scale; and (2) participants' perceived effectiveness of the blog for the learning of Euclidean Geometry – measured by calculating the median response of another 18 Likert-type scale items (#s 24 to 41) measured on a six-point scale. Participants' cumulative quiz scores attained on eight in-class quizzes was used as a

dependent variable to see whether or not there were relationships between the quiz total and either of the other dependent variables. There were two independent variables: (1) participants' gender – a categorical variable with two categories: male and female; and (2) participants' self-reported total time spent on the Internet per week – these values were divided into two categories using a median split. Also, the study qualitatively measured the advantages and disadvantages of using this blogging activity; and the trends emerged in the analysis of student contributions to an online discussion board on the blog.

First, 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 gender did not have a significant relationship with preservice secondary mathematics teachers' attitudes toward or perceived effectiveness of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Thus, both male and female students and teachers appear to benefit from using a blog as a supportive teaching-learning tool.

Second, the study did not find any significant difference either in the median attitude scores of the participants toward the blogging activity in terms of their gender or in the median perceived effectiveness scores toward the blogging activity in terms of their gender. These results support some other studies that found that men and women use the Internet very differently (Bimber, 2000; Fallows, 2005; Grove, 2010); and that "gender did not have a significant relationship with Web 2.0 usage" (Cash, 2010, p. 81). The result of this study may be due to the fact that it was conducted in a single course with a small number of participants; Moreover, the median attitude and median perceived effectiveness scores in this study implied that both male and female participants experienced consistent perceptions that the blogging activity was appropriate and effective in the Euclidean Geometry course.

Thirdly, the study did not find any significant difference in the participants' median attitude scores toward the blogging activity in a college Euclidean Geometry course with regard to their self-reported total time spent on the Internet per week. However, a significant difference was found in the participants' median perceived effectiveness scores of the blogging activity for the learning of Euclidean Geometry with regard to their self-reported total time spent on the Internet per week. This indicates that participants who spend more time on the Internet were more likely to perceive the use of a blogging activity for the learning of Euclidean Geometry to be more effective than those who spend less time on the Internet. One possible explanation of this finding is that participants who spend more time on social network sites might perceive the blog to be more effective than those who spend less time on the Internet and thus less time on social network sites. This prediction is consistent with the finding of another study that found that "students who spent a moderate amount of time online for learning actually perceived higher capability and more experience of collaboration than the group who spent less time" (Lee & Tsai, 2011)(p. 909).

Fourth, the study did not find a significant correlation between the participants cumulative quiz scores and their median attitude scores toward the blogging activity. Similarly, the study did not find a significant correlation between the participants cumulative quiz scores and their median perceived effectiveness scores toward the blogging activity. These findings imply that all

participants, regardless of their relative strength in mathematics problem solving, reasoning, and understanding skills, as measured by the in-class quizzes, tended to have positive attitudes toward the blogging activity and considered it to be effective in the teaching and learning of Euclidean Geometry. This finding coincides 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.

Fifth, qualitative measures of the study revealed that the preservice mathematics teachers reported numerous advantages and a few minor problems of the blogging activity as a supportive tool in the Euclidean Geometry course. No major disadvantage was found. Participants described the use of the blog as: 24/7 accessible; alternative source of solution; collaborative; convenient; enjoyable; encouraging; engaging; source of getting feedback from others; safe and secured; and technology savvy. One problem mentioned was that some participants who were first time users of the blog found it difficult to start and to follow the directions provided. Another problem was that the participants were unable to use mathematical symbols, equations, and construction tools on the blog. Participants reported the collaborative nature of the blog and its ability to be engaging as the most beneficial features of using a blog in a Euclidean Geometry course.

Sixth, preservice mathematics teachers found use of the online discussion board of the blog was effective and appropriate by the participants who brought up a number of issues that were important for them to be aware of and presented their perceptions to resolve or manage these issues. Also, their discussion topics were found to be appropriate and effective in improving their teaching-learning techniques, career goals, and professional development. Participants reported that blogs helped them sharing their ideas and opinions on the topics being studied in class and have improved learning in the English classroom. Students recommend that blogs be used in various school subjects, especially subjects that require sharing of information and opinions. In addition to sharing ideas on discussion boards, blogs may serve as personalized spaces for students to write their own thoughts and experiences in an organized way. It provided an organized paperless track of all student discussion.

IMPLICATIONS OF THE MODEL

The results of this study have possible implications not only to researchers in the field of mathematics education, but also for mathematics students, teachers, teacher educators, curriculum developers, instruction designers, and policy makers regarding the use of a blog and other Web 2.0 applications as supportive or comprehensive tools for teaching, learning, and planning purposes. The remaining part of this section presents some possible implications of this study.

The first, implication of this study might be that, since undergraduate college students and preservice mathematics teachers responded positively to this activity and perceived it to be effective then there is a good chance that high school and middle 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 should provide instruction to preservice teachers regarding the implementation of blogging activities and encourage these future teachers to use

them in their future classrooms. Additionally, curriculum developers and policy makers should 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.

Second, the participants in this study found a number of advantages of using the blogging activity in the college Euclidean Geometry course. One such advantage was the collaborative nature of this type of activity. Not surprisingly, collaboration is considered to be an important aspect of learning mathematics, as stated in the National Council of Teachers of Mathematics' (2000) Principles and Standards for School Mathematics, "Technology also provides a focus as students discuss with one another and with their teacher" (p. 25). Through collaboration, preservice mathematics teachers gain "a better appreciation of mathematics content and pedagogical strategies that lie beyond the grades they will likely teach" (Edwards, 2006), p. 1). Thus, as this study suggests, blogs could be a vehicle to improve teaching-learning mathematics because in such an activity students get more opportunities to communicate and collaborate with the teacher and their peers. This could also apply to mathematics teachers engaged in professional development activities.

Third, the blog was found to be a source of alternative solutions which have been identified as effective components in the teaching and learning of mathematics. The importance of encouraging alternative solutions is emphasized by the NCTM (2000) Principles and Standards as it urges the implementation of different strategies allowing students to experience with a wider variety of problems and solutions. The importance of encouraging alternative solutions, also, is witnessed by Stipek, Givvin, Salmon, & MacGyvers (2001) who state that "teachers should emphasize process and encourage students to seek alternative solutions rather than to find a single correct solution" (p. 216); and by Cohen and Ball (1990) who contend that "teachers should encourage students to offer alternative solutions to problems and invite them to collaborate in figuring out what makes sense and why" (p. 3).

Fourth, participants found the blog to be a source of positive feedback from other students in the course. This is also an important component in the teaching and learning of mathematics. Regarding positive feedback, Lou and MacGregor (2004) found that, in a collaborative learning environment, "receiving positive feedback from other groups was rewarding and encouraging" (p. 435). Lou and MacGregor (2004) also found that:

Providing feedback to each other across groups helps students to develop critical thinking skills, self-regulating skills, as well as the skills in evaluating the work of others – a professional skill important for educators. Through evaluating each other's work, the students become more aware of possible areas of weakness in their projects. It enhances the transfer between conceptual understanding and applying newly learned concepts in their own projects and in evaluating other projects. (p. 437)

Fifth, the researchers and the participants experienced some minor difficulties in using the blog in the Euclidean Geometry course, such as being unable to use mathematics symbols, equations, and construction tools on the blog. The free version of the WordPress blog used in this study did not allow the instructor to install and use any third party plugins for these purposes. Software developers should consider making the use of mathematical symbols easier on their free blog

websites. Doing so will make their products more convenient to use and would most likely lead to an increase in the number of mathematics teachers and/or students who would opt to purchase upgraded versions of the product. Another potential solution for software developers would be to create low cost plug-ins that allow for easy use of mathematical and scientific symbols and equations that could be used in tandem with their free blogs. Policy makers could encourage software developers in this regard by investing in software development programs with the promise of purchasing successful and innovative software programs after they have been developed.

LIMITATIONS OF THE STUDY

The main limitation of this study was that it dealt with a single medium sized class of 28 students in a college Euclidean Geometry course. Moreover, due to the nature of the ordinal nature of the dependent variable that was used to measure participants' perceived effectiveness of using the blogging activity, it was not possible for the researchers to use more powerful parametric tests for analyzing quantitative data. Thus, the non-parametric Wilcoxon-Mann-Whitney U test, which is considered less powerful than the corresponding parametric t-test, was used to analyze the research questions. Due to limited sample size, this study has only about 51% chance of getting a significant mean difference between the groups, if that difference really existed. Thus, the findings of this study cannot be claimed as generalizable; and the researchers suggest implementing this or similar studies in a broad range. Finally, this study did not use a control group, therefore, the researchers were not able to compare the participating (treatment group) students' perceived effectiveness of using the blogging activity with another group (control group) of students who did not participate in the blogging activity.

CONCLUSIONS

This blogging model described in this study has several potential benefits. Working in groups may motivate students to explore, discuss, and share research knowledge and findings with classmates. These kinds of collaborative activities are useful for mathematics teachers to help students exploring various mathematical topics in depth. For instance a high school geometry teacher can use this model for an depth analysis of properties and attributes of two- and three-dimensional objects, explore relationships among shapes, discuss geometric transformations, and solve geometry problems related to real-life situations (Hossain & Wiest, 2011a). Teachers and students can locate additional resources for the topic, such as other blogs and websites, and place the links to these resources on the blog. They can record and publish full or partial class activities and podcasts on the school's server or a free server so students can access this information repeatedly at their own pace until they understand a concept clearly (Hossain & Wiest, 2011a, 2011b).

This blogging model can be used to create a collaborative teaching-learning environment for any grade level, including middle school, high school, college, or university level, and for all possible mathematical topics. This model would, also, be appropriate for mathematics teacher education programs since preservice teachers need in depth knowledge of the mathematics topics they will be teaching in the classrooms. Due to the nature of some secondary mathematics classes that make extensive use of paper- and pencil-based instruction, construction, and use of

special mathematical symbols this model might have some limitations; however, it can still be a great means to integrate the outside world into the mathematics classrooms. Blogs, wikis, and/or facebook can be used alone or in conjunction with one another to implement and conduct the activities included in this model. Edmodo and WordPress are two suitable blogging services that can be used for this purpose

Finally, and most importantly, using this model would provide many classroom teachers as well as first-time participants, whose voice and experience come to the print media very rarely with a great opportunity to share their perspectives in a public forum. As more students participate in online discussion on important mathematical topics and take the opportunity to publish their voice on Web 2.0 media, the depth and breadth of their mathematics study may expand. In similar ways, mathematics teachers, educators, and researchers can develop instructional models to meet the demands of current and future generation students' and teachers' needs.

REFERENCES

Alexander, B. (2006). Web 2.0: A new wave of innovation for teaching and learning? *Educause Review, 2006*(March/April), 33-44.

Anderson, P. (2007). What is Web 2.0? Ideas, technologies and implications for education. *JISC Technology and Standards Watch.* Retrieved July 15, 2010, from http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf

Baker, S. C., Wentz, R. K., & Woods, M. M. (2010). Using virtual worlds in education: Second Life® as an educational tool. *Teaching of Psychology, 36*(1), 59-64.

Bimber, B. (2000). Measuring the Gender Gap on the Internet. *Social Science Quarterly, 81*(3), 868-876.

Bonk, C. J., & Wisher, R. A. (2000). Applying collaborative and e-learning tools to military distributed learning: A research framework. *Technical Report.* Alexandria, VA: U.S. Army Research Institute for the Social and Behavioral Sciences.

Brindley, J., Blaschke, L., & Walti, C. (2009). Creating Effective Collaborative Learning Groups in an Online Environment. *The International Review of Research in Open and Distance Learning, 10*(3), Article 10.13.11. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/675/1271.

Bruner, J. (1990). *Acts of Meaning*. Cambridge, MA: Harvard University Press.

Butler, F., & Butler, M. (2008). Using Technology to Enhance Liberal Arts Math. *Academic Exchange Quarterly, 12*(4), 227-231.

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

Clark, W., Logan, K., Luckin, R., Mee, A., & Oliver, M. (2009). Beyond Web 2.0: Mapping the technology landscapes of young learners. *Journal of Computer Assisted Learning, 25*(1), 56–69.

Cohen, D. K., & Ball, D. L. (1990). Policy and Practice: An Overview. *Effects of State-Level Reform of Elementary School Mathematics Curriculum on Classroom Practice: NCRTE Research Report 90-14.* Ann Arbor, MI: Michigan State University.

Cole, M. S., Field, H. S., & Harris, S. G. (2004). Student learning motivation and psychological hardiness: Interactive effects on students' reactions to a management class. *Academy of Management Learning & Education, 3*(1), 64-85.

Crowe, D., & Zand, H. (2000). Computers and undergraduate mathematics: Setting the scene. *Computers and Education, 35*, 95-121.

Edwards, M. T. (2006). Shutting the Box: Fostering collaboration among early grades and secondary preservice teachers through authentic problem solving. *Contemporary Issues in Technology and Teacher Education [Online Serial], 6*(4), Available at: http://www.citejournal.org/vol6/iss4/mathematics/article1.cfm.

Fallows, D. (2005). *How Women and Men Use the Internet. Pew Internet & American Life Project.* Retrieved September 16, 2011, from http://pewinternet.org/~/media/Files/Reports/2005/PIP_Women_and_Men_online.pdf.pdf

Grove, J. V. (2010). *How Women Use the Web.* Retrieved September 15, 2010, from http://mashable.com/2010/07/28/women-on-the-web/

Hodson, J. (2008). *A tangled web: Public reason, web 2.0 and a new definition of action for participatory technologies.* (M.A. MR45943), York University (Canada), Canada. Retrieved from http://proquest.umi.com/pqdweb?did=1672517351&Fmt=7&clientId=1846&RQT=309&VName=PQD

Hossain, M. M., & Aydin, H. (2011). A Web 2.0based collaborative model for multicultural education. *Multicultural Education & Technology Journal, 5*(2), 116-128.

Hossain, M. M., & Quinn, R. J. (2012). *Prospective Use of Web 2.0 Technologies in Promoting Mathematics Education in the United States*. Paper presented at the *Society for Information Technology & Teacher Education International Conference 2012* (pp. 3637-3642). Chesapeake, VA: AACE.

Hossain, M. M., & Wiest, L. R. (2011a). Building Web 2.0-Based Collaborative Environments for Teaching-Learning High School Geometry. In M. Koehler & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011* (pp. 3064-3069). Chesapeake, VA: AACE.

Hossain, M. M., & Wiest, L. R. (2011b). Web 2.0 Technologies in Building Collaborative Teaching-Learning Environments for Middle School Geometry Instruction *Proceedings of Global TIME 2011* (pp. 73-76). Chesapeake, VA: AACE.

Kairer, R. (2009). *Mobile Internet Users to Reach One Billion in 2013.* Retrieved September 3, 2011, from http://www.palminfocenter.com/news/6665/mobile-internet-users-to-reach-one-billion-in-2013/

Kamel Boulos, M. N., & Wheeler, S. (2007). The Emerging Web 2.0 Social Software: An enabling suite of sociable technologies in health and health care education. *Health Information and Libraries Journal, 24*(1), 2-23.

Lee, S. W.-Y., & Tsai, C.-C. (2011). Students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning. *Computers in Human Behavior, 27*, 905-914.

Lenhart, A., & Madden, M. (2009). Social networking websites and teens: An overview. *Pew Internet and American Life Project report.* Retrieved October 10, 2010, from www.pewinternet.org/PPF/r/198/report_display.asp

Lou, Y., & MacGregor, S. K. (2004). Enhancing Project-Based Learning Through Online Between-Group Collaboration, Educational Research and Evaluation. *An International Journal on Theory and Practice, 10*(4-6), 419-440.

Maddux, C. D., Liu, L., & Johnson, L. (2008). Web 2.0: On the cusp of a revolution in information technology in education? *Computers in the Schools, 25*(3-4), 159-162.

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

McLoughlin, C., & Lee, M. J. W. (2008). Mapping the digital terrain: New media and social software as catalysts for pedagogical change *Hello! Where are you in the landscape of educational technology? Proceedings ascilite* (pp. 641-652). Melbourne, Australia National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Norton, P., & Hathaway, D. (2008). On Its Way to K-12 Clasrooms, Web 2.0 Goes to Graduate School. *Computers in the Schools, 25*(3-4), 163-180.

O'Reilly, T. (2005). *What is Web 2.0: Design patterns and business models for the next generation of software*. Retrieved February 16, 2010, from http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

O'Reilly, T., & Battelle, J. (2004). Web 2.0 opening welcome: Web 2.0 Conference. Retrieved October 12, 2009, from http://itc.conversationsnetwork.org/shows/detail270.html

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers and Education, 52*(1), 1-12.

Ray, B. B., & Hocutt, M. M. (2006). Teacher-created, teacher-centered Weblogs: Perception and practice. *Journal of computing and Teacher Education, 23*(1), 11-18.

Ray, J. (2006). Welcome to Blogsphere: The educational use of Blogs (a.k.a. Edublogs). *Kappa Delta Pi Record, 42*(4), 175-176.

Ryan, S. (2001). Is online learning right for you? *American Agent & Broker, 73*(6), 54-58.

Selouani, S., & Hamam, H. (2007). Social impact of broadband internet: A case study in the Shippagan Area, a rural zone in Atlantic Canada. *Journal of Information, Information Technology, and Organizations, 2*, 79-94.

Solomon, G., & Schrum, L. (2007). *Web 2.0 new tools, new schools*. Washington, DC: International Society for Technology in Education.

Stipek, D. J., Givvin, K. B., Salmon, J. M., & MacGyvers, V. L. (2001). Teachers' Beliefs and Practices Related to Mathematics Instruction. *Teaching and Teacher Education, 17*, 213-226.

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

Tuzun, H., Yilmaz-Soylu, M., Karakus, T., Inal, Y., & Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers and Education, 52*(1), 68-77.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University.

Waycott, J., Gray, K., Thompson, C., Sheard, J., Clerehan, R., Richardson, J., & Hamilton, M. (2010). Transforming assessment in higher education: A participatory approach to the development of a good practice framework for assessing student learning through social web technologies. In C. H. Steel, M. J. Keppell, P. Gerbic & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future. Proceedings ascilite Sydney 2010* (pp. 1040-1050).