Web 2.0 Technologies in Building Collaborative Teaching-Learning Environments for Middle School Geometry Instruction

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Abstract: Web 2.0 is a collaborative Web development platform that allows users to develop user-centered, participatory Web applications to add, control, and share information interactively and interoperably. This paper explores the interactive features of Web 2.0 technologies to build collaborative environments for teaching and learning middle school geometry. Specifically, it proposes a model for creating a collaborative environment for using Web 2.0 in geometry instruction.

Introduction

Technology has been a powerful engine in mathematics teaching and learning over the past few decades throughout the world. In the United States it is included as one of six principles in the National Council of Teachers of Mathematics' (NCTM; 2000) *Principles and Standards for School Mathematics*. The NCTM encourages teachers and students to use technology to broaden and deepen their mathematics understanding. It states, "In mathematics-instruction programs, technology should be used widely and responsibly, with the goal of enriching students' learning of mathematics" (p. 25). The NCTM maintains that appropriate technology use helps students learn mathematics by affording an opportunity, for example, to examine a broad range of visual models and dynamic transformations.

The NCTM (2000) envisions that all students should have access to technology-enhanced mathematics learning facilitated by a skilled teacher. The interactive and emerging features of Web 2.0 technologies could enable geometry teachers and students to build collaborative learning environments inside and outside of the classroom. This may be an especially effective avenue for fostering mathematics learning in today's technologically advanced American youth, who tend to use the Internet extensively from desktops, laptops, cell phones, PDAs, and similar devices.

This paper explores the use of Web 2.0 in middle school geometry instruction. Specifically, it addresses the interactive features of Web 2.0 technologies, the feasibility of using Web 2.0 technologies in geometry teaching and learning, and a proposed model for creating a collaborative environment for using Web 2.0 in geometry instruction.

Web 2.0 and its Interactive Features

Web 2.0 is a collaborative Web development platform that involves cumulative information production and development of applications, which has changed the types of benefits users gain from the Web (O'Reilly, 2005). It allows users to develop user-centered, participatory Web applications to add, control, and share information interactively. Compared with traditional Web 1.0 development tools, Web 2.0 includes some additional features that are accessible to users entirely through a browser located anywhere – connected to the Internet via personal computer or handheld mobile devices (O'Reilly, 2009). Social networking tools such as blogs, wikis, and podcasts are popular Web 2.0 applications that provide web hosting, audio-video sharing, social collaboration, and many more web-based applications and services. They permit free online collaboration, social connections, and resource sharing among users.

Web 2.0 not only has additional features not possessed by its predecessor Web 1.0, but it is qualitatively different from Web 1.0 in many ways. Web 2.0 enables users to interact with other users actively (for example, in chat rooms) as well as view provided information passively. The dynamic features of Web 2.0 allow users to interact

with each other and to change website content jointly over time. In the Web 2.0 platform everyone may be both a consumer and producer of information that appears on the Web. The interactive features of Web 2.0 technologies enable users to actively participate and contribute to developing and extending web page contents. Web 2.0 users also become able to develop, share, and enhance their knowledge and thinking through interactions with other users.

Creating and editing most Web 2.0 applications is free and relatively easy and fast, requiring only basic computing knowledge rather than programming knowledge. Middle school teachers and students typically have enough computing knowledge to build Web 2.0 applications free of charge. Thus, Web 2.0 could provide appropriate tools for middle and secondary geometry instruction.

Feasibility of Using Web 2.0 in Teaching and Learning of Geometry

The emergence of Web 2.0 technologies and increased Internet access through desktop, laptop, and netbook computers, as well as cellular and handheld devices, has led to enhanced interest in exploring their potential use in K-12 teaching and learning. Increased access to and use of electronic classrooms, Web 2.0-based interactive applications, and contemporary web-based conferencing tools are changing the ways students learn and teachers teach (Greenhow, Robelia, & Hughes, 2009; Lee, 2007; Tammets, Tammets, & Laanpere, 2009). Educators and students now seek to have "any time, any place, any path, and any pace" learning opportunities (Thompson, 2006).

Research shows that young students spend more time with computer, Internet, and mobile phone use than any other age group. A 2008 British study found that 94% of British teenagers had Internet access at home and school; 92% owned or had access to a mobile phone, 88% a computer with 29% an additional laptop, 69% an iPod/mp3 player, 73% a game console device, 40% a standalone digital camera, and 10% a video camera (Clark, Logan, Luckin, Mee, & Oliver, 2009). Another research report commissioned by the British Educational Communications and Technology Agency (BECTA) found that teens had higher levels of access to the Internet and many technologies that support Web 2.0: 98.4% had access to a computer; 96.6% had access to the Internet; 74% had at least one social network site account; and over 50% had shared pictures, video, or music in the last week of the survey (Luckin et al., 2008). By that time more than 71% of American teens had mobile phones with an Internet connection (Lenhart, 2009).

Teens spend more time on the Internet for gaming, instant-messaging, file and photo sharing, and social communicating than on studying or information searching (Clark et al., 2009; Selouani & Hamam, 2007). They participate in Web 2.0-based activities as authors and consumers of content from file sharing to online gaming and writing on blogs (Boyd, 2007; Lenhart & Madden, 2007; Richardson, 2006). One survey showed that "35% of all teens do blogging, 54% post photos online, 19% post videos, 39% share their own artistic creations online, 26% remix content, 27% maintain personal web pages, 28% have their own blogs" (Ivanova, Ivanova, & Smrikarov, 2009). Clark et al. (2009) found that young students surf about 30 social networking sites. Most use these sites in and out of school for social communication; only a few, however, use them for academic purposes. This might be because schools or students are unaware of the educational advantages of using social-networking sites and social-networking tools. Young students enjoy the benefits of getting multiple resources from the Web (Douma, Ligierko, & Romano, 2009).

Web 2.0 technologies offer unlimited possibilities for building collaborative teaching-learning environments for middle school geometry. The openness and collaborative and interoperability features of Web 2.0 technologies enable teachers to engage students in working together in sophisticated areas of school geometry. Web 2.0 tools can provide excellent ways to help students discuss and explore geometry topics (Solomon & Schrum, 2007). To initiate a new blog on a topic, teachers first need to form small groups of students to work together on specific topics. For instance, a middle school geometry teacher might form several study groups for discussing important or sophisticated topics that he or she wants to explore more extensively so that students can clarify and deepen their understanding. Students may be more motivated to join and study in such a group 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 a group, teachers can add or reject the request based on the nature of the activity.

A Web 2.0-Based Collaborative Model for Middle School Geometry

A sample Web 2.0-based activity for a middle school geometry class might involve in-depth discussion of the topic *Quadrilaterals*. In this activity, the teacher prepares the class for exploring common and unique

characteristics of different types of quadrilaterals: *parallelograms*, *rectangles*, *squares*, *rhombuses,* and *kites*. The activity uses a simple Web 2.0 application blog. The project is initiated locally in a single class with approximately 20 students under the supervision of the class teacher. The teacher divides the class into five groups of four students each. She or he then creates a free blog on a free server such as Google or WordPress and adds students' email addresses or invites students to the blog address. Each group has a leader responsible for initiating the process and maintaining communication with the teacher and other group members. Group leaders also maintain good interpersonal relations within their group. Groups might be named and assigned specific tasks. For example, each of the following groups might be asked to research and explore the common and unique characteristics of their assigned two-dimensional shape as a subgroup of quadrilaterals:

- Parallelograms Group
- Squares Group
- Rectangles Group
- Rhombuses Group
- Kites Group

(Trapezoids might also be added.)

A well-planned project requires several phases. Each phase might take several days to weeks, based on the intention of the class teacher. In the first phase the groups individually research and collect information about their task. In the second, they publish their findings on the blog. In the next phases they read and share all other groups' findings on the blog, and they offer comments and explanation about others' or their own findings. This time they have the chance to correct, modify, or change their own group's findings based on the discussion of their work. In the last phase the groups publish their summarized outcomes on the blog. Thus, by the end of the project, participants should learn the common and unique characteristics of the five types of quadrilaterals noted.

Benefits of the Model

The proposed model has several benefits. Working in groups may motivate students to explore, discuss, and share research knowledge and findings with classmates. Web 2.0-based collaborative learning enables students to disseminate ideas among each other more readily than in traditional classroom settings. Once group members determine key ideas about their specific task component, they may ultimately gain the confidence to continue further discussion or participate in other groups or blogs. This could be a great opportunity for first-time participants as well as classroom teachers to share their voices and perspectives in a "print" public forum. As more students participate in online discussion on important geometry topics and take the opportunity to publish their voice using Internet media, the depth and breadth of their mathematics study may expand.

Participants in such a model are expected to verify their conjectures about various geometric shapes and their properties. They might develop broader, class-inclusive thinking. For example, the Squares Group might notice that squares are a subset of both rectangles and rhombuses but with perpendicular, congruent diagonals. Upon reading and comparing the findings of the Rectangles Group and Rhombuses Group, students might notice that rectangles have congruent diagonals that bisect each other and rhombuses have diagonals that bisect each other perpendicularly. Once a student learns something new or important and uploads that information on the blog, others can investigate the idea further in order to justify it. Thus, once group members explore an idea or strategy and publish it on the blog, it is anticipated that all or most participants will personally acquire and retain the concepts discussed.

In sum, Web-2.0 technologies could be crucial tools for students and educators to build and participate in virtual collaborative groups to discuss middle school geometry topics. Ultimately, Web 2.0-based activities could motivate young students toward higher study in geometry, the arts, engineering, and architecture. Participation in these activities may also encourage students to continue to take advantage of educational opportunities via the Web and thus engage in lifelong learning.

Conclusions

Geometry is an important area of mathematics study from the early grades on, and it is used widely in real-life situations. However, the topic can be challenging for some students. Dynamic geometry software and various static technology tools have been popular and widely used in geometry classrooms for decades. However, due to students' and younger teachers' current trend toward Web 2.0 technologies with computers, laptops, and handheld

devices, it is assumed that geometry instruction in the traditional static mode is not sufficient to satisfy student needs. Thus, our technological world demands that technology be used in dynamic and flexible ways to build collaborative environments inside and outside the classroom in order to strengthen geometry learning.

Web 2.0 technologies have already started to be adopted in the fields of technology, engineering, business, language, journalism, and the medical sciences (Lemley & Burnham, 2009). Thus, it is time to utilize the interactive and impressive features of emerging Web 2.0 technologies for learning middle school geometry, which is the gateway to higher studies in art, architecture, engineering, and many other important fields. Web 2.0 technologies are likely to motivate technologically advanced youth, who are more interested in new technologies than other existing learning aids that have served geometry instruction in the past.

References

Boyd, D. (2007). Why youth (heart) social network sites: The role of networked publics in teenage social life. In D. Buckingham (Ed.), *MacArthur Foundation Series on Digital Learning - Youth, Identity, and Digital Media Volume* (pp. 119-142). Cambridge: MA: MIT Press.

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.

Douma, M., Ligierko, G., & Romano, J. (2009, August). *Creating online mind maps and concept maps*. Paper presented at the 25th Annual Conference on Distance Teaching and Learning, Madison, WI. Retrieved October 30, 2010, from http://www.uwex.edu/disted/conference/Resource_library/proceedings/09_20011.pdf

Greenhow, C., Robelia, B., & Hughes, J. (2009). Web 2.0 and classroom research: What path should we take now? *Educational Researcher*, *38*(4), 246–259.

Ivanova, A., Ivanova, G., & Smrikarov, A. (2009). *Virtual university 2.0*. Proceedings of the 5th International Conference on e-Learning and the Knowledge Society - e-Learning '09, Berlin, Germany (pp. 94-106). Retrieved November 1, 2010, from http://www.iit.bas.bg/esf/docs/2009/VirtualUniversity%202.0.pdf

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. Retrieved October 30, 2010 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2605032/

Lee, M. J. W. (2007). *Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era*. Proceedings of ascilite Conference, Singapore. Retrieved October 30, 2010, from http://www.ascilite.org.au/conferences/singapore07/procs/mcloughlin.pdf

Lenhart, A. (2009, August). Teen and mobile phones over the past five years: Pew internet looks back. Retrieved October 30, 2010, from http://www.pewinternet.org/Reports/2009/14--Teens-and-Mobile-Phones-Data-Memo.aspx

Lenhart, A., & Madden, M. (2007). *Social networking websites and teens: An overview*. *Pew Internet and American Life Project report*. Retrieved October 30, 2010 from www.pewinternet.org/PPF/r/198/report_display.asp

Luckin R., Logan K., Clark W., Graber R., Oliver M., & Mee A. (2008) *Learners' use of Web 2.0 technologies in and out of school in Key Stages 3 and 4*. Coventry, UK: Becta. Retrieved October 30, 2010, from http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/web2_technologies_ks3_4.pdf

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

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. (2009). The war for the Web. *IT Conversations*. Retrieved October 30, 2010, from http://itc.conversationsnetwork.org/shows/detail4317.html

Richardson, W. (2006). *Blogs, wikis, podcasts, and other powerful web tools for classrooms*. Thousand Oaks, CA: Corwin.

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*. Retrieved October 30, 2010, from http://jiito.org/articles/JIITOv2p079-094Selouani74.pdf

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

Tammets, K., Tammets, P., & Laanpere, M. (2009, October). *Introducing open classroom 2.0 to teachers through immersive learning*. Proceedings of the Seventh Open Classroom Conference, Porto, Portugal. Retrieved November 1, 2010, from http://www.eden-online.org/contents/conferences/OCRCs/Porto/KT_PT_ML.pdf

Thompson, M. (2006). *Online k-12 education: Opportunities for collaboration with higher education*. *Journal of Asynchronous Learning Networks*, *10*(3).