

# Today's Technologies Enhance Writing in Mathematics

AMY COOPER

**Abstract:** It is widely accepted that including writing activities in the learning process positively impacts student achievement and leads to greater depth of student understanding. This writing is often missing in the math classroom though, when the focus is misplaced on rote procedures. In these classrooms students learn mathematical processes but have little depth of understanding into the mathematical foundations, nor have an ability to clearly express their mathematical reasoning. This article promotes the use of Internet-based chat, forums, and blogs as the environment in which necessary mathematical writing can occur. Zemelman, Daniels, and Hyde provide a best practice framework through which the benefits of chat, forum, and blog writing are obvious. Student engagement with material increases in a cooperative environment, where a real audience and purpose for writing is clear, and student ownership in personal learning grows. In addition, students mature in traditional reading and writing literacy and further develop critical thinking skills.

**Keywords:** technology, writing in mathematics, best practice, collaboration

In recent years the demand for writing across all content areas has increased as researchers and teachers alike recognize its importance. The math classroom is not exempt from these demands. Putting math problems into words is a valuable tool to help students in their comprehension and ability to clearly express their ideas (Morris 2006). Unfortunately, math teachers are often preoccupied with students' ability to perform math procedures to the exclusion of math explanations, applications, and problem solving (Millard, Oaks, and Sanders 2002; Steen 2007). When this happens, students do not learn how to express mathematical reasoning or participate in higher-level thinking and are

often left unable to express quantitative ideas verbally (Steen 2003, 2007). Writing is a natural way to provide students opportunities to express their reasoning and expand their understanding beyond calculations.

While the demand for writing has increased, so has the amount of new technologies available to students. Students are increasingly using more types of technology and spending more of their time using these technologies. Educators cannot afford to ignore the obvious question of how these technological tools can be used in the classroom to increase student learning. This article will address how the technological mediums of chat, forums, and blogs are a prime location for students to use writing to create depth of understanding of material, express their understanding, record their thinking, and communicate with peers or the instructor.

## Importance of Writing in the Math Classroom

Starting in the 1970s, researchers and teachers recognized the direct relationship between writing and learning (Emig 1977). Since then teachers have incorporated more writing activities in their classrooms, which has, in turn, led to higher levels of student achievement (Bangert-Drowns, Hurley, and Wilkinson 2004). More recently the National Council of Teachers of Mathematics (NCTM) has promoted the use of writing specifically in the mathematics classroom. The Principles and Standards for School Mathematics (National Council of Teachers of Mathematics 2000) recommends that written communication be encouraged because it leads to reflection, clarification of ideas, and a greater depth of understanding into the many processes involved in mathematics. This depth of understanding is crucial for students to be able to properly justify their own work and analyze the work of others.

When students write about mathematics, they express not only their understanding of the operations they

---

*Amy Cooper is a math teacher and technology coordinator at Valley Lutheran High School, Saginaw, MI, and a graduate student at Saginaw Valley State University.*

perform but also, more importantly, their reasoning for performing those operations. They share the connections that they see between current material and past material. They express their understanding of how the topic fits into the greater picture of mathematics. Through the process of writing students learn how to express themselves more clearly and how to be more persuasive (National Council of Teachers of Mathematics 2000). Simple writing activities such as student-created glossaries, graphic organizers, journals, and visual aids assist in increasing students' ability to understand vocabulary, solve word problems, and express mathematical ideas (Blessman and Myszcza 2001; Schoenberger and Liming 2001). Writing in mathematics helps students learn how to express quantitative ideas, which will benefit them in other disciplines as well. Students' writing provides invaluable insight to the teacher regarding students' personal understandings (Burns 2004). Writing is an essential part of the mathematics classroom and can easily be introduced through technological media, with which students are very familiar.

### **Importance of Technology in the Math Classroom**

The Internet and cell phones play a major role in the lives of today's students. The Lenhart, Arafeh, Smith, and Macgill (2008) report that 83 percent of teenagers ages 12–17 use the Internet or cell phones for personal communication at least occasionally. In this same age group, 94 percent use the Internet for any purpose, while 63 percent do so daily. Not only do students use these technologies regularly, but many also have private access to them (59% of teenagers own their own computers; 71% own their own cell phones). These percentages are likely to increase in coming years. School administrators and teachers must recognize the role that these technologies play in students' lives and determine whether they can have a significant role in their classroom lives as well.

New technologies provide teachers a new approach to education, one that is not book- and teacher-driven, but one in which students are active in creating their own knowledge and expression of it (McLoughlin and Lee 2008; Pearson 2010). Three key components of education in the digital age are personalization, productivity, and participation (McLoughlin and Lee 2008), and three Internet tools that fit these components are chat, forums, and blogs. These tools allow for full class participation in the discussion, which is not likely in the traditional classroom. They also provide personalization through profile-picture emoticons (pictures that express emotions) (Graham and Hodgson 2008). Productivity expands as students learn cooperatively, pose questions, read each other's comments, and respond with their own thoughts. Chat, forums, and blogs all

allow for student personalization while participating in a productive learning environment.

### **Putting Writing and Technology Together**

Using technologies in the math classroom to meet predetermined learning goals is not new. Previous research shows the benefits of using Geometer's Sketchpad (an interactive graphing environment; Jiang and McClintock 2000), hypermedia (Lloyd and Wilson 2001), and spreadsheets (Dugdale 2001). Because of the changing face of technology and the resulting new possibilities for classroom inclusion, it is necessary for teachers to assess new technological tools, namely chat, forums, and blogs. These can be used in the mathematics classroom in a way that recognizes students' technological interests and uses traditional writing to create a greater depth of mathematical understanding in students. While students' involvement and comfort with these tools may not be immediate (Smelser 2002), intentional work on the part of the teacher to create a positive classroom climate both on- and off-line will help ensure that these online additions add dimension to students' understanding and knowledge base.

Zemelman, Daniels, and Hyde (2005) provide a listing of qualities of best practice in both writing and mathematics. Using these qualities as a framework, it is apparent that chat, forums, and blogs are not only useful tools for the mathematics classroom but also, truly, best practice as well. First, Zemelman et al. advocate that writing should be a part of all curricular areas because of its inherent ability to activate thinking in students. Students are more engaged in material and have a greater depth of understanding when they write about what they are learning (Daniels, Zemelman, and Steineke 2007). This serves as the foundational argument for why writing should be a part of mathematics instruction. Additionally, Zemelman et al. (2005) propose that in mathematics there are five processes that work together to create understanding: reasoning, problem solving, communication, making connections, and creating representations. Chat, forums, and blogs provide an authentic writing environment where these processes are likely to occur. Students can use these tools as mediums to communicate with one another, using reasoning and problem-solving skills to build representations of their knowledge and make connections between their prior knowledge and new knowledge.

Having a real audience and purpose for writing increases students' interest and commitment (Zemelman, Daniels, and Hyde 2005). When students write in forums or on blogs, they are writing for the purpose of expressing their understanding and to learn from others. Students create their own knowledge as they discuss topics with classmates and evaluate peer responses (Pearson 2010). Additionally, students know that there is an audience of not only their teacher but also their

Algebra  
by Student 1 - Monday, 15 November 2010, 04:29 PM

1. What is the line  $y = 5$  going to look like on a graph?
2. Remember,  $m = \text{slope}$  and  $b = \text{y-intercept}$ .

Re: Algebra  
by Student 2 - Monday, 15 November 2010, 05:43 PM

thanks! i sometimes forget that the  $m$  resembles the slope, or 'x'

Re: Algebra  
by Student 3 - Monday, 15 November 2010, 07:04 PM

thats a good question it will have an upward slope and a pretty steep slope.

Re: Algebra  
by Teacher - Tuesday, 16 November 2010, 05:18 PM

Good description St. 3 . IF it were  $y = 5x$ . But without the  $x$ , it will look like what St. 4 describes. Was that a trick question, St. 1? :)

Re: Algebra  
by Student 4 - Tuesday, 16 November 2010, 04:45 PM

the line ' $y=5$ ' will be like this:  
Start at the origin. (0,0)  
Go 5 up.  
Then, since a slope isnt defined, it looks like this  
<----->  
Hope i helped!

Re: Algebra  
by Teacher - Tuesday, 16 November 2010, 05:20 PM

Nice description, St. 4 ! But is the slope really 'not defined'? What do you know about the slope when the  $x$  disappears?  
We'll review this tomorrow. :)

Re: Algebra  
by Student 5 - Tuesday, 16 November 2010, 09:09 PM

$y=5$  will be a horizontal line going through 5 on the  $y$ -axis.

Re: Algebra  
by Student 6 - Tuesday, 16 November 2010, 09:27 PM

Yeah probably something like this -----> crossing the  $y$ -axis at positive 5! Good job everyone! ^-)

**FIGURE 1. A forum thread used as an algebra chapter review activity.**

In the original post the student was to (1) ask a question that classmates could answer about material from the chapter and (2) remind classmates of an important chapter idea.

peers who will read their posts and comments. If blogs are public (meaning that they are accessible to anyone on the Internet), the audience extends beyond the members of the class and into the world. One teacher, Mr. K., who keeps a public blog with his students, notes that when his students see comments posted from people all over the world they recognize that their learning environment is not just limited to their classroom—it extends into the global sphere (MacBride and Luehmann 2008). Offering students a real purpose for their writing and a real audience is especially significant in the math

classroom, because students often feel that what they learn in the classroom does not connect to the world in which they live.

Another best practice is that the context of the classroom should be that of shared learning, in other words, cooperative learning (Zemelman, Daniels, and Hyde 2005). The group communication that occurs in chat, forums, and blogs is decidedly cooperative. Peer review, questioning, and commenting allow the whole community to be a part of the learning process (McLoughlin and Lee 2008) (See Figure 1).

P.2 and P.4  
by Student - Friday, 24 June 2011, 02:20 PM

**P.2.**

46) I can't figure out what it is asking, and it makes no sense. 😊

70) I understand how the formula works for increase like on 67, but I don't know if my formula is right for decrease.

83) Just letter a). I understand how to solve it for b and c. I just don't know how to put it into a formula.

**P.4**

9) How do I find correlation coefficient ( $r$ ) on my calculator, because I can find the LinReg?

**FIGURE 2. A student-initiated post requesting help with a summer calculus assignment.**

This shared learning is of additional benefit to nonnative speakers. Another teacher who often uses chat and forums notices that nonnative speakers model the language and written format of other students' comments and are active participants in the online conversation (Graham and Hodgson 2008).

Students should take responsibility for and ownership of their writing and learning (Zemelman, Daniels, and Hyde 2005). When students write on blogs they choose what to write and how to express their thoughts. Back to Mr. K.'s class for a moment: students take turns writing on the class blog about daily class activities. Students choose both the method and the means that they use to explain the day's events to their classmates (MacBride and Luehmann 2008). When students blog, they also take responsibility for their personal learning by asking clarifying questions of classmates and the teacher through the online classroom (Figure 2).

While this questioning is also possible in the traditional classroom, the online forums are not controlled by bells and thus students have almost unlimited access. As students make posts and read comments after school, in the evenings, and on weekends, they increase their interaction time with course content (Cuhadar and Kuzu 2010; MacBride and Luehmann 2008).

The goal of math instruction should be to help students reach a level of understanding where they can use the concepts confidently (Zemelman, Daniels, and Hyde 2005). Underlying mathematics education is the need for metacognition, for students to consider their thinking, understand what they know, and express what they do not know. This naturally happens in the online environment as students consider their personal thoughts and understandings, compare them to the understanding of others, and develop new understandings (Graham and Hodgson 2008; MacBride and Luehmann 2008). Students also grow in their ability to express these

understandings in writing, from offering simple examples to logical reasoning to detailed arguments supported by mathematical properties (National Council of Teachers of Mathematics 2000). Teachers who actively look to new forms of communication will find new means to deepen students' interaction with material and provide opportunities for them to confidently express their knowledge.

### **Beyond the Curriculum**

Beyond the obvious academic benefits of including chat, forums, and blogs in the math classroom, students experience additional benefits beyond the curriculum. Mr. K. reports that his students become a cohesive group faster because of the online environment of which they are also a part (MacBride and Luehmann 2008). This positively impacts his traditional classroom by leading to greater student participation as well as more interaction between himself and the students. Similarly, other students report feeling a greater connection to their instructor because of the communication available on the blog, specifically the ability to ask questions and receive responses quickly (Cuhadar and Kuzu 2010). Students emphasize that the blog helps them become better acquainted with classmates. These aspects of classroom climate are important because students are more likely to share ideas and express concerns when they are comfortable with their classmates and the instructor.

Students' mathematical literacy does not exist in a vacuum. While students use writing to increase their mathematical literacy, a natural byproduct is growth in reading and writing literacy as well as in critical thinking. As students practice summarizing, questioning, and expressing ideas (while conversing through forums or blogs), their oral and written communication skills naturally increase (Clough 2008). Students also learn how to express themselves and their opinions more clearly.

Students who write on blogs for class report increase not only their writing abilities but also their critical thinking skills (Pearson 2010). Students' mathematical literacy should naturally and visibly interact with other aspects of literacy, benefiting students not only today but also in their futures as communicators in whatever field they enter.

### Challenges to the Use of Technology

With any suggestion of change comes challenge. One likely question in this discussion is whether this Internet-based, informal writing can really be considered writing. While 60 percent of teens do not consider their electronic writing (text messages, e-mails, posts on social networking sites, or other) to be writing (Lenhart et al. 2008), Daniels, Zemelman, and Steineke (2007) argue that today's students are authoring more than ever before! So, where should educators stand on this issue?

In responding to this challenge it is important to understand the point of mathematical writing; it is not to create research papers or formal essays. In math, writing is not for publication, it is for reflection (Burns 2004). With this focus in mind it is clear that the strategies presented all encourage reflection and metacognition in students and, thus, meet the goal of mathematical writing. Additionally, blogging is a more natural way to write (Marcani, as cited in Ramaswami 2008). It offers a wider audience than just the teacher while still allowing for the traditional writing process of drafting, editing, revising, and publishing. Thus, while mathematical writing in a blog will not look the same as the writing a student will produce in another class, it is just as valuable because it meets the goals of writing in its subject area.

A second concern is that teachers may be unlikely to use these forms because they are not sure of their worth or are simply uncomfortable using them. Before any change is made in educational practice, especially in one related to technology, it is necessary to have conversations explaining how the technology can be useful in helping to reach learning goals (McLoughlin and Lee 2008). It is also important for teachers to practice the technology that they want their students to use, even collaborating with other teachers about its uses as they do (Ferdig and Trammell 2004; Ramaswami 2008). Some schools have created programs that help both younger and older faculty to include new technologies effectively in their classrooms (Clough 2008). While teachers may not personally be comfortable with new technologies, by discussing their educational benefits, practicing the tools, and receiving training, they can confidently include new technologies in their classrooms.

### Conclusion

In math classrooms where the focus is put only on computation and not on the underlying mathe-

matical themes, students miss great learning opportunities. Including writing in the math curriculum changes this focus and encourages students to express their ideas and deepen their understanding of the content. These are necessary pieces of mathematical instruction.

Chat, forums, and blogs provide a medium in which this writing can happen. These mediums provide students many benefits, both academic and nonacademic. Students learn cooperatively, scaffolding for each other. They make decisions about how to express their understanding and how to communicate it to others. They speak to a real audience of their peers and the teacher. All the while they are growing in mathematical literacy, reading and writing literacy, and critical thinking.

The benefits of writing in mathematics are not likely to be dismissed. Nor is the role of technology in students' lives likely to change. Today's teachers have a distinct opportunity to change the way that teaching and learning is carried out by choosing new tools that help students successfully meet traditional learning goals. It is time to harness the power of these technologies to positively impact students in their learning today, and to build a foundation of reflective critical thinking and collaborative learning for their futures.

### REFERENCES

- Bangert-Drowns, R. L., M. M. Hurlley, and B. Wilkinson. 2004. The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research* 74 (1): 29–58.
- Blessman, J., and B. Myszczyk. 2001. *Mathematics vocabulary and its effect on student comprehension*. ERIC Document Reproduction Service No. ED 455 112, Arlington, VA.
- Burns, M. 2004. Writing in math. *Educational Leadership* 62 (2): 30–33.
- Clough, G. W. 2008. Wanted: Well-rounded students who can think. *Educational Digest* 74 (2): 58–62.
- Cuhadar, C., and A. Kuzu. 2010. Improving interaction through blogs in a constructivist learning environment. *Turkish Online Journal of Distance Education* 11 (1): 134–61.
- Daniels, H., S. Zemelman, and N. Steineke. 2007. *Content-area writing: Every teacher's guide*. Portsmouth, NH: Heinemann.
- Dugdale, S. 2001. Order out of chaos: A spreadsheet excursion into a mathematical frontier. *Journal of Computers in Mathematics and Science Teaching* 20 (4): 347–65.
- Emig, J. 1977. Writing as a mode of learning. *College Composition and Communication* 28 (2): 122–28.
- Ferdig, R. E., and K. D. Trammell. 2004. Content delivery in the "blogosphere." *T.H.E. Journal* 31 (7): 12–20.
- Graham, J., and T. Hodgson. 2008. Speaking math: Using chat in the multicultural math classroom. *Learning and Leading with Technology* 35 (5): 24–27.
- Jiang, Z., and E. McClintock. 2000. Multiple approaches to problem solving and the use of technology. *The Journal of Computers in Mathematics and Science Teaching* 19 (1): 7–20.
- Lenhart, A., S. Arafeh, A. Smith, and A. R. Macgill. 2008. *Writing, technology and teens*. Washington, DC: Pew Internet and American Life Project.
- Lloyd, G. M., and M. Wilson. 2001. Offering prospective teachers tools to connect theory and practice: Hypermedia in mathematics teacher education. *Journal of Technology and Teacher Education* 9 (4): 497–518.
- MacBride, R., and A. L. Luehmann. 2008. Capitalizing on emerging technologies: A case study of classroom blogging. *School Science and Mathematics* 108 (5): 173–83.

- McLoughlin, C., and M.J.W. Lee. 2008. The three p's of pedagogy for the networked society: Personalization, participation, and productivity. *International Journal of Teaching and Learning in Higher Education* 20 (1): 10-27.
- Millard, E. S., T. L. Oaks, and T. M. Sanders. 2002. *Improving student achievement through inclusion of problem solving in the math curriculum*. ERIC Document Reproduction Service No. ED 469 078, Arlington, VA.
- Morris, W. L. 2006. Math in the writing center. *The Clearing House* 80 (2): 70-73.
- National Council of Teachers of Mathematics. 2000. *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- Pearson, A.F. 2010. Real problems, virtual solutions: Engaging students online. *Teaching Sociology* 38 (3): 207-14.
- Pew Internet and American Life Project. 2008. *Writing, technology, and teens*. Washington, DC: Pew Internet and American Life Project.
- Ramaswami, R. 2008. The prose of blogging (and a few cons, too). *T.H.E. Journal* 35 (11): 21-25.
- Schoenberger, K. M., and L. A. Liming. 2001. *Improving students' mathematical thinking skills through improved use of mathematical vocabulary and numerical operations*. ERIC Document Reproduction Service No. ED 455 120, Arlington, VA.
- Smelser, L. M. 2002. *Making connections in our classroom: Online and off*. ERIC Document Reproduction Service No. ED 464 323, Arlington, VA.
- Steen, L. A. 2003. Math education at risk. *Issues in Science and Technology* 19 (4): 79-81.
- Steen, L. A. 2007. How mathematics counts. *Educational Leadership* 65 (3): 8-14.
- Zemelman, S., H. Daniels, and A. Hyde. 2005. *Best practice: Today's standards for teaching and learning in America's schools*, 3rd ed. Portsmouth, NH: Heinemann.

Copyright of Clearing House is the property of Taylor & Francis Ltd and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.