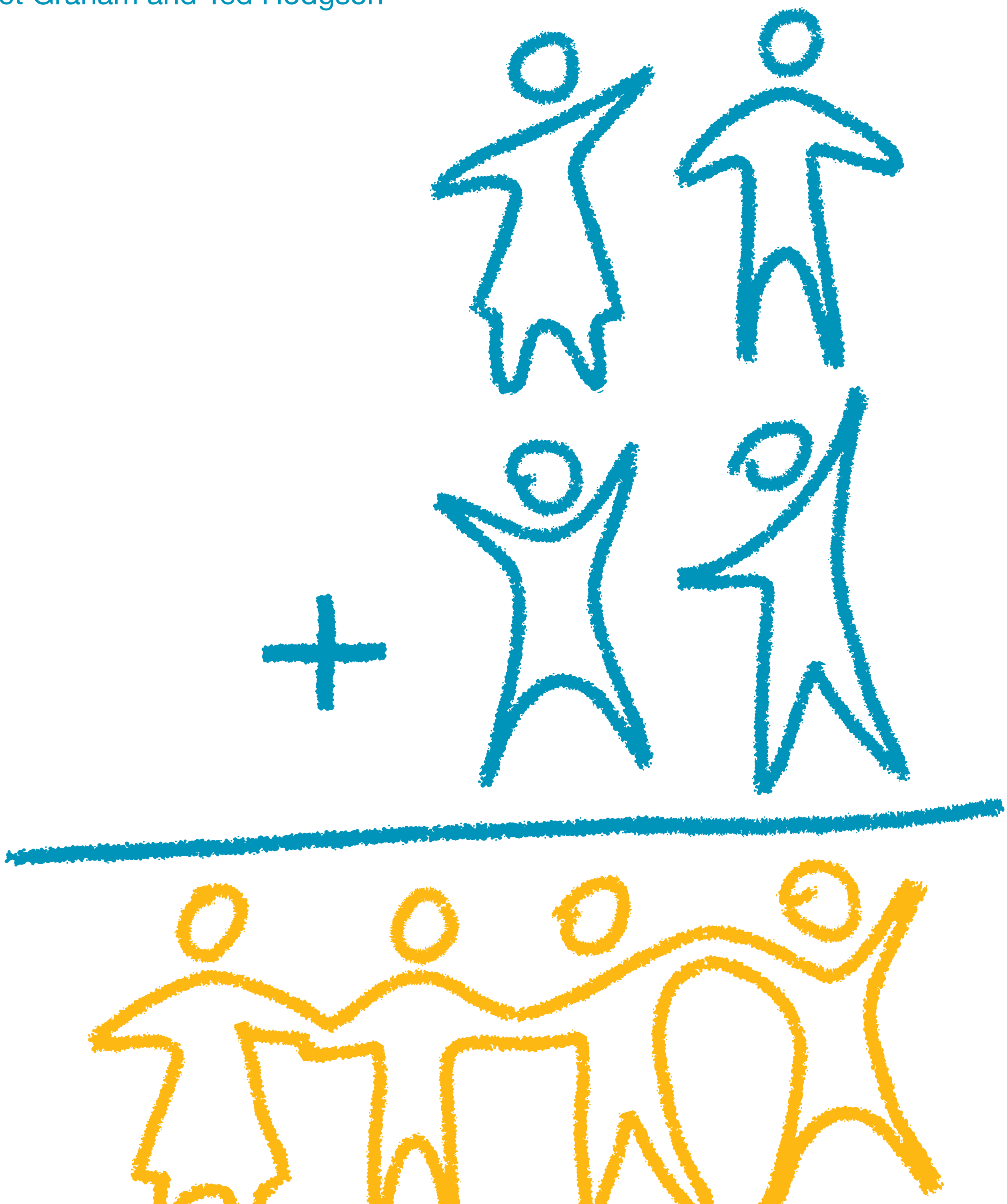
Speaking Math | Using Chat

By Janet Graham and Ted Hodgson



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in the Multicultural Math Classroom

Since 2004, we have explored the use of electronic discussion tools in geometry and algebra II classes with students of many cultures in an action research project. The use of such tools has led to the development of mathematical understanding and enhanced accessibility to the educational process among multicultural students.

The Setup

The setting for our courses is Osbourn High School (OHS), a multi-ethnic school in suburban Washington, DC. Knowing the popularity of online chats and forums among teenagers, we believed these tools might serve as effective supplements to the traditional classroom setting, so we began to incorporate online discussions into two math classes.

We use Moodle as our course management system (CMS) to facilitate online discussion, mainly using synchronous chat rooms and asynchronous discussion forums. Chat rooms allow students to conduct real-time discourse in short bursts, whereas forums promote discussion at different times over the duration of an assignment. Icons (which signal a student's presence in a discussion) and emoticons (which convey attitude) allow students to personalize their discussion messages. The teacher monitors the discussions for content and responds with additional questions and follow-up activities.

Our online discussions focus on specific math vocabulary and concepts because Moodle, like most CMS software, does not allow math symbols. Our goal is to encourage students to use mathematical vocabulary to co-construct meaning. Each chat has an initial prompt as shown below. To contribute to the chat, students interpret relevant portions of their textbook or lecture notes in terms that make sense to them. Credit for answering the questions is contingent on the use of specific target vocabulary items. Students help each other develop an understanding of the math by reading and reacting to discussion posts.

Click to enter the chat now

Are a factor and a zero the same thing? If you said yes, define factor. If you said no, tell the difference. Use the words: "expression" and "factor."

State the Zero Product Property in your own words. Why is standard form important in solving a quadratic? Use the word "solve" and/or the phrase "zero the equation" in your answer.

The Value

As with traditional classroom discourse, students' use of mathematical language and the meanings they extract from electronic communication may be imprecise. One of the most convenient features of CMS, and something that sets it apart from traditional discourse, is that the chat and forum interactions can be printed and analyzed at the teacher's convenience. The information gleaned can guide future instruction and provide insights into students' thought processes.

Consider the excerpts of two chats that focused on the connection between factors and zeros of a polynomial. In the first exchange, the group seems unsure about the nature of factors in general. However, they can produce a generic binomial as an example of a factor of a quadratic and seem to understand that there is some relationship between factors and zeros. In fact, they identify the relationship between factors and zeros as one of "oppisites." Note the sense of confidence as students talk about expressions.

13:41 Tristan: an expression is any combination of letters and numbers

13:46 Stevens: ur problably right

13:44 Joshua: that be right

13:44 Stevens: a factor is (x-7)

13:46 Tristan: a factor and a zero are different because the factor and the zero are always oppisite

13:42 Stevens: we need the definition of a factor

The responses of the second group, on the other hand, convey confusion over the definition of "expression," although this seems to resolve itself over time. They may or may not understand the concept of factor, but the mechanics of converting a binomial factor into a zero of an equation seems intact.

13:37 James: I think that factor and zero r different things

13:37 Jessica: because the answer to the expressin and the answer of ther factor are always different

13:37 James: zero is the things you add or subtract to get the factor to equal zero

13:37 Jessica: or opposite of each other

13:37 Devin: A factor and zero are assuredly completely different concepts

13:38 Jessica: the zero product property is a expression that equals zero

13:38 James: zero is the things you add or subtract to get the equasion to equal zero

13:39 Jessica: standard form is important because it is the base to your answer in a expression

13:39 Devin: Zero Product Property - If A and B are real numbers and AB=0, A=0, B=0, or A=B=0

13:39 Jessica: so that you can solve the quadratic and get the expression to equal zero

13:40 James: standard is important because you need to know what your making zero

Based on the groups' responses to the initial prompts, we decided to hold an in-class discussion of the questions posed on the chat, so that students could clarify the meaning of the term *factor*. We designed a lesson to convey to students that factors are expressions that, when multiplied together, lead to the original expression.

We have found that electronic communication allows non-native speakers time to plan out well-constructed responses or use others' responses as grammatical templates for their own thoughts. As an example, the following group's response to a chat about polynomial graphs indicates that group members have some command of the underlying concepts. While students' descriptions of the mathematical entities are imprecise, the descriptions make sense to them. According to the students, for instance, the standard form of a polynomial has "two variables" (presumably x^2 and x) and a "real number at the end," in reference to a constant. Students use "smile" to refer to a concave-up parabola and "frown" to refer to one that is concave down. Justin, a native Spanish speaker, mimics the syntactic structures that others model. Note the use of national flags to identify speakers, and the ease with which international participants use standard online acronyms, such as lol (laughing out loud).

12:10 Stevens: in standard form a polynomial is a quadratic equation with two variables and a real number at the end the first number of the equation is squared

12:10 Justin: in standard form a polynomial is a quadratic equation with two variables and a real number at the end the first number of the equation is squared

12:10 Jessica: you graph this by the last number of the equation is on the y axis and the x squared tells you if its a smile or frown

12:10 Stevens: i agree with u jess

12:10 Justin: i agree with steven cause he's smart

12:11 Stevens: lol

12:11 Stevens: you graph this by the last number of the equation is on the y axis and the x squared tells you if its a smile or frown

12:12 Jessica: you can factor it by getting the numbers on the x axis

12:12 Justin: you can factor it by getting the numbers on the x axis

12:13 Jessica: you solve for the equation by zeroing it

12:13 Stevens: you can factor it by getting the numbers on the x axis

12:13 Stevens: you solve for the equation by zeroing it

12:13 Jessica: and you r get the x intercepts wich is the zeros of the equation

12:13 Stevens: and you r get the x intercepts wich is the zeros of the equation

12:13 Justin: thanks guapo

Based on our experience, online communication provides an additional avenue of participation for non-native speakers and others who struggle with the language of mathematics.

It is our hope that online discussions also promote deeper understandings of mathematics. To test this question, we compared the performance of students participating in a traditional classroom with those in a class that combines face-to-face communication with online discussions. Although the study is certainly preliminary, our results indicate that electronic communication positively affects student learning (Find a complete report on the action research project at http://www.math.montana.edu/mathed/distance/capstone/graham/home.htm). For instance, students using electronic discussion tools exhibited significant improvements in their use and recognition of math vocabulary, as compared to students in traditional classrooms. Additionally, students' concept maps (of the concept polynomial) revealed that the greatest improvements occurred among students using electronic discussion tools. Again, while our results are not conclusive, they do reveal a potential connection between learning gains and participation in electronic discussions.

The Benefits

Naturally, electronic communication introduces an entire new set of management needs. Our directed group chats, for instance, required the use of a computer lab during one class period or during pre-arranged times. Because the very students who would benefit the most from electronic communication are the same students who do not have access to home computers, we found that chats are most effective during school hours in a computer lab. CMS software also allows the instructor to assign students to groups. Large groups lead to confusion, and no one's opinion receives the attention it deserves, whereas groups of four to five students seem to work well. Conceptual questions requiring use of specific targeted vocabulary items may require only a 10-minute computer session.

Directed forums, on the other hand, allow students to contribute at different times and enable participation by a broader population of students over time. Assignments can be completed in class, in the library, at lunch, or after school—anywhere there is computer access. CMS software allows access by the student from off-site locations while maintaining the exclusive, protected environment of a school-sanctioned activity. Although we don't require students to participate in forums after school, we often observed students online "speaking math" during after-school hours.

We have found that whole group forums—in which students must respond to a given prompt but are not assigned to specific discussion groups—are particularly effective in our setting. Each student creates a strand of the discussion as he or she responds to the prompt. The next phase of the assignment involves responding to another student of the individual's choice. In this way, students who share the same language or culture can construct meaning within their cultural context, which is invaluable in multicultural schools such as OHS. Students are often delighted to find others who share their own ethnic identity.

Whole group forums also allow students to seek out diversity and participate in groups that we might not have picked for them. In our classes, Spanish- and Portuguese-speaking students often write math notes to each other in Spanish. Some of our English-speaking students study Spanish and often try "speaking math" in Spanish. Even schools that have homogeneous populations have students who come from various interest groups. Construction of meaning comes from community, and electronic forums help all students become more fluent with the language of mathematics.

The Takeaways

Our use of CMS and electronic communication occurred in secondary geometry and intermediate algebra classrooms. The benefits that we found, however, are probably not restricted to these topics or levels. Rather, discussions can focus on any mathematical concept or even concepts from other disciplines.

For instance, physics students could be asked to connect Rutherford's experiments to the discovery of the nucleus of an atom, while history students could discuss how the U.S. Civil War would be different if General Lee had remained with the Union.

Whether one teaches math, science, English, or history, chats and electronic discussion boards facilitate rich discussions about course content and broad participation by our increasingly diverse learners. They add new, effective tools to the teacher's instructional toolkit.

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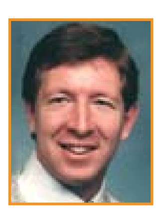

Ted Hodgson is an associate professor of mathematics education at Northern Kentucky University. His research interests include conceptual understanding of mathematics, the use of technology in the classroom, and the preparation of preservice and inservice teachers.