

Assessing Attitudes Through Student Writing

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Attitude and motivation have a profound impact on mathematics teaching and learning. Students who view mathematics as useful, worthwhile and sensible (Kilpatrick, Swafford and Findell 2001) are more likely to invest the cognitive energy required to become truly proficient mathematicians.

Recent reforms in mathematics education clearly acknowledge the importance of the affective domain in mathematics teaching and learning. The development of positive attitudes towards mathematics is now incorporated into many curriculum standards documents, such as the National Council of Teachers of Mathematics *Principles and Standards for School Mathematics* (2000) and the *Alberta Program of Studies for K–9 Mathematics* (2006). However, many children still develop negative attitudes towards mathematics, often at a very young age. Research shows that these negative attitudes are learned (Middleton and Spanias 2002) and that teaching practices greatly influence student motivation (Kazemi and Stipek 2002).

How can teachers create classroom environments characterized by enthusiasm for mathematics and high levels of engagement in challenging tasks? This issue was addressed in a year-long professional development project that involved eleven Grade 3 and Grade 4 teachers from schools representing a wide range of socioeconomic backgrounds. The Collaborative Project in Mathematics Professional Development focused on assessing student attitudes and mathematical thinking through writing. Teachers met once a month to share student work samples and discuss topics such as using open-ended tasks, asking better questions to promote student thinking and setting criteria for a good mathematics task. Student attitudes and motivation were the main topic of the September and June sessions.

September Attitude Tasks

In September, teachers read the article “Writing in Mathematics: Assess the Affective Domain” (McKay, Willson and Wolodko 2000). This article highlights the benefits of using writing tasks, including open-ended journal prompts and mathematical metaphors, to assess student attitudes and perceptions of mathematics. Teachers then created their own tasks to assess student attitudes towards mathematics. These included

- Journal prompts
 - In your own words, explain what math means to you.
 - What do you like/not like about math?
 - When I do math, I feel ...
 - What does math mean to you?
 - What are some words or symbols that come to your mind when you think of the word *math*?
 - Math is ...
- Math art posters
 - A study of colour and contrast in art became the vehicle for students to create vivid posters that expressed their feelings toward math.
- Word webs
 - Grade 3 students created word webs using the prompt *Math is ...*; and
- Math heads
 - One of the project teachers asked a Grade 1 colleague to assess student math attitudes. The teacher asked her students to draw “math heads” (Figure 1) that described what came to mind when they thought of mathematics (in their brain) and how they felt about mathematics (on their face).

Student Attitudes Towards Mathematics

A wide variety of student attitudes towards mathematics was evident in the writing samples collected

in September. For example, the “math head” samples showed that children can have strong feelings about mathematics at a very young age.

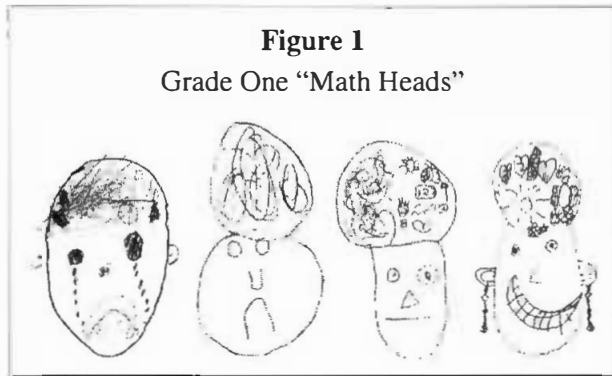


Figure 1
Grade One “Math Heads”

One Grade 3 teacher using the prompt *What is math?* found very little negativity in her class towards mathematics. The teacher was pleased to find that there seemed to be a general consensus among students regarding the importance of mathematics in the real world.

In contrast, many students from the other classes in the project showed more negative attitudes towards mathematics. One Grade 3 student’s metaphor in response to the stem *Math makes me feel like ...* was particularly powerful (Figure 2)—the student likened mathematics to running through a door without turning the handle.

Teachers discovered that positive attitudes toward mathematics are not always correlated with ability. Some children identified as strong math students by their teachers displayed negative attitudes towards the subject. For example, a Grade 4 teacher shared an art poster created by a child identified as the best math student in the class. The student drew a dark image of a boy spiralling down into a black hole and wrote words such as *boring*, *pathetic*, *death*, *scary* and *confusing* to describe his feelings toward mathematics. In contrast, a student in the same class, described by the teacher as a struggling math learner, drew a brightly coloured poster with images of smiling children.

Student Conceptions of Mathematics

Samples across the different Grade 3 and 4 classes showed that the children’s conception of mathematics was closely tied to counting strategies and the four arithmetic operations. Noting a “mixed feeling tone” in the class, one of the project teachers stated that most students in her Grade 3 class viewed mathematics as consisting of number awareness and the operations, although the time unit they were working on at the time appeared in some student writing samples.

The teacher also noted that many students were apprehensive about the upcoming year, because they had heard about the challenges of the Grade 3 mathematics program, especially multiplication and division.

Open-ended journal prompts also revealed that many students’ perceptions of mathematics emphasized getting the correct answer and completing drill exercises. Finding the correct answer was often linked to positive feelings. “Sometimes I feel good if I get them rite [right]” (Figure 2). This sentiment was also expressed by another student in the same class, who wrote, “When I do math I feel if I’m having truble [trouble] I don’t feel good but if I know the anser [answer] I feel good that I know the anser.” Figure 3 illustrates the conception of math as drill and practice. Other students’ writing and drawing clearly supported this narrow view of mathematics learning.

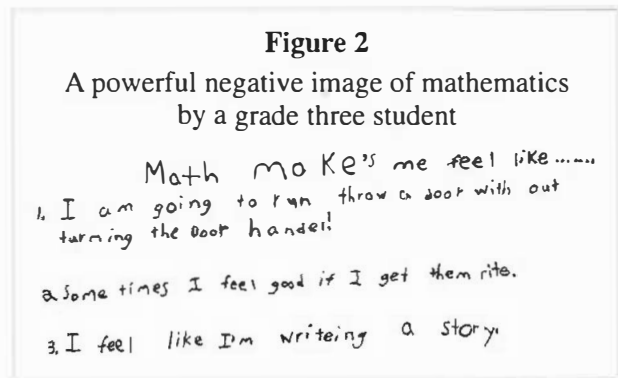


Figure 2

A powerful negative image of mathematics by a grade three student

Math make's me feel like.....

1. I am going to run throw a door with out turning the door handle!
2. Some times I feel good if I get them rite.
3. I feel like I'm writeing a story.

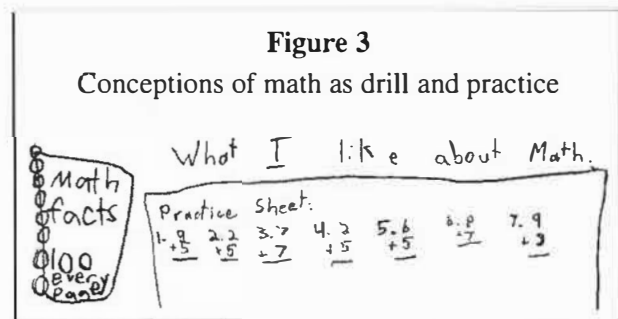


Figure 3

Conceptions of math as drill and practice

What I like about Math.

Practice Sheet:

$1. \begin{array}{r} 9 \\ +5 \\ \hline \end{array}$	$2. \begin{array}{r} 2 \\ +5 \\ \hline \end{array}$	$3. \begin{array}{r} 7 \\ +7 \\ \hline \end{array}$	$4. \begin{array}{r} 2 \\ +5 \\ \hline \end{array}$	$5. \begin{array}{r} 6 \\ +5 \\ \hline \end{array}$	$6. \begin{array}{r} 8 \\ +7 \\ \hline \end{array}$	$7. \begin{array}{r} 9 \\ +3 \\ \hline \end{array}$
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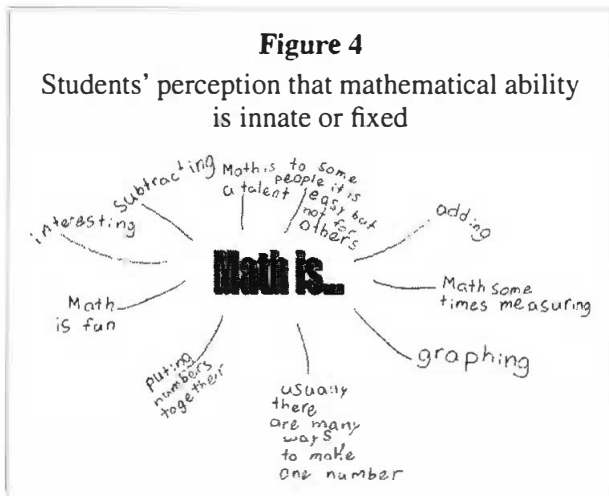
Math facts
Every
panel

Another Grade 3 teacher who used the prompt *When I do math, I feel...* found that her students had similar concerns about correct answers. Her students also viewed mathematics as basic fact drills. She was dismayed to find that her students also equated success in math with getting the answer quickly and viewed incorrect answers as failures.

Student Beliefs About Mathematical Ability

Student writing samples also revealed the common belief that success in mathematics can be attributed

to innate ability rather than effort. Grade 3 students created word webs centred on the prompt *Math is ...* to describe mathematics. As shown in Figure 4, many students had developed the belief that being good at math is more a personality trait than a goal for all learners. This student wrote “Math is a talent” and “to some people it is easy but not for others.” Studies show that students who “conceive of ability as *fluid*, or subject to improvement through effort ... are better achievers than students who believe that mathematical ability is *fixed*.” (Middleton and Spanias 2002, 10).



Incorporating Good Mathematical Tasks and Math Journals

Early in the project the teachers shared student writing samples they had collected in their classrooms. These student samples helped teachers develop their own criteria for a good mathematical task—one that provided a) student engagement, b) a range of possible solutions and/or solution strategies, c) access to significant mathematics, d) a meaningful context that supports student thinking and e) developmental appropriateness.

Project teachers experimented throughout the year with alternative forms of oral and written assessment that elicited student thinking. Through professional readings and collegial dialogue, teachers focused on incorporating more student writing in mathematics. This was achieved mainly through the use of open-ended math tasks and the use of math journals.

Several of the teachers had used mathematics journals, at least occasionally, in their classrooms, while some had never used a math journal before. As the project progressed, many teachers incorporated journaling as a regular part of their mathematics lessons.

In June, student writing samples were collected to help teachers assess the impact of the project on student attitudes and motivation. Teachers wondered if their focus on open-ended tasks and journaling throughout the year would affect student attitudes and conceptions of mathematics.

June Attitude Tasks

Most teachers used writing activities similar to those they used at the beginning of the project to reassess student attitudes. A few teachers experimented with a different activity that they felt would give them a more comprehensive picture. Attitude tasks included

- Journal prompts
 - Write a letter to Grade 3 students to tell them what to expect in Grade 4 math.
 - Write about your personal feelings towards mathematics.
 - Compare your thoughts and feeling about mathematics now as compared to the beginning of the year.
 - How do you feel about math since using the math journals?
- Math art posters
 - Create a poster to advertise what Grade 3 math is all about.
- and
- Word webs
 - students re-created word webs using the prompt *Math is*

Student Attitudes Toward Mathematics

In general, teachers stated that more positive attitudes were evident in the June writing samples. Students often expressed a sense of pride in their accomplishments. Many children wrote about personal learning gains or overcoming challenges throughout the year. This reinforces findings in motivation research that indicate students develop more positive attitudes if they interpret their successes and failures as being within their own control (Middleton and Spanias 2002).

Another notable change was a shift from judging mathematics as good or bad based on how easy it is to valuing mathematics as a subject worthy of effort. In September, negative attitudes were often accompanied by comments that mathematics is “hard.” At the end of the year, many children stated that they liked mathematics despite the challenges it poses.

The June writing samples also revealed that journaling had a positive impact on student attitudes.

One teacher asked her Grade 3 students to write specifically about their experience with mathematics journals (Figure 5). Students stated not only that they liked working in their journals, but that they saw them as a valuable learning tool. As one teacher stated at the end of the project, “Incorporating journals introduced a new perspective on math; eg, rather than just worksheets/textbooks, the students could share ideas individually, in pairs or in large groups. Quiet students spoke up, where normally they wouldn’t say anything.”

All teachers agreed that the project had a positive impact on their students—especially on their attitudes towards mathematics and their conception of what is means to “do math.” Many teachers attributed this also to their own enthusiasm for learning and trying out new ideas and approaches.

Figure 5

Student reflections on math journals

How do you feel about Math since using the Math Journals?

I really enjoy My Math Journals because it's not like adding two numbers together. You explain why the answers are what they are in words. First you write your answer then you say why. I think My Math Journal is really good.

Student Conceptions of Mathematics

Various student samples collected in June showed that students held a much broader conception of mathematics than they had held the previous fall. Although many students wrote about addition, subtraction, multiplication and division, they also identified graphing, symmetry, measurement, probability and geometric shapes as part of mathematics.

Using mathematical tasks set in real-life contexts also seemed to have influenced students. As shown in Figure 6, students wrote about how mathematics was important and useful in the real world. Other comments from student writing samples included statements such as “Math is pretty much all around us” and “I will always know that math is important.” Teachers confirmed that making connections between mathematics and real-life situations was key to improving student attitudes, as illustrated by the following quotes.

- “Connecting math to a story or mind map or project relating to life application was the real motivator.”
- “Talking math was great. Students talked about the application of math and how important it is in the real world. Students were able to see the value of math.”

In general, teachers felt that students emphasized right answers much less in their year-end journal reflections. Instead, students began to write about using strategies and sharing their thinking. Below are some examples of student comments illustrating their conceptions of math at the end of the year:

- “Math gets your brain started.”
- “Math is a way that helps you learn.”
- “I think of math like a great thing because it has thinking things.”
- “Math is ... thinking.”
- “Math is ... strategies.”

One Grade 4 student, whose task was to write a letter to the upcoming Grade 3 class telling them what to expect in Grade 4 math, was particularly encouraging. The student began his letter by writing “In Grade 4 math you will have tons of fun. There are so

Figure 6

Math is useful in the real world

In math I learned a lot! Now I use it in everyday life. Like in the store I estimate prices. On the high way I can figure out how many kilometers it takes to get to the farm. I even took some time to practice elapse time. Now math gets harder but I like getting challenged.

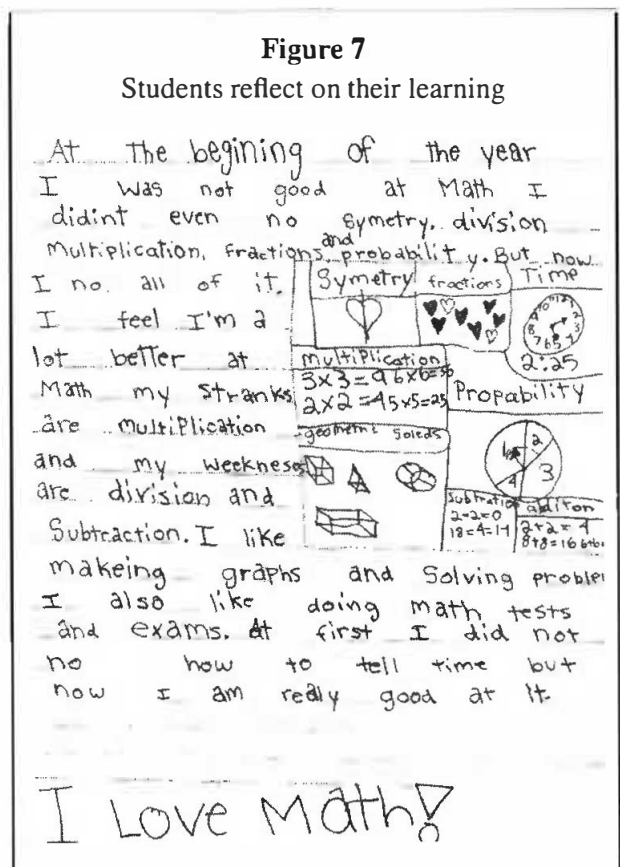
This year my favorite subject in math was probability now that I know what it means I hear it in the store and on the News. Math is easier now! I love math!

many different ways to learn math besides worksheets, quizzes and tables. When you learn math in fun ways, it makes you want to learn.”

Teachers felt that as they selected better mathematics tasks and incorporated writing into daily instruction, students began to recognize that mathematics could go beyond memorizing procedures and completing practice exercises.

Student Beliefs About Mathematical Ability

In June, none of the students identified themselves as “bad at math.” Only a very few stated that they were “good at math” in general. Instead, students simply identified personal areas of strength or weakness. Many stated that subtraction and division, for example, were things they had to work on. As illustrated in one Grade 3 student’s journal entry (Figure 7), students became more reflective about their own learning. In June, students’ self-assessment samples seemed to indicate that they believed that mathematics was within their reach if they tried. This was an important shift in student thinking from what the teachers had observed in September.



Conclusion

Examples of year-end reflections from the teachers sum up the influence of the year-long project on their students:

- My students, I believe for the first time in their “mathematical lives,” really recognized and felt the freedom to be able to approach mathematical tasks knowing that there are always a variety of ways to solve a problem or represent a situation. I also am grateful for the positive attitude that all my students demonstrated towards themselves as math learners.
- Kids became more relaxed about trying things that reflected their understanding rather than “what I think the teacher wants.”
- I think my students have more tools now in math and a broader understanding of what math is.
- I believe my students have gained a deeper understanding of math and are better suited to handle future learning.
- Students in my class were previously taught math skills/concepts in a traditional manner. The students became more confident in their mathematical abilities and showed great enthusiasm when using these innovative and exciting ideas.

The project illustrated that a focus on student writing and open-ended, engaging real-life mathematical tasks can increase student motivation and improve conceptions of mathematics. It is important that teachers develop an awareness of student attitudes as early as possible, because children’s dispositions towards mathematics develop at a young age and are often difficult to change.

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