

A Mathematical Change

Gail Koors

Bartholomew Consolidated School Corporation

Introduction

In 2002 when the NSF MSP grant and Indiana Mathematics Initiative started in nine Indiana school districts, the author was teaching second grade in the Bartholomew Consolidated School Corporation and knew little about process standards or standards-based mathematics. She believed the old paradigm that teachers teach and students learn.

But what happens when the teachers learn and the students teach? Since 2002, schools in Bartholomew Consolidated School Corporation (BCSC) have been experiencing this very paradigm. The Indiana Mathematics Initiative has provided various opportunities for teachers to learn about, understand, utilize, practice, and live the National Council of Teachers of Mathematics' process standards that a standards-based math program is built upon (NCTM, 2000). Using the process standards of communication, representation, reasoning and proof, problem solving, and connections as vehicles to approach the content standards is the basis of the "reform" happening in classrooms throughout BCSC.

Learning from the Indiana Mathematics Initiative

Funded by an NSF Math-Science Partnership Grant and Indiana University Bloomington, the Indiana Mathematics Initiative (IMI) provided the opportunity for elementary teachers to participate in this professional development. IMI has helped many teachers throughout the district. In 2002 the first cohort of teachers was enabled by attending workshops funded, organized, and manned by IMI. As a second grade teacher from BCSC, the author was a member of this initial cohort of teachers meeting to explore standards-based math programs and to develop leadership capabilities.

The teachers were provided materials and manipulatives. They communicated through computer logs with master teachers. They learned about different avenues and understandings of assessment through a program called MARS. They were encouraged by the IMI district coordinator for BCSC, Dale Nowlin. The teachers gathered monthly to use each other's experiences to enhance their own. It was an eye-opening and exciting new adventure!

To provide consistency in the professional development, one particular standards-based math program, *Everyday Mathematics*, was chosen to be used in the nine participating school districts. As a second grade teacher, the author attended the meetings provided by IMI with great presenters who were experienced with the program. She learned about the math program, but more importantly she learned the difference between *process standards* and *content standards*. She learned the importance of all forms of communication in math, and she learned that problem solving was not a separate lesson once a week addressed at the bottom of the page. She practiced representation of many forms, learned new algorithms, and valued the importance of accepting different avenues of completion. She came to understand the capabilities of the students to solve, represent, reason, and explain their thinking. She was astounded at how the students could question and explore, and dare to be wrong!

As the second year began, a leadership cadre was formed and those teachers had an opportunity to travel to Michigan in the fall of 2003 to view standards-based math in action. After a two-day trip to Ann Arbor, followed by a two-day trip to Detroit, this leadership cadre was ready to lead meetings in its own district. Opportunities were open for new teachers, and each of them was paired with a “mentor” who had learned from experience the first year. The leadership cadre led meetings for the mentors and continued to staff the summer trainings that were open for more new teachers. The project goals were listed at the first cohort meeting. The first goal was, “The IU-IMI Partnership aims to develop district cadres of mentor/coach teachers who are both exemplary standards-based mathematics instructors and have leadership and coaching skills to be the major district resource to professionally develop all its mathematics teachers.” The partnership accomplished this goal in Bartholomew Consolidated School Corporation. From the onset, and now years later, the leadership cadre is still learning and new teachers are being reached each year.

After participating in these first two years of standards-based professional development, this teacher was devastated when her district did not adopt that program from which she had learned so much. Rather the district teachers voted to adopt the traditional Houghton-Mifflin math textbook. However, those teachers in the minority who preferred the standards-based program were given the opportunity to use the alternative standards-based text *Math Expressions*.

The Process Standards

This teacher dove into the new program using everything she had learned from her professional development workshops sponsored by IU-IMI. IU-IMI continued to support BCSC’s efforts by funding opportunities for meetings with teachers from Chicago schools using *Math Expressions*. The district then utilized the leadership that had been built from within to train other teachers. This second grade teacher was learning something new: it is not necessarily the program or materials that make a successful math program, but rather it is the attitude, the approach, and the awareness of the power of the process standards!

Two years later, this teacher moved to sixth grade. This was a huge transition after teaching second or third grade for fifteen years. She moved into a peculiar math curriculum since the sixth grade used materials matching those of the middle schools, even though they were not in the same building as the middle school students. The traditional textbook was not based on the process standards. However, this teacher discovered that, because her concept of “math” had been irrevocably changed as a result of the efforts and support of her training with IMI, she could allow her class to be successful with any available materials. While it took a bit more work and creativity on her part with the given materials, she could provide, permit, and expect the use of all the process standards in her classroom. On any given day, the students were drawing, discussing, asking questions, making connections, computing, explaining, and proving their mathematical thinking, the essence of the process standards.

Quoting the National Council of Teachers of Mathematics on the Teaching Principle, “A good curriculum is not sufficient for effective learning and teaching. Teachers are required each day to make choices about how the learning environment will be structured and what mathematics will be emphasized. These decisions determine, to a large extent, what students learn. Effective teaching conveys the belief that each student can understand mathematics and that each will be supported in accomplishing this goal.” This is the life-changing epiphany that IMI has facilitated for many teachers in the Bartholomew Consolidated School Corporation. It is

not necessarily what materials are available with which to teach, but the way the available materials are used, and the atmosphere of trust that is built in the classroom that matters.

Two Classroom Episodes

While teaching during the exciting primary election in the spring of 2008, this teacher used the current candidates to teach probability. While integrating current events, social studies, and reading, the teacher asked the students to solve, explain, reason, justify, question, and prove their thinking. The following episode from this teacher's classroom provides an example of the type of mathematical discourse that typically occurred in her sixth-grade classroom.

1. A political poll was taken to see how the two leading Democratic candidates for president were doing. Obama got 47 percent, Clinton got 45 percent, and the rest of the people who responded were undecided. What percent were undecided?
2. Seventy-five percent ($\frac{3}{4}$) of the undecided voters were leaning toward Obama. _____ percent of all polled voters were undecided but leaning toward Obama.
3. If 200 people were polled, how many said they would vote for Clinton?

The students were asked to discuss and solve the problems, being ready to explain their thinking. All students agreed on #1 that the percentages needed to be added, and then subtracted from 100%. There would be 8% of the polled voters that were undecided.

On #2 there was great discussion.

Jacob: I put 75% because they are just saying the same thing in both sentences. I think they are trying to trick me!

Dakota: Jacob, you said that 8% of the voters were undecided and then it tells me that 75% of the undecided voters were leaning toward Obama, so shouldn't you find 75% of 8%?

Jacob: How can I find a percent of a percent?

Dakota: The whole group of undecided voters is 8%, so if I take $\frac{3}{4}$ of that, I would get 6%, right?

Jacob: Yeah, but you said 75% of 8%.

Dakota: If you have $\frac{3}{4}$ of a dollar, how much do you have?

Jacob: 75 cents

Dakota: Is that the same as 75%?

Jacob: Oh I see!!

Other students chimed in to help students that did not understand. The teacher just stood by and helped only when asked. The discussion then moved to #3.

Haley: I took the 45% that would vote for Clinton from #1 and I know that 45 out of 100 would be doubled if I had 200 people, so I believe there are 90 percent that would vote for Clinton.

Evan: I agree, but I took .45 times 200 because 45% can be written as point four five and "of" means multiply. I got 90 people because I don't think it is asking me for percent. It says "how many..." and I think they are talking about people.

Mackenzie: But don't you have to subtract the 8% that were undecided from that 90 people?

Haley: No, because that 45 percent would be for Clinton and we could figure how many people would vote for Obama and then there would be some people left over from the 200 total and that would be the 8%.

The discussion continued until everyone was satisfied with the answers. The focus then moved to probability with the following sentences.

Which statement is most likely true based on the above information?

- Obama is going to win the nomination.
- Clinton is going to win the nomination.
- If the election were held on the same day as the poll, and only those who were polled voted, Obama would win.
- If the election were held on the same day as the poll, and only those who were polled voted, Clinton would win.
- If the election were held on the same day as the poll, and only those who were polled voted, Obama would probably win.
- If the election were held on the same day as the poll, and only those who were polled voted, Clinton would probably win.

This teacher did her job by providing the opportunity for the process standards of communication, representation, problem-solving, and reasoning, to guide math students to meaningful learning experiences.

Another time, use of the NCTM process standard of making connections was evidenced in the same sixth-grade classroom, while figuring the percentage of fat calories in popular lunch foods. The figure below shows Dakota's written work, which is followed by the explanation he gave in class for finding his estimates.

[See figure on next page.]

When asked about how he made his estimates, Dakota replied, "Well, with the waffles I knew that 190 was close to 200 and I knew that 50 was 25% of 200, so I think the percentage will be about 25%. The peanut butter was harder, but I thought about 140 as 150 and 190 as 200, and I knew that 50 would go into each of them and it would be $\frac{3}{4}$ so that would be about 75%. I had trouble with the cheese, but I finally decided if I added 30 to the 70 to make it 100, so that I could figure a percent, then I had to add 30 to the numerator as well. That gave me 80 over 100, so I thought it would be close to 80%."

Another student asked him why he didn't use the same method on the egg. He responded, "Well, I knew that 35 was half of 70 and that would be 50%. I thought it would be more accurate."

This student knew about making connections and taking a mathematical concept and using it in an everyday situation. The teacher has offered many opportunities for problem solving, reasoning, and communication concerning those connections.

Conclusion

There is a shift happening! Teachers no longer think simply about finishing chapters, but instead about making connections. The National Council of Teachers of Mathematics writes, "Mathematics is an integrated field of study, even though it is often studied in separate areas or

The Fat Content of Foods

1. Use the information about calories on each food label below and on the next page.
 - a. Write the ratio of calories that come from fat to the total number of calories as a fraction.
 - b. Then estimate the percent of total calories that come from fat. Do not use your calculator.
 - c. Finally, use your calculator to find the percent of calories that come from fat. (Round to the nearest whole percent.)

Food Label	Food	$\frac{\text{Calories from Fat}}{\text{Total Calories}}$	Estimated Fat Percent	Calculated Fat Percent
Nutrition Facts Serving Size 1 slice (28 g) Servings Per Container 12 <hr/> Amount Per Serving Calories 90 Calories from Fat 80	bologna	$\frac{80}{90}$	About 90	89%
Nutrition Facts Serving Size 2 waffles (72 g) Servings Per Container 4 <hr/> Amount Per Serving Calories 190 Calories from Fat 50	waffle	$\frac{50}{190}$	About 25%	26%
Nutrition Facts Serving Size 2 tablespoons (32 g) Servings Per Container 15 <hr/> Amount Per Serving Calories 190 Calories from Fat 140	peanut butter	$\frac{140}{190}$	About 75%	74%
Nutrition Facts Serving Size 1 slice (19 g) Servings Per Container 24 <hr/> Amount Per Serving Calories 70 Calories from Fat 50	American cheese	$\frac{50}{70}$	About 80%	71%
Nutrition Facts Serving Size 1 egg (50 g) Servings Per Container 12 <hr/> Amount Per Serving Calories 70 Calories from Fat 40	egg	$\frac{40}{70}$	About 50%	57%

topics. Viewing mathematics as a whole helps students learn that mathematics is not a set of isolated skills and arbitrary rules. Focusing on mathematics in context and establishing mathematical connections makes it easier to apply mathematical knowledge and makes it less likely that students will forget or misapply important mathematical skills and rules.”

The Indiana Mathematics Initiative has allowed teachers to learn from the students and from each other. The role of the teacher has changed, and it presents a more effective and reasonable scenario. Math is an everyday occurrence, not just a page from a chapter of a textbook. There are better teachers at Bartholomew Consolidated School Corporation as a result of the experiences with standards-based teaching and the opportunities provided by the Indiana Math Initiative.

References

National Council of Teachers of Mathematics. (2000) *Principles and Standards for School Mathematics*. For “Process Standards,” see Appendix, Table of Standards and Expectations: <http://standards.nctm.org/document/appendix/process.htm>

Contact info.: Gail Koors
Bartholomew Consolidated School Corporation
Rockcreek Elementary School
13000 E. 200 S.
Columbus, IN 47203
koorsg@bcsc.k12.in.us