Training Activities: Major Shifts in Teaching

As the authors have moved away from lecturing to more engaging teaching practices, we have found that occasional, brief statements about what we want and expect from the class can a constructive and valuable use of class time. We give special attention to those behaviors we want to encourage which may not be common expectations of students in a mathematics content course. "Training activities," which explicitly address the new roles of both teachers and students in an inquiry-based curriculum, are given below. These activities can be especially beneficial during the first week or two as the learning environment for our classroom is being established.

This document contains information, a collection of transparencies, and a list of possible "training activities" for teachers to choose from as they develop their own approach to creating an engaging learning environment in their classrooms.

Important issues that can be addressed include the following:

- Encouraging more active participation in discussions;
- Involving all students in class activities;
- Supporting students growth toward autonomy in learning;
- Stressing the importance of attentive listening to the ideas expressed by other students;
- Welcoming conjecturing, guessing and wondering about mathematical truths;
- Helping students find sources of help other than the teacher;
- Developing more effective learning groups;
- Encouraging thoughtful writing in response to the frequent writing prompts in the APs.

Several items in the text are provided to aid in the transition to an inquiry-based approach to instruction:

i. The preface to the student on page xiv titled "Making Sense of Geometry in an Inquiry-based Class."

ii. The excerpt "Major Shifts in Teaching" reproduced on pages xvi and xvii of the text and taken from the *Professional Standards for Teaching Mathematics* published by the National Council of Teachers of Mathematics.

iii. The Skills Chart "Making Sense of Geometry in an Inquiry-based Class" on page xv at the beginning of the text. This chart summarizes the suggestions in the student guide in the appendix.

iv. The guide for the student contained in the appendix (page 641) titled "Making Sense of Geometry in an Inquiry Class."

Brief Training Activities:

These "Brief Training Activities" are intended to take just 4 or 5 minutes of class time. More substantial activities are given in the next section.

- **TA1:** Call attention to the excerpt "Major Shifts in Teaching" on page xvi and xvii of the text and assign it as a reading for the next class. Use the transparency on page 5 below which lists the five shifts.

- **TA2:** On the day after TA1, ask for students to share their ideas based on their reading of the "Major Shifts in Teaching" excerpt. Use the transparency on page 5 which lists the five major shifts.

- **TA3:** On different days, comment briefly on one of the five major shifts listed. Use one of the five transparencies titled "Major Shifts in Teaching – A, B, C, D, or E" on pages 6-10. Mention the teacher prompts listed on the transparency or else mention your favorite activities that illustrate these shifts. Another possibility is to ask students to suggest a question they might ask when they are teachers which supports this shift. We particularly like shifts A, B and D for this activity.

- **TA4:** Ask students to journal for a few minutes on their reactions to a journal prompt relating to autonomous learning. Suggestions for a prompt:

    - *If I do not understand something in this class, what are ways to learn either working on my own or else with the help of other students or friends?*

    - *When I become a teacher how can I encourage my students to actively think about mathematics and geometry on their own?*

    - *In theory of teaching courses the term "autonomous learners" is sometimes mentioned. What can I do in this class to grow in my ability to be an autonomous learner?*

    - *In theory of teaching courses the term "autonomous learners" is sometimes mentioned. After I become a teacher, how can I help my students develop as autonomous learners in mathematics?*

- **TA5:** Assign readings from the student guide (page 641) titled *Making Sense of Geometry in an Inquiry Class* in the appendix at the back of the book.

- **TA6:** An important part of the process of establishing norms for class interactions is to capitalize on incidents that either illustrate or transgress expectations that are being established. Spontaneous, candid remarks of the

following sort can help students to learn the kinds of behaviors which provoke active learning.

- *Thank you, Jennifer, for your comment. That was very thoughtful.*
- *How many understand what Jessica is saying?*
- *We had a great class today. This is the kind of active discussion I like.*
- *I was disappointed in the amount of discussion today. I hope that you will be more involved during the next class.*
- *Does anybody see another way to explain John's idea?*

More substantial training activities:

- **TA7:** Ask students to look at some of the definitions in the "Geometry Words" link on the student website for the text at www.math.okstate.edu/~geoset. Assign students to make a display showing a way to make sense of a geometric term that is appealing to them or that might help school children to understand the idea.

- **TA8:** Many examples of students' comments about their experiences taking this course are given on the website for this text (click on the link "Comments by GeoSET Students" under the "Student" tab at www.math.okstate.edu/~geoset). For example, student responses are given for this prompt: "When I don't understand a problem or idea or when it doesn't make sense to me, this is what I do:…" Assign students to read all of the student comments on the above prompt and then write a page with their thoughts on the prompt. (Note: Use the transparency on page 11 which reproduces part of the webpage. Any of the prompts on the web page can be used in place of the one quoted above.)

- **TA9:** Assign students to read and write a one-page commentary on an article about practical issues with creating an active learning environment in elementary or middles school classrooms. A list of articles to choose from is given on the next page.

Articles – Creating and Active Learning Environment

These articles are recommended as reading for students.

Elementary Level:

Sandra L. Atkins, Listening to Students: The Power of Mathematical Conversations, *Teaching Children Mathematics*, pages 289-295, January 1999.

Hollylynne Drier, Investigating Mathematics as a Community of Learners, *Teaching Children Mathematics*, pages 358-363, February 2000.

Carolyn A. Maher and Amy M. Martino, Teachers Building on Students' Thinking, *Arithmetic Teacher*, 39(7)32-37, March 1992.

Diana Steele, Learning Mathematical Language in the Zone of Proximal Development, *Teaching Children Mathematics*, pages 38-42, September 1999.

Nancy Nesbitt Vacc, Planning for Instruction: Barriers to Mathematics Discussion, *Arithmetic Teacher*, 41(6)339-341, February 1994.

Nancy Nesbitt Vacc, Teaching and Learning Mathematics through Classroom Discussion, *Arithmetic Teacher*, 41(4)225-227, December 1993.

Middle School Level:

Azita Manouchehri and Mary C. Enderson, Promoting Mathematical Discourse: Learning from Classroom Examples, *Mathematics Teaching in the Middle School*, Vol. 4, No. 4, January 1999, pages 216-222.

Steven C. Reinhart, Never Say Anything a Kid Can Say! *Mathematics Teaching in the Middle School*, Vol. 5, No. 8, April 2000, pages 478-483.

Miriam Gamoran Sherin, David Louis, and Edith Prentice Mendez, Students Building on One Another's Mathematical Ideas, *Mathematics Teaching in the Middle School*, Vol. 6, No.3, November 2000, pages 186-190.

Major Shifts in Teaching

See page xvi of text.

- **Toward classrooms as mathematical communities and away from classrooms as simply a collection of individuals;**
- **Toward logic and mathematical evidence as verification and away from the teacher as the sole authority for right answers;**
- **Toward mathematical reasoning and away from merely memorizing procedures;**
- **Toward conjecturing, inventing, and problem solving and away from an emphasis on finding answers mechanically;**
- **Toward connecting mathematics, its ideas, and its applications and away from treating mathematics as a body of isolated concepts and procedures.**

Taken from the NCTM *Professional Standards for Teaching Mathematics*

Major Shifts in Teaching - A

- **Toward classrooms as mathematical communities and away from classrooms as simply a collection of individuals**

Helping students work together to make sense of mathematics

With this vision, possible teacher questions:

"What do others think about what Janine said?"

"Do you agree? Disagree?"

"Does anyone have the same answer, but a different way to explain it?"

"Would you ask the rest of the class that question?"

"Do you understand what they are saying?"

"Can you convince the rest of us that that makes sense?

Adapted from the NCTM *Professional Standards for Teaching Mathematics*

Major Shifts in Teaching - B

- **Toward logic and mathematical evidence as verification and away from the teacher as the sole authority for right answers**

Helping students to rely more on themselves in determining whether something is mathematically correct

With this vision, possible teacher questions:

"Why do you think that?"

"Why is that true?"

"How did you reach that conclusion?"

"Does that make sense?"

"Can you make a model to show that?"

Adapted from the NCTM *Professional Standards for Teaching Mathematics*

Major Shifts in Teaching - C

- **Toward mathematical reasoning and away from merely memorizing procedures**

Helping students learn to reason mathematically

With this vision, possible teacher questions:

"Does that always work?"

"Is that true for all cases?"

"Can you think of a counterexample?"

"How could you prove that?"

"What assumptions are you making?"

Adapted from the NCTM *Professional Standards for Teaching Mathematics*

Major Shifts in Teaching - D

- **Toward conjecturing, inventing, and problem solving and away from an emphasis on finding answers mechanically**

Helping students learn to concecture, invent, and solve problems

With this vision, possible teacher questions:

"What would happen if . . .? What if not?"

"Do you see a pattern?"

"What are some possibilities here?"

"Can you predict the next one?"

"How did you think about the problem?"

"What decision do you think he sould make?"

"What is alike and what is different about your method or solution and hers?"

Adapted from the NCTM *Professional Standards for Teaching Mathematics*

Major Shifts in Teaching - E

- **Toward connecting mathematics, its ideas, and its applications and away from treating mathematics as a body of isolated concepts and procedures**

Helping students to connect mathematics, its ideas, and its applications

With this vision, possible teacher questions:

"How does this relate to . . .?"

"What ideas that we have learned before were useful in solving this problem?"

"Have we ever solved a problem like this one before?"

"What use of mathematics did you find in the newspaper last night?"

"Can you give me an example of . . .?"

Adapted from the NCTM *Professional Standards for Teaching Mathematics*

Reproduced from GeoSET Website: Under student tab

Comments by GeoSET Students

Often teachers of the GeoSET course ask students to give their thoughts and ideas about their own experiences with geometry and how the course works for them. These are interesting to read, and we hope they might also be of help to new students taking the class.

When I don't understand a problem or idea or when it doesn't make sense to me, this is what I do:

"I listen to others and try to understand their thinking. I am also not afraid to ask questions of how they got to a certain point. Questions that get answered help me think through my mistakes."

Click here for additional student comments...

The way I know that I am sure about concept or idea is when:

"I talk with fellow students in a group setting and compare answers. Not only does this help me understand if I know the concept, but it also gives me a chance to discuss the concept with others."

Click here for additional student comments...

What are your thoughts and feelings about this course so far? Are there things you like? Are there things that really bother you? How is it like you expected or different from what you expected?:

"I like how when a difficult problem comes up that someone can't seem to solve on their own, the class is encouraged to suggest alternate methods of solving it. I expected it to be more of a lecture class instead of being based on group work and discussion, but I'm glad I was wrong."

Click here for additional student comments...