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ABSTRACT

A researcher surveyed 161 students in adult education math classes at four community colleges in Illinois and 13 adult education math teachers. Both groups were asked to complete the survey from the viewpoint of a student. The respondents were asked what should math classes teach; what kind of problems they most enjoy working on in class; whether they prefer working on their own in a good workbook with teacher help, working with a partner or small group, or working as a whole class; whether they think it is more productive to do workbook word problems, seek solutions to math problems in students' lives, or practice addition, subtraction, multiplication, and division; would they rather listen to the teacher's explanation, practice by solving games and puzzles, watch an example being done, use rulers and other tools to help them "see" the math, or work problems in pairs and small groups; and why they were learning math. Students but not teachers were strongly unanimous on most choices, including that they thought math classes should teach rules for solving problems, would most enjoy working on the practice problems on the General Educational Development test, prefer working as a whole class, and want to find solutions to real math problems. (The author contrasts student preferences with teaching standards and suggests that respecting student preferences would keep more students in class. Contains 7 references.) (MO)

Math Is in the Eye of the Beholder

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For successful teaching to take place, there must be a teacher and student(s). The teacher must know and communicate the information to the student in a way that the student can understand, use, and appreciate. To do that, the teacher must be aware of how the student learns, how the student feels about learning, what goals the student has, and what needs the information fulfills for the student. The student must be ready to learn and must believe the teacher can teach him or her. The student must be able to translate the information into an understandable form, be able to connect the information with what was known before, and have a context in which to apply the information. Whether articulated or not, every good teacher understands this.

In order to teach more effectively, teachers engage in a lot of theoretical discussions. Researchers take select groups of students and test theories. Both groups reflect on their own successful learning. They listen to professors and read journal articles. A consensus is reached on the most effective teaching methods. Teachers distill the consensus with their own opinions and past experiences and then use the framework to conduct their classes.

Students who object to the format or goal of the class have three choices: argue convincingly for a different approach, trust the teacher and wait for results, or leave. Overwhelmingly in adult education classes, they leave.

Of course, attrition has many reasons. There are situational causes: lack of babysitters, transportation, new job schedules. There are emotional causes. Students in adult education classes have impulsively left commitments before, dropping out of high school, quitting jobs, leaving other adult education classes. There are institutional causes: changes in class schedules, costs or locations. Whatever the causes, it is common for programs to have 50-70% attrition rates (Quigley, 1995).

The perception that the class is not providing a forum in which they can learn is an important contributing factor in attrition. In a classroom research study conducted by Pamela Meader, a math teacher in Portland, Maine, "math difficulties were the barrier that students perceived as keeping them from finishing a class." Over 60% of the students mentioned math difficulties as a barrier to persistence compared with the next highest category of fewer than 10% for a child's illness (Meader, 2000, p. 9).

Students and teachers do not see math and math instruction in the same way. Most math teachers enjoy math, have been successful at it, and relish the challenge. They consciously use math in their everyday lives, perhaps especially chosen among their family and friends to figure the tip or keep the family finances. Students, on the other hand, have often been unsuccessful at math, avoiding it as much as possible. Math learned in school appears useless, a creation of teachers and textbook writers. "Most math is just a game. If you like it, you play it. I don't like it." (student, Prairie State College, Illinois, 1992).

> I don't care how many cookies Sally made. And I don't care how many were oatmeal and I don't care how many were chocolate chip and I could care less who ate them. You know, I'll never in my life forget that problem as long as I live. Who cares?! You cook 'em, you eat 'em. (Curry, Schmitt, & Walton 1996, p. 15)

It is not surprising then that students and teachers have very different perceptions of how a math class should be conducted.

These facts were brought home to me this year during an afternoon substituting in a GED math class at Harper College in Palatine, Illinois. One of the tasks for the six students in the class was to learn how to divide fractions. I approached it with manipulatives, discussion, and problem-solving. The students participated and

seem to successfully grasp the concept. At the end of the class, I asked for their reactions. One student was enthusiastic both at her learning and the way the material had been presented. The other students responded more negatively. These are some of their comments:

"We don't need to understand why this works. In life you are just given a problem, you follow the rules and you do it."

"Understanding is too hard."

"Real math teachers in high school don't teach like that."

"You know, she hasn't had much math so this seems good to her. But we all remember a little how to do this and we want to start from where we remember."

"All I want is to know the rules and get my GED. I don't care about math."

Were these general attitudes with all students or just those almost ready for the GED? Was this, perhaps, just a reaction to a particular class and a difficult concept? I created a survey completed by students in adult education math classes at four widely separated community colleges in Illinois.

I. *Palatine area including Harper College and several workplace sites.* This college is in the far northwest suburban area of Chicago. Most students have jobs and are somewhere in the middle income range. There is a fairly even distribution of Hispanic, Caucasian, and African-American students along with a significant number of other ethnic and racial groups.

II. *Elgin Community College.* Elgin is a middle-sized older city about 45 miles northwest of Chicago. The students are similar to those at Harper with a large percentage of immigrants, especially from Mexico.

III. *Olive Harvey Community College* is located on the south side of Chicago. The students at Olive Harvey are primarily African-American although there are other ethnic and racial groups represented. The income level varies from low to middle class. Many students have jobs, but there are also many who are unemployed.

IV. *Prairie State Community College* is in Chicago Heights, a southern suburb of Chicago. The student population is similar but somewhat more diverse than at Olive Harvey.

The teachers surveyed came from two groups:

I. Those at the schools where the students were surveyed.

II. Teachers belonging to the Adult Numeracy Listserv.

Both groups were asked to complete the survey from the viewpoint of a student. The teachers were asked to imagine themselves as students in a math class.

MATH SURVEY

Under each number, mark **1** by the answer you most agree with and **2** by the second best answer.

1. **What should a math class teach?**
   A. The rules that tell how to do math problems.
   B. The understanding behind the rules.
   C. The ability to look at problems and develop your own rules.

2. **Which kind of problem would you most <u>enjoy</u> working on in your class? They will all teach you the math.**
   A. How many years of carpet would it take to carpet your living room?
   B. Could all the people in the world float in Lake Superior?
   C. Develop a budget.
   D. Do practice problems from the GED test.
   E. Figure out how much money in interest you pay on your credit card bill.

3. **Do you prefer:**
   A. Working on your own in a good workbook. The teacher helps you if you get stuck.
   B. Working with a partner or in small groups studying and doing problems together.
   C. Working as a whole class learning the same math strategies all together step-by-step.

4. **Do you think it is more productive to:**
   A. Do the word problems that are most common in math workbooks.
   B. Learn math by problem solving to find solutions to the real math problems in student's lives in the classroom.
   C. Spend most of the time practicing addition, subtraction, multiplication, division on whole numbers, decimals and fractions and not do too many word problems.

5. **Would you rather learn math by:**
   A. Listening to an explanation from the teacher.
   B. Practicing problem solving by using games and puzzles.
   C. Watching an example done on the board by students or teachers.
   D. Using rulers and other "hands-on" tools that help you to "see" the math.
   E. Discussing and working problems in pairs or small groups of other students.

6. **Why are you learning math?**
   A. For my job.
   B. To pass the GED
   C. Because I always felt I didn't know the math I should have learned in school.
   D. To help my own kids.
   E. Because it is interesting.
   F. To use in my everyday life.

The rationale behind the questions and choice of responses is obvious with the exception of Question Two. In Question Two, the following is the reasoning behind the responses:

1. What kinds of problems would you most enjoy working on in your class?

   A. How many yards of carpet would it take to carpet your living room.
   This is a false "real-life" question found in many math texts. Most people when they need carpeting either give dimensions to the carpet store or have the salesman/installer measure the room. Few people actually figure the area.

   B. Could all the people in the world float in Lake Superior?
   This is an intriguing question both for the information and the challenge of solving. It has no connection to any essential need.

   C. Develop a budget
   Many people have the need to do this and have tried before entering math class. It is necessary, but it is a process that people frequently feel they know already.

   D. Do practice problems from the GED
   A common belief is that if you practice similar type problems, you will do better on the test. Even for those not ready for the GED, it may be a goal.

   E. Figure out how much money in interest you pay on your credit card bill.
   This is a real-life, important challenge that many of us cannot do.

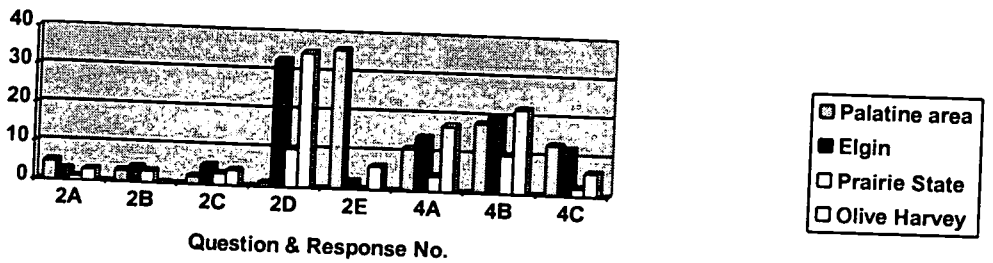
Students completing the survey: 161
Teachers completing the survey: 13

Palatine area students: 46
Prairie State students: 19
Elgin students: 47
Olive Harvey students: 49

Charts for total student responses and total teacher responses are on the next page.

There were some differences in the sites.

Comparison of First Choices: Students



2. Which kinds of problems would you most enjoy working on in your math class

All sites but Palatine chose **2D**: "Do practice problems from the GED test." Palatine preferred **2E**: "Figure out how much money in interest you pay on your credit card bill.

Students were not distinguished according to what type of adult education math class they were in. It is possible that those in Palatine were not in a GED program to the extent that the other groups were.

4. Do you think it is more productive to:

Three sites were quite close between choices **4A**: "Do the word problems that are most common in math workbooks" and 4B: "Learn math by problem-solving to find solutions to real math problems in student's lives in the classroom." However, Prairie State overwhelmingly chose **4B** and Elgin and Palatine gave a strong showing to **4C**: "Spend most of the time practicing addition, subtraction, multiplication, division on whole numbers, decimals and fractions and not do too many word problems."

Looking back at the Student Total chart, note that students were strongly unanimous on most choices. They want "The rules that tell how to do math problems." They would like to "do the practice problems on the GED test." They would prefer "working as a whole class" over working alone or in small groups. They want to find solutions to "...real math problems." Instruction should come directly from the teacher, and the emphatic goal is to pass the GED.

Teachers, on the other hand, want "the understanding behind the rules." They agree with students on doing "practice problems from the GED," "working as a whole class," and doing "real life math problems." However, teachers prefer to "work in pairs or small groups," and they see the reason to learn math "because it is interesting."

Teachers' choices are much more varied than student choices. For instance, 3 out of 13 teachers, approximately 23%, chose "Could all the people in the world float in Lake Superior" as their favorite type of problem to work on in class. Only 10 out of 161 students, or 6%, chose the same problem, intellectually interesting but neither "real world" nor directly applicable to the GED.

One of the most striking contrasts was in the attitude toward small group work, with 38% of the teachers favoring it and only 14% of the students in question 3 and less in question 5.

The results of the survey questions are consistent whether the numbers are for just first choice or the sum of the first and second choices.

What implications does this have for teaching?

The National Council of Teachers of Mathematics issued standards for math education in 1989. These were translated into standards for adult education in a 1996 research study funded by The National Institute for Literacy titled: *A Framework for Adult Numeracy Standards*. The similarity of selected standards is shown below:

NCTM Standards, grades 5-8
(selected standards with selected bullet points)

Standard 1: Mathematics as Problem-Solving

- *Use problem-solving approaches to investigate and understand mathematical content*
- *Formulate problems from situations within and outside mathematics;*
- *Develop and apply a variety of strategies to solve problems, with emphasis on multistep and nonroutine problems;*

Standard 2: Mathematics as Communication

- *Model situations using oral, written, concrete, pictorial, graphical and algebraic methods;*
- *Reflect on and clarify their own thinking about mathematical ideas and situations;*
- *Develop common understandings of mathematical ideas, including the role of definitions;*
- *Discuss mathematical ideas and make conjectures and convincing arguments;*

Standard 3: Mathematics as Reasoning

- *Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs;*
- *Make and evaluate mathematical conjectures and arguments;*

Standard 4: Mathematical Connections

- *Use a mathematical idea to further their understanding of other mathematical ideas;*
- *Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science and business;*

Standard 5: Number and Number Sense

- *Understand, represent and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real-world and mathematical problem situations;*
- *Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers;*

A Framework for Adult Numeracy Standards

- **Relevance/Connections**
- **Problem-Solving, Reasoning/Decision-Making**
- **Communication**
- **Number and Number Sense**

There has been support for these standards both in the K-12 and the adult education community. (The NCTM Standards were amended in 2000, but they were not substantially altered.)

In 1995, District 2 in Manhattan, New York introduced a new standards curriculum.

"Before the district adopted TERC, a full-year pilot project showed comparable performance between the comparison group and the TERC group on traditional computation tasks. But the TERC group demonstrated greater flexibility in their choice of approach to problems and greater accuracy in solving them" (Hausman, 1998).

"In 1994, in Arlington, Virginia, 110 adult educators from 30 states met for a three-day working conference on adult mathematical literacy. Their recommendations included the following:

1. Class math activities should be collaborative, involve problem solving, and help learners develop reasoning skills. (Ciancone, 1996)."

"Educators interested in developing numeracy (rather than in merely teaching mathematics) are challenged not only to address learners' formal knowledge of mathematics or their ability to solve word problems, but also to attend to their abilities to transfer skills and effectively manage numeracy situations" (Gal & Stout, 1997-1998, p. 15).

This information presents a contradiction. The research indicates that learners need to have "the ability to look at problems and develop (their) own rules." They need to problem solve and communicate their thoughts to others moving away from knowledge centered in and directly transmitted from the teacher. Students need to experience math in a variety of ways including with physical objects, in conversation, and by symbolic abstraction.

But if this teaching makes students uncomfortable and challenges their trust in the efficacy and accessibility of the math class, they will drop out. If the student is not in class, it does not matter if the method of math instruction is the most optimal or not.

Perhaps if the teacher steps back a little with respect toward students' perceptions, both good teaching and retention can be accomplished.

- Start with whole class instruction and move toward small groups as the comfort level in the class increases. It is not bad for the teacher to be respected as a source of information. Discussion and thought can occur in a whole class as well as in a small group.
- Let students, who are frequently unsure and apprehensive, have the confidence of learning a procedure and applying it successfully. Give rules. Just because students learn a rule does not mean that they will never understand it.
- Recognize and applaud students who are seeking a GED. It may not be the only goal in adult mathematics education, but it is a worthy one. Let students see GED type problems. Practicing problem types reduces anxiety, which helps test taking.
- When students seem confident enough to move out on their own, give choices. Let them decide if and who they will work with. Some students learn better if they struggle with the problem on their own. Some work best with one friend. Some like the camaraderie and ideas generated in a group.
- Validate the bits and pieces of knowledge the student has accumulated. Begin a discussion by asking them what they already know. Stepping off from familiar ground is reassuring and makes it easier to explore the unknown.
- Encourage students to use "math words" such as "balance," "rate," "measure," "weigh," "share," etc. to develop problems that are relevant to their lives and past experience.
- As the class becomes more oriented toward problem solving and independence, explain not only the math but also the reasons for approaching it in this fashion.

In summary, treat the class with the same compassion and support as you would any friend who came to you for help even if you and that friend have some differences in perception as to how the help should be given.

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