

# Standards, Special Education, and Access to Mathematics Curriculum

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## Abstract

Recent legislation has pushed reform efforts to new heights. Students with disabilities now have higher standards, which include participation in high stakes testing. This article explains one elementary teacher's approach to math education and preparing all students to be successful on standardized tests. Details of how she gives all learners access to the curriculum are described.

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## Introduction

Disability is a natural part of the human experience and in no way diminishes the right of individuals to participate in or contribute to society. Improving educational results for children with disabilities is an essential element of our national policy of ensuring quality of opportunity, full participation, independent living, and economic self-sufficiency for individuals with disabilities.

(IDEIA, 2004, p. 3)

Assessment, standards and high-stakes testing provide for many stressful moments in teachers' lives. Recent legislation places teachers under stronger accountability standards in regards to access to the general education curriculum for students with disabilities. The 1997 amendments to the Individuals with Disabilities Education Act (IDEA) and the No Child Left Behind Act of 2002 provide provisions for alternative assessments for students with disabilities, but they stress that students are to be assessed (Browder, Spooner, Ahlgrim-Delzell, Flowers, Algozzine, & Karvonen, 2003). The Individuals with Disabilities Education Improvement Act of 2004 (IDEIA) further stresses the need to ensure access to the general education curriculum. Teachers are to have high expectations and challenge students so that they will be prepared to lead productive lives (IDEIA, 2004).

In addition, the National Council of Teachers of Mathematics (NCTM, 2000) suggested six principles that describe particular features of high-quality mathematics education: Equity, Curriculum, Teaching, Learning, Assessment, and Technology. Ac-

cording to NCTM (2000), equity requires high expectations, opportunities for all, accommodating differences to help all students, and resources and support for all students. "All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study-and support to learn-mathematics" (NCTM, 2000 p.12).

This case study describes the study of one teacher, Deb, using her experience and skill to teach all learners mathematics curriculum. Deb is an experienced teacher in an urban elementary school. She teaches 4th grade, but because of how the school began grouping students in the second semester of the 2004-2005 school year, she taught 1 session of accelerated mathematics and three 40 minute-long mathematics classes. Students were grouped according to their Standardized Testing and Reporting (STAR) mathematics score. The groups include a typically performing group who, the teacher feels, can pass the proficiency test, a bubble group who can pass with extra help, extra encouragement, and extra exposure, and the students who are at-risk or have designated disabilities. Deb worked with one of authors through a year-long professional development program for mathematics teachers. During the program, she introduced her work to the program participants and has been receiving requests from local school districts to share her work with other teachers. In order to document her work, Deb was observed by the authors during class, interviewed in person and via email to discover what techniques she finds effective for all her students. The authors hope that her work will inspire other general educators to provide access to math vocabulary for all students.

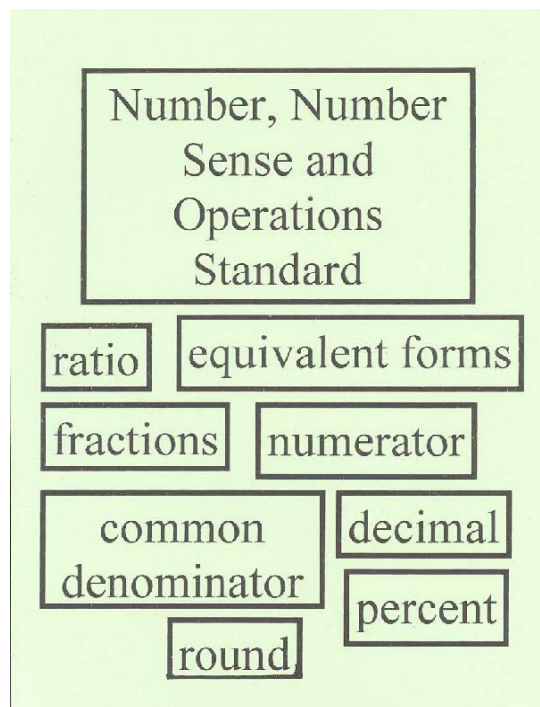
## A General Educator Working with All Learners

Deb was persistent in positive classroom management and used a variety of instructional approaches (direct and indirect methods of presentation) that stimulated students' interest and assisted students who were struggling. She also valued all children's learning by using different techniques. Sometimes, she used different difficulty levels of problems (simpler) for students with special needs. An example would be problems for typically performing groups including more than 4 lines of symmetry whereas 2 or 3 symmetrical lines were used for students with special needs.

Most teacher educators have concerns that preservice/inservice teachers have a difficult time putting educational theories into practice. However, Deb converted her idea into a product, *Word of Math*®, and

then adopted it in her daily teaching. She started to develop *Word of Math* (Grades 2-6) to help students learn mathematical terms listed in the state standards. The vocabulary is the same terminology that appears on both curriculum-based assessments and standardized state tests.

In addition, her professional/personal orientation to students helped establish rapport with students in the classroom, as well as developing students' positive self-concepts. Moreover, she made her teaching techniques applicable for all school settings by providing inservice programs along with the *Word of Math*® package (see Figure 1). In brief, Deb satisfies characteristics of an effective teacher (Harberman, 1995; McKinney, Robinson & Spooner, 2004) and is one of the facilitators of knowledge we need in our schools.



Deb states that she has not had any special training for working with students with special needs, but she started to realize right away that different types of learners needed different things.

**Deb:** I use the same language, but I don't present material in the same way. For example, with the bubble group and the typical group, area and perimeter were introduced together. As a class we compared area and perimeter. We drew figures that had exactly the same area, but had different perimeters. I would ask the question, "If I want to buy a fence, which would be most economical? How do we know?" We worked area and perimeter together. However, with the group with special needs we worked on perimeter for 2-3 days and then introduced area. We then worked on area for 2-3 days. Only then could we connect the two concepts. (D. Gronas, personal communication, February 5, 2005)

This is an important difference. Access to the same curriculum does not mean the students are taught in the same manner. NCTM (2000) supports Deb's approach, "Equity does not mean that every student should receive identical instruction; instead, it demands reasonable and appropriate accommodations be made as needed to promote access and attainment for all students" (p. 12).

Students with disabilities often have a difficult time processing information, reading for relevant information, and problem solving (Gagnon & Maccini, 2001). Because of these difficulties, students with disabilities often become very reluctant to try

more challenging math tasks. When Deb sees these students in 4th grade, some have already started to shut down and refuse to see that they have any skills. Academic self-esteem becomes critical at this stage (Montague & van Garderen, 2003).

One way that Deb encourages all learners and helps students develop self-esteem is to start and end each class with a chant. She says, "We" and the students shout, "love math!" The students with disabilities took a little longer to learn this routine and do not say it as loudly as their typically performing peers, but it is apparent that the thought that they can do mathematics is starting to sink in.

### **Tools that Work**

In order to help all children learn mathematics, the role of curriculum materials, instructional strategies, and the professional development of teachers are crucial (Browder et al., 2003; Defur, 2002; NCTM, 2000). Deb has created *Word of Math*® which is a multicolored bulletin board of mathematical terms used in Ohio Academic Content Standards (see Figure 2). She realized the importance of mathematics vocabulary words after analyzing her students' performance on the state standardized test. Her students missed questions due to a lack of understanding of mathematical vocabulary words. Deb started to have her students keep a notebook, and students kept all of the vocabulary, along with drawings and their own thoughts about concepts, in their notebook.

**WORLD OF MATH**

- Numbers, Number Sense and Operations Standard**
  - Way to represent numbers; numerals words physical models expanded form
  - symbols
    - equal =
    - equation
  - operations
    - less than <
    - even 2, 4, 6, 8, 0
    - odd 1, 3, 5, 7, 9
    - estimate estimation front-end estimation
    - round
  - equivalent
    - associative property
      - $2 + (3 + 4) = (2 + 3) + 4$
      - $2 \times (3 \times 4) = (2 \times 3) \times 4$
    - commutative property
      - $2 + 3 = 3 + 2$
      - $2 \times 3 = 3 \times 2$
    - inverse operations
      - $(+ \text{ and } -)$
      - $(\times \text{ and } \div)$
- Dollars & cents**
  - place value
  - billions hundred thousands ten thousands thousands hundreds tens ones
  - decimal
    - hundredths tenths
    - thousandths
- Fractions**
  - part of a set
  - part of a whole
  - numerator
  - denominator
- Patterns, Functions and Algebra Standard**
  - multiply
  - right-angle
  - repeated addition skip counting arrays
  - area model
  - factors
  - divide
    - division repeated
    - subtraction
    - sharing equally arrays
    - area model
- Data Analysis and Probability Standard**
  - graph (5 things to make it complete)
    - probabilities
    - likelihood
    - likely
    - unlikely
    - impossible (0)
    - less likely
    - equally likely
    - more likely
    - certain-to-happen (1)
  - mode
  - median
  - data
  - range of data
  - table
  - line plot
  - chart
  - line graph
  - bar graph
  - picture graph
  - line segment
  - line
  - point
  - two-dimensional shape
  - three-dimensional object
  - face
  - edge
  - quadrilaterals
    - square
    - rectangle
    - parallelogram
    - trapezoid
    - rhombus
- Geometry and Spatial Sense Standard**
  - vertex
  - vertices
  - symmetry
  - line of symmetry
  - translation (slide)
  - rotation (turn)
  - reflection (flip)
  - congruent
  - similar
  - side
  - base
  - cone
  - cylinder
  - pyramid
  - labeled grid
  - pairs
  - right angle
  - acute angle
  - obtuse angle
  - quadrilaterals
  - square
  - rectangle
  - parallelogram
  - trapezoid
  - rhombus
- Measurement Standard**
  - U.S. Standard
    - length
      - inch
      - foot
      - yard
      - mile
    - volume
      - cup
      - ounce
      - pint
      - quart
      - gallon
  - Metric
    - length
      - centimeter
      - meter
      - kilometer
    - volume
      - liter
      - milliliter
  - time
    - hour
    - half-hour
    - quarter-hour
    - minutes
    - seconds
  - area

during reading class; and symbolic vocabulary are the special alphabet and nonalphabet symbols used in mathematics such as  $>$ ,  $<$ , and  $=$ , as well as abbreviations, which present great challenges to understanding mathematics for many students (Monroe & Panchyshyn, 1995-1996). The importance of developing mathematical vocabulary and students' ability to communicate about mathematics are emphasized in mathematics literature (Monroe & Orme, 2002; NCTM, 1989, 2000). Educators must strive for facilitating learning that helps students learn not only to "do" math problems, but also to discuss mathematics with others using the appropriate vocabulary (Chard, 2005).

### *Instructional strategies*

In order to maximize performance for the group that was low-achieving, “re-phrasing questions, being warm and encouraging, giving hints, and allowing more time to respond” are reported as effective instructional techniques” (Bachor, 1985, p. 184). Deb used these techniques and also allowed students to work in groups and work with tools other than the paper and pencil. Some students with special needs feel very unsure about writing and getting out that paper and pencil worksheet is deflating for them. Using a small whiteboard or blackboard can have a positive effect because it is something they do not get to use every day, but it allows for effective math practice (Rhone, 2001).

**Deb:** Sometimes I use individual chalkboards for the students. Other times students work in groups to solve problems and record the process on overheads. I do this mostly when I’m introducing a concept. I know my students well enough that when I put them in groups usually at least one of them understands the concept. The students start to explain to each other what they learned from the introduction to the lesson. The next day we review the concept or vocabulary and I give individual homework. The third day we go over the individual homework to see where the students may have had problems. That night I’ll give an assignment to assess. (D. Gronas, Interview 2/05)

### *Constructing knowledge*

Though there is yet to be a large amount of evidence that large scale assessments improve achievement, they require that teachers do focus on providing access for students with disabilities (Schulte, Villwock, Whichard & Stallings, 2001). Deb believes in helping students to construct

their own knowledge based on their previous knowledge. This belief is supported by constructivists (Piaget, 1954; Vigotsky, 1978). For students to construct their own unique view of the world is very important (Knight, 2002). This helps them feel more confident in their approach to the general education curriculum.

**Deb:** Sometimes, I give the students a word and they tell me what it means. Then they write the vocabulary word and definition in their notebook. When introducing a concept or vocabulary that I know is going to be new to the students, I first give them the term and its definition to write. That is my introduction of the concept. We go over the concept with examples and they have the rest of the notebook page to make their own notes, to draw their own pictures, to add things that help them construct meaning. (D. Gronas, Interview, 2/05)

Another way Deb improves the students’ understanding of the mathematics concepts is to approach the vocabulary in unique ways. She always uses the proper terms. Students are never talked down to, or given a different expression when the correct mathematical language may seem cumbersome. Students rise to the challenge and use their notebooks as sources of information when they aren’t sure of a term.

**Deb:** This is the first year I’ve made the flash cards. *Word of Math*® is an evolving idea. When I find something that works I go to the next step and then the next step. This year, particularly with geometry, I have found that the flashcards used for a quick five minute review are one of the kids’ favorite parts of the day. They love doing the flashcard activity. (D. Gronas, Interview, 2/05)

It is not always easy to show how mathematics connects to the real world.

Finding ways to motivate students means finding what affects their lives and what they are excited about (Classen, 2002). Deb also incorporates real life examples into daily mathematics lessons.

**Deb:** It's critical to make real life connections. I can talk to them about a rectangular prism, but, I can give the students a cereal box and say, "This is a rectangular prism." They can hold it and it makes a connection in their mind; "Oh, yeah this is a rectangular prism". In fact, we had an activity one day where we tried to think of all the things in our cabinet at home that were rectangular prisms. The students came up with mashed potato boxes, rice boxes, cereal boxes. Somebody said an oatmeal box. I said, "My oatmeal is in a cylinder." Well, their oatmeal does come in a rectangular prism because they were talking about the boxes of instant oatmeal with the packets. I show students things to connect what they are learning to their world. (D. Gronas, Interview, 2/05)

### *Learning and movement*

Kinesthetic learning opens students up to the way they learned as young children; exploring the world through movement (Griss, 1994). Gardner (1983) described the bodily-kinesthetic intelligence as one avenue for learning new material. Encouraging movement is one way Deb attempts to connect with students with disabilities.

**Deb:** We use our bodies to model. We try to show with our arm straight and our elbow bent a right angle, an obtuse and acute angle. Of course I did that with all the groups just to get them up and get them involved in what we're doing, but I do more physical activity with the group of learners with special needs to address learners' specific needs. (D. Gronas, Interview, 2/05)

Deb also circulates around the room when allowing the students to work in groups. She encourages them to explain concepts to each other, and she monitors their progress. This allows students to be active, rather than passive, learners throughout the math lesson.

**Deb:** It's really an assessment of my teaching as well as student learning. I see what they know or if the students are talking and there's a really obvious misconception, then I can stop and say, "Wait, is this really how...let's look at this...or let's think about it," so that I don't let them go down the wrong path too far. It lets me know whether they have an understanding of what they're doing. Sometimes I think the students will understand a concept and they don't. Other times I think a concept or vocabulary is really going to be tough, and they get it right away. (D. Gronas, Interview, 2/05)

### **Professional development of teachers**

*Word of Math*© has been shared with other schools in this district. Deb has given inservices on the proper use of the vocabulary and the ideas about using the terminology effectively.

**Deb:** I shared with the principals how Math vocabulary builds. Math is truly building blocks and the vocabulary builds from one year to the next. I showed the administrators what I developed. *Word of Math*© was so well received by the principals and building coaches that all of the elementaries in Lima except one, have purchased a *Word of Math*© bulletin board kit for every teacher in their building. The principals are expecting the teachers to have a bulletin board, to be using a bulletin board, and to be using the appropriate math vocabulary. (D. Gronas, Interview, 2/05)



Deb is also concerned with the way the mathematical vocabulary words are taught.

**Deb:** The teachers in Lima are good teachers and teach concepts, but a lot of times what they do is try very hard to put the concept into words that the kids understand without really forcing the students to use the appropriate vocabulary. In math, teachers need to start from day one using the appropriate vocabulary because the students are going to be tested on that vocabulary. (D. Gronas, Interview, 2/05)

## Discussion

According to Smittle (2003), six principles for effective teaching, especially for underprepared students, are teachers committed to teaching underprepared students, demonstrating good command of the subject matter, addressing noncognitive issues that affect learning, providing an open and responsive learning environment, communicating high standards, and engaging in on-going evaluation and professional development.

Deb reported changes in students' attitudes toward mathematics and growth in students' understanding, as well as achievement scores. One of Deb's recent test results showed students making a gain from a 3.8 grade level to 5.5 grade level in math, but that was before she switched to the current grouping and started working with more than her homeroom on mathematics curriculum. She is hoping future tests will show growth for all the groups of fourth graders she is currently teaching.

**Deb:** The students' scores started to improve with the math notebooks. I saw growth, but not enough growth. I did a bulletin board

using the words that we were putting in our notebook. Proficiency scores improved. The students started to use words that were on the bulletin board in their class conversation, and in their responses to questions. I knew that it was becoming more effective. (D. Gronas, Interview, 2/05)

While we have standards-based reform we will continue to have large scale standardized assessments, but schools can choose to look at students' performance in terms of growth versus level (Schulte et.al, 2001). For students with disabilities looking at growth over a school year versus comparing the student to others in the same grade may be a more realistic standard, but this approach is not used in most districts (Schulte et.al, 2001). Because these students will continue to be compared to their peers, access to the general education curriculum is extremely important. These students have skills, but often don't feel capable because they have always been treated as different. Even when the student with the disability has the required knowledge they are often hesitant to apply it and their perception is that they hate math and can't do it (Montague & van Garderen, 2003). The approaches that Deb uses help these students gain confidence and increase the perception that, though they may take a longer road, they can solve the problem and understand the concept. It will be a great day when all the 4th grade students shout confidently, "We....love math!"

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