



INFORMATION SHARING SESSION OCTOBER 11, 2004 SESSION 2

PRESENTATION BY DR. SHANON HARDY

Effective Math Instructional Strategies

Are the National Council of Teachers of Mathematics (NCTM) standards equally applied to all students? Guiding the goals of the NCTM standards are five basic principles:

1. Equity (mathematics is for all students);
2. Effective teaching (mathematics teaching includes understanding the development of the child and instructional techniques);
3. Curriculum (mathematics curriculum should be viewed as an integrated whole);
4. Problem-solving (mathematics should create good problem solvers);
5. Continual assessment (mathematics should acquire feedback for student progress); and importance of technology (tools for use in mathematics).

According to Dr. Shanon Hardy, some of the principles are consistent with goals for students with disabilities. However, some principles will require the implementation of accommodations or interventions to reach these goals. Research has shown that processing difficulties associated with memory, language, and communication disorders, as well as poor self-esteem, attention deficits, and organizational skills, pose some special challenges to achieving these goals in mathematics instruction.

Dr. Hardy presented several interventions that have been found to be effective for teaching students with disabilities, including the use of:

- Manipulatives, such as physical objects to learn number sense, patterning, etc.
- **Concrete-Semi-concrete-Abstract Instruction, or CSA.** Through this intervention, teachers would develop the math concept with a manipulative, move to the representational or semi-concrete stage by drawing objects, then advance to the abstract stage by symbolically writing numbers and words to symbolize the objects and drawings. It is important for students to master 80% of the material in each stage. This sets the stage for problem-solving with practice.
- **Direct Instruction.** This very scripted teaching process is a widely researched component of math instruction and has been found to be effective.
- **Demonstration Plus Permanent Model.** This practice includes teacher demonstration of a concept, creation of a model, and a permanent display in the classroom or in mathematics notebooks.
- **Mnemonics.** This is an effective strategy, particularly when teaching a math problem-solving process.
- **Meta-cognitive strategies** such as self-monitoring and self-instruction. A checklist strategy can prompt or remind students of the next steps in the problem-solving process.

- Computer-assisted instruction with software such as *Geometry Sketchpad* and *Making Equations*. Research is not well-established on this topic since specific computer software is difficult to evaluate when the manufacturer conducts the research. The available evidence shows that when students set their own goals, performance increases.

Dr. Hardy proceeded to focus on difficulties students with disabilities have with algebra and algebraic concepts. Algebra is perceived by students as difficult because it is more abstract and based upon manipulation of symbols. Students who normally have difficulty translating a word problem, have additional difficulties translating an algebraic problem with abstract variables and unknowns. One difficulty for students with disabilities is distinguishing relevant and irrelevant information in an algebraic problem. In order for students to succeed in algebra, students must learn new terminology and be fluent in basic operations with numbers. Success in algebra is essential as a gateway to higher level math courses, as a requirement for high school graduation, and for many professions.

Some resources that may be of interest to teachers and administrators are listed below:

- The NCTM Web site (<http://nctm.org>) provides lists of journals, books and publications, problems, and lessons. Interventions like CSA are not built into the textbooks, but teachers still need to be aware of the strategies for students with disabilities.
- Hands-On-Algebra provides a strategy for instruction. The research on this strategy is limited, but it is still worth the time to investigate and apply this technique.
- Research by Cawley, Parmar, Yan, & Miller (1996) on students with disabilities in mathematics can be useful to those who work with this population.
- Effective instructional strategies to teach algebra skills to students with disabilities (CSA, direct instruction, computer-assisted instruction, strategy instruction, structured worksheets, meta-cognitive strategies, and graphic organizers) can be applied in various settings.
- Star Strategy for algebraic problem-solving (search the problem, translate the words into an equation in picture form, answer the problem, review the problem for accuracy and reasonableness) is helpful to all mathematics students.

How can teachers make a change in teaching algebraic concepts? Teachers can use principles of effective instruction in algebra such as: designing structured lessons with a focus on goals to achieve before (provide a review and objective for the concept), during (model, prompt, provide lots of practice and feedback), and after the lesson (assess performance).

Dr. Hardy concluded her discussion with the following recommendations for teachers and administrative staff:

- Continue to instruct secondary math students with mild disabilities in basic arithmetic.
- Use think-aloud techniques when modeling steps to solve equations.
- Allot adequate time to teach specific strategies.
- Provide guided practice before independent practice so that students can understand what to do and comprehend the reasons for each step.
- Provide a physical and pictorial model, such as hands-on materials, illustrations, or diagrams for each problem.
- Relate problems to real-life events.
- Continue to encourage students to practice, practice, practice.

FACILITATED DISCUSSION

Effective Math Strategies for Instruction

Alabama

Alabama's Math Standards Technology Initiative (AMSTI) is fully funded in three in-service regions. Teachers have two weeks of intensive training with manipulatives and models provided in kits, and are taught strategies for writing out in words, drawing, and explaining math problems. Schools, administrators, and staff must buy into the program (about 80%). Preliminary results of the *AMSTI* schools indicate an increase in scores for math. Math specialists, who are teachers from the district, provide models and follow-up training to K–12 teachers. The Master site director, from the University of Alabama, provides guidance to the initiative. This is a marriage between the university and school district. A train-the-trainer model provides demonstration to teachers in proper use of manipulative kits for the classroom and mathematics lesson. Since test scores were lacking in previous years, all 7th- and 8th-grade regular and special education teachers will be trained in both content standards and manipulatives. Teachers' manipulative kits are distributed (and refreshed) with appropriate grade level manipulatives and lesson plans. Kits are built around grade level content standards. Teachers must be willing to change their instructional techniques in mathematics. For more information, participants can go to: www.amsti.org.

Facilitator: The NCTM standards encourage using manipulatives and CSA for both special education and general education classes.

North Carolina

A variety of programs exist in North Carolina to provide improvement in algebra for students with disabilities. Some special and general education teachers received training in Making Algebra Child's Play and thought it was great. The State Improvement Grant (SIG) addressed mathematics in one of the counties, but the data has not shown improvement for children with disabilities. The state is taking the route of better preparing teachers to teach algebra. This summer, general education algebra teachers were trained in strategies on teaching algebra to all students through training and scripting what a teacher should say in the adopted algebra textbook. As a result, teachers did a better job of teaching and student performance improved. Currently, a team of regular and special education teachers in the state are coming together to discuss and develop a math plan. The effort to remove LD students from algebra (by the LD association) is about access to the general education curriculum. The publication, *Math is Reading Too* shows that mastering math is about learning to read and use symbols, just like reading is about learning to use letters.

Pennsylvania

PAttan training conferences, which emphasized reading in the past, are now turning their focus to mathematics as well. The math conferences through PAttan offered 5 days of training on 5 major mathematics concepts, focusing on monitoring mathematics and using the CBM Web site. PAttan is a technical assistance network that supports large and small efforts in school districts through regional offices by offering a train-the-trainer model. For more information, participants can access the Web site at www.pattan.k12.pa.us.



Kentucky

Changes to the teaching strategy in mathematics is in the planning stages in Kentucky. Some programs that receive federal funding are developing a statewide mathematics initiative.

Louisiana

Because of the lack of highly qualified math teachers, some regional training for scripted programs such as *Strategic Instruction Model* has been initiated for teachers of students with disabilities.

Washington

The mathematics initiative that started this year includes a mathematics education training core of teachers for special education. However, the special education department is not part of this initiative.

California

California districts have directed their programs over a 2-year period to focus on all students using an accelerated math program and technical assistance with developed resources and strategies. Discussion of hands-on strategies versus direct instruction have encouraged special education and regular education teachers to teach and work together. Team teaching, co-teaching in regular classes, and extended instruction to special education classes for further teaching have been initiated in the schools.



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