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Teaching Strategies for Students with Learning Disabilities in Mathematics

Rarely is there a single cause for a learning disability. Often there is a constellation of causes operating together that result in a child's learning difficulties. Mathematics is a complex process requiring visual and cognitive perception abilities, comprehension ability, and adequate prior knowledge. This article addresses students' learning difficulties in mathematics and provides some suggested activities that have been proven to work with students with learning disabilities.

Learning Disabled (LD) is the largest category of special education. LD is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities, especially in academic settings.

More than one half of all students in the public education system who are eligible for special education services are learning disabled (Geary, 1999). Since 1976, the number of students identified with LD has more than doubled; there are 3 boys for every 1 girl challenged by LD (Garrett, 1998). The National Council of Teachers of Mathematics (NCTM, 2000) specifically identified "Equity" as their first principle for school mathematics. They feel educators need to have high expectations and strong support for all students and that accommodating differences to help everyone learn mathematics is critical. The NCTM has taken a prominent stand that as educators we must take an "equity for all students" approach to teaching mathematics. All students, including special needs or even second language learners, have the right to learn math and feel confident in their ability to do math (Furner, Yahya, and Duffy, 2005). Teachers must see to it that "mathematics can and will be learned by all students" (NCTM, 2000, p. 13).

Math learning difficulties are common, significant, and worthy of serious instructional attention in both regular and special education classes. Students may respond to repeated failure with withdrawal of effort, anxiety, lowered self-esteem, and avoidance behaviors. In addition, significant math deficits can have serious consequences on the management of everyday life as well as on job prospects and promotion opportunities.

Math learning problems range from mild to severe and manifest themselves in a variety of ways. Most common are difficulties with efficient recall of basic arithmetic facts and with reliability in written computation. When these problems are accompanied by a strong conceptual grasp of mathematical and spatial relations, it is important not to bog the student down by focusing only on remediating computation. While important in working with these students, such efforts should not deny a full math education to otherwise capable students.

Too frequently and too readily, individuals with dyslexia who have difficulty with mathematics are misdiagnosed as having dyscalculia - literally trouble with calculating, a neurologically based disability (Wright, 1996). True dyscalculia is rare. We know that for individuals with dyslexia, learning mathematical concepts and vocabulary, as well as the ability to use mathematical symbols, can be impeded by problems similar to those that interfere with the acquisition of written language. Additionally, we know that the learning of mathematical concepts, more than learning in any other content area, is tied closely to the teacher's or academic therapist's knowledge of mathematics and to the manner in which these concepts are taught. Therefore, there are individuals with dyslexia who will exhibit problems in mathematics, not because of their dyslexia or dyscalculia, but because their instructors are inadequately prepared in mathematical principles and/or in how to teach them.

Language disabilities, even subtle ones, can interfere with math learning. In particular, many LD

students have a tendency to avoid verbalizing in math activities; this tendency is often exacerbated by the way in which math is typically taught in the United States. Developing habits of verbalizing math examples and procedures can greatly help in removing obstacles to success in mainstream math settings.

Many children experience difficulty in bridging between informal math knowledge and formal school math. To build these connections takes time, experiences, and carefully guided instruction. The use of structured, concrete materials is important in securing these links, not only in the early elementary grades, but also during concept development stages of higher-level math. Some students need particular emphasis on translating between different written forms, as well as on different ways of reading these and various other representations (with objects or drawings) of what these forms mean.

Significant visual-spatial-motor disorganization, an extremely handicapping though less common math disability is when Specific Learning Disabled students experience:

- ✓ a weak understanding or lack a comprehension of concepts,
- ✓ have very poor "number sense,"
- ✓ experience specific difficulty with pictorial representations,
- ✓ have poorly controlled handwriting,
- ✓ and experience confusion with arrangements of numerals and signs on textbook/ workbook pages.

The formation of foundation math concepts is impaired in this small subgroup of students. Methods of compensation for this disability include avoiding the use of pictures or graphics for conveying concepts, constructing verbal versions of math ideas, and using concrete materials as anchors. The organizational and social problems that accompany this math disability are also in need of long-term appropriate remedial attention in order to support successful life adjustment in adulthood.

In summary, as educators, there is much that can be and needs to be done in this area that calls for much greater attention than has been typically provided. Some suggested activities/lessons adapted from (Su and Su, 2004) are included to assist teachers in reaching students with learning disabilities.

Some suggested activities:

Activity 1: Popsicle Patterns

Grade: 6 – 7

Objective: To explore geometric relationships and describe results using algebraic notation.

Materials: Popsicle sticks, butcher paper, markers, scissors, glue, overhead projector

Sunshine State Standards:

Benchmark(s): MA.A.3.3.3- Student understands and explains the effects of addition, subtraction, multiplication, and division on whole numbers, fractions (including mixed numbers), and decimals, including the inverse relationships of positive and negative numbers.

Teaching Method: Direct/Explicit Instruction/ Modeling

- In small groups of 3 or 4, students examine patterns in geometric context.
- Model geometric shapes on the overhead projector using toothpicks.
- Have students examine the patterns. They should conclude that the first array of materials forms one square, the second forms two squares, and the third forms three squares.
- Have students copy the shapes you made on the overhead with Popsicle sticks. Provide individual assistance as needed.
- Guided practice: Give hints for finding the number of Popsicle sticks needed to a square, two squares, and n number of squares.
- Oral discussion: Looking for patterns
- Have students describe in words how they found the number of Popsicle sticks. Then translate words to symbols (verbal translation). Review and discuss answers.
- Distribute glue, scissors, and strip of butcher paper.
- Working in groups of 3 or 4, each group will glue pattern onto the butcher paper, each group making a different number of squares.

Assessment: Each group will present their written explanations of shapes and patterns included on their display. Each group will also do an oral presentation. Groups should select a speaker to give an oral presentation to the whole class about their project.

Extension: Students will work in teams of 4 to create new puzzles that will include the skills acquired from the above activity. The puzzles will include only three clues and the rest of the students in the class must guess the geometric shape.

Activity #2: Tick Tack Fractions

Grade: 7

Objective: Students will use fraction comparisons and equivalences to exactly cover eight bars. (Students will work in teams of twos)

Materials: Overhead projector, fraction tower cubes set, butcher paper, pencils, markers, and math journals

Sunshine State Standards: Mathematics Grade Level 7

Benchmark(s): MA.D.1.3.1- Student will describes a wide variety of patterns, relationships, and functions through models, such as manipulatives, tables, graphs, expressions, equations, and inequalities.

Teaching Method: Direct/explicit instruction/ Modeling

- Teacher will model the Tick Tack Fractions game on the overhead. The object of the game is for a player to get three equivalent fractions in a row (horizontally, vertically, or diagonally).
- First, the players must decide who goes first.
- The player who successfully aligns three equivalent fractions in a row wins the game.

Informal Assessment: Assess whether the students recognize and use appropriate Equivalences. Have students record in their math journal fraction equivalences.

Extension: Have partner groups compete with other partner groups within the class. Have students present different game moves they made for given fractions and different strategies they used during game play.

Activity #3: Initial Expressions

Grade: 6 – 8

Objective: Students will write and simplify an expression used to form the area of their initials.

Materials: Overhead projector, different size colored paper clips, one 11" x 14" sheet of paper, pencils, and colored pencils.

Sunshine State Standard:

Benchmark(s): MA.D.2.3.1- Student will represent and solves real-world problems graphically, with algebraic expressions, equations, and inequalities.

Preparation for assignment:

- On the overhead projector, the teacher will construct his/her first initial with paper clips of all colors and sizes.
- Review the paper clip names by identifying variables and constants, combine like terms by grouping "like" paper clips, and write a simplified expression for the clips forming the teacher's initial.

Teaching Method:

- Students will use different color and size paper clips to form the two or three initials of their names on the 11" x 14" paper.
- Students will trace, label, and color the paper clip images with colored pencils.
- Students will then combine like clips into groups and place the highest powers first, followed by the first degree terms in alphabetical order and then the constants.

Assessment:

- Students will write a simplified expression for the area covered by their initials.

Extension:

- Students will write an expression for the perimeter of their initials.

The above strategies can be adapted and used by teachers who are working with students with learning disabilities in mathematics. They also may be effective with learning-handicapped children who also are functioning at that level. Meeting the needs of all types of students in mathematics is critical in an age where a child's future depends so much on their success with mathematics.

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About the Authors:

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Dr. Hui Fang Huang "Angie" Su is a Program Professor of Innovative Teaching in Mathematics Program and Professor of Mathematics Education for Nova Southeastern University's Fischler Graduate School of Education. She is the creator of Project MIND - Math Is Not Difficult®, a K -12 mathematics enhancement project currently being implemented in several school districts throughout the United States. Project MIND was a multi-million dollar project funded by the South Florida Annenberg Challenge, the Toppel Family Foundation, the Quantum Foundation, National Science Foundation, JM Family Enterprise, Inc., the School District of Palm Beach County, Broward County Public Schools, Miami-Dade County Public Schools, and the Community Foundation for Palm Beach and Martin Counties.

Prior to becoming a Professor for Nova Southeastern University, Dr. Su was the K-12 Mathematics Specialist in the division of Academic Programs for the Palm Beach County School District. In addition to providing assistance in mathematics curriculum and instructions to the schools, Su also designed and created practice tests for the district to help teachers identify the needed skill areas for their students in order to prepare them for the state's standardized test. Su developed a website for the Division of Academic Programs, and served as the division's web master.

Partnering with the Annenberg Foundation, the Quantum Foundation, and the Toppel Family Foundation, Su initiated the state's first Teacher Incentive program. As an Instructional Specialist in the Palm Beach County School District's Department of School Improvement and Staff Development, Su designed the Technical Assistance Plan for the District to help students in critically low-performing schools improve their achievement. In this role, she coordinated and organized the site review teams, including managing their schedules, visits, and responsibilities, created a Teacher Resource Book, and organized a community and district mentoring project for the schools.

Dr. Su has received numerous awards and recognitions, including the Presidential Award for Excellence in Mathematics and Science Teaching from the National Science Foundation, the William T. Dwyer Award for Excellence in Teaching, Palm Beach County Elementary Mathematics Teacher of the Year, Wal Mart Teacher of the Year, State of Florida's Little Red School House Award for principals (for Project MIND), and the Women of Distinction Award from the Soroptomist International. In 2002, Su was name one of the fifty Most Successful Business Women in South Florida by Fast Track Magazine. She received the 2003 March of Dimes Women of Distinction Award in Broward County. In addition, Su was named 2003 Professor of the Year by Fischler Graduate School of Education and was one of the five finalists as the University Professor of the Year. She was also the recipient of several presidents' research awards. Most recently, Su has received the Governor's Points of Light Award for her innovative work with the homeless women. This award led to the appointment by Governor Bush to serve on his council for the homelessness. Su has appeared in numerous television programs, including NBC's national Nightly News, and regional and local news segments, as well as more than forty newspaper articles and magazines (including the Redbook Magazine) for her expertise in mathematics education, curriculum development, early childhood education, gifted education, and child rearing. Author of numerous teacher resource books and college textbook in mathematics education, Su shares her expertise with

educators, community leaders, parents, and lawmakers through workshops, seminars, conferences, journal publications, and classroom demonstrations. Su is a known national consultant in mathematics education. She is also listed in the Marquis Who's Who in America, Who's Who is American Education, Who's Who of American Women, Who's Who in the World, Who's Who in Science Engineering, and International Who's Who of Historical Society.

Cicely Scott

Cicely Scott is currently a graduate student enrolled in the Masters of Education program with a specialization in mathematics education at the Fischler School of Education and Human Services of Nova Southeastern University. Cicely lives and teaches in Belle Glade, Florida, a small farming community of 18,000 people. The city is located about fifty miles west of West Palm Beach. She earned her Bachelors of Science degree in Organizational Management from Palm Beach Atlantic University in December 2000. Cicely worked as a substitute teacher for the School District of Palm Beach County for eight years before returning back to school to receive certification in Mathematics grade five through nine in 2002.

In August 2002, Cicely started her teaching career. She was hired as a middle school mathematics teacher at Pahokee Middle Senior High School. She graduated from the same high school in 1991. Her desire to enter the teaching profession came from the dynamic teachers, their abundance of knowledge, and admiration and dedication they bestowed on all of their students.

Cicely was born and raised in Pahokee, Florida. Pahokee is a rural area with 50% of its citizens below poverty level. She saw the need to educate the children of this small city located on the southern edge of Lake Okeechobee, Education is their key to a better way of life. She loves the community and feels that it is her duty to give something back.