

MIDDLE SCHOOL STUDENTS WITH LEARNING DISABILITIES: MATHEMATICS INSTRUCTION, STUDY SKILLS, AND HIGH STAKES TESTS

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Abstract

This article reviews characteristics of middle level students with learning disabilities and presents instructional modifications and study skills to help them succeed in the mathematics classroom and on federally mandated mathematics assessments.

Introduction

Because of recent legislation and current educational trends, students with learning disabilities (LD) learn middle school mathematics and algebra in general education classes. The curriculum is often challenging, and the high stakes mathematics tests required in most states are particularly difficult as well. However, students with LD have the potential to pass these middle school courses and the related tests and most importantly understand the mathematics content and skills at this level. The purposes of this article are to overview the typical LD characteristics, which can interfere with mathematics learning, and then suggest strategies for differentiating instruction and teaching study skills to ensure success for ALL students.

LD Characteristics

Several of the typical LD characteristics can make middle school mathematics courses frustrating. All students with LD have at least one academic subject that is weak. Reading is the most frequently affected subject, and students could be several years below grade level by the time they are in middle school (Smith, 2004). In a middle school mathematics textbook, terms such as polyhedron, permutation, and rotational symmetry may complicate reading comprehension of mathematical explanations, directions, and problems. Writing problems associated with learning disabilities can also interfere with mathematics performance (Smith, 2004). With the emphasis on integration across curricular areas, many mathematics books incorporate writing assignments such as journal entries related to mathematics procedures, creation of word problems, and explanations for ways of solving problems. Oral language deficits for students with LD may include

problems answering questions aloud and understanding directions, which are typical activities during middle school mathematics lessons (Pierangelo and Giuliani, 2006).

Perceptual or processing problems are also common characteristics that can make middle school mathematics lessons challenging (Henley, Ramsey, and Algozzine, 1999). A visual processing problem may interfere with tasks such as constructing bisectors with a compass and ruler or making scatter plots, while an auditory processing deficit will make partner and group activities such as making predictions and finding probabilities using number cubes or spinners very difficult. Memory problems, including difficulty remembering new information, repeating information from textbooks or lecture, and sequencing correctly can all be problem areas for students with LD (Pierangelo and Giuliani, 2006). It may be difficult for a middle school student, for example, to apply all steps in order for graphing a function, even if a graphing calculator is used.

Attention and organizational problems associated with learning disabilities can make mathematics lessons particularly frustrating. Students with LD may have trouble beginning their assignments, using skills that they have learned for a particular problem, or choosing approaches that are appropriate for a specific mathematics problem (Pierangelo and Giuliani, 2006). Students may have difficulty keeping up with materials and tasks related to ongoing projects such as applying different formulas for calculating surface areas and then later volumes of the same objects, or organizing information from surveys to make charts and graphs.

Instructional Modifications

To make differentiation possible for the middle school mathematics teacher, it is important to start with collaboration. If the special education and mathematics teacher work together, they will have the advantages of expertise in both specialization areas. Frequently, collaboration is viewed as the best resource available for middle school mathematics teachers who have students with LD in their classes. Planning and teaching together prevents student frustration and enables teachers to be successful and feel more confident with their instruction (DeSimone and Parmar, 2006).

Curriculum assessment measures are also beneficial to ensure appropriate LD modifications. When teachers know students' specific difficulties with mathematics performance, they can more effectively individualize their instruction (Bottge, Heinrichs, Chan, Mehta, and Watson, 2003; Bottge, Rueda, Serlin, Hung, and Kwon, 2007). Furthermore, the classroom assessment activities allow teachers to more efficiently focus their remediation so that additional time can be spent on higher level thinking skills (Yeh, 2006). Finally, assessment can contribute to positive attitudes for students since they can be given specific feedback on their performance and improvements (Scarlato and Burr, 2002).

To clarify complex mathematics standards and textbooks, it is beneficial to integrate some additional structured instruction to provide differentiation for students with learning disabilities. For example, modifying instruction for students with processing and organizational deficits might include more explicit explanations of textbook examples, modeling of steps, additional practice, and extensive feedback (Jitendra, Hoff, and Beck, 1999). In teaching word problems to middle school students, it is helpful to include systematic instruction with modeling steps, prompts, guidance as students work through the steps, frequent feedback, and practice until mastery (Montague, Warger, and Morgan,

2000). Teaching decimals and fractions using structured lessons including modeling, practice, guidance, review of pre-requisites, and feedback also benefit students with learning disabilities (Scarlato and Burr, 2002).

Using various strategy instructional techniques can benefit students with LD and other students in the class who are struggling with mathematical problem solving. The techniques are particularly effective for students with language, processing, and organizational problems. One example incorporates the following steps for word problems: reading, putting the problem in students' words, visualizing or actually creating a diagram, deciding on a strategy, predicting, calculating, and finally, checking the answer. While students work through the problem, they also monitor their progress to be sure they are following all steps in the right order (Montague, Warger, and Morgan, 2000). Students with LD can learn to use high level thinking skills in analyzing word problems if they are taught specifically how to determine the kind of structure involved in the word problem and then draw a picture to represent the structure. They can learn to organize the key information logically, draw an appropriate picture, and then transfer the information to an algebraic equation (Xin, Jitendra, and Deatline-Buchman, 2005).

Multimedia can be used to enhance instruction for students, especially if there are language, reading, memory, and attention deficits. Using videos of algebraic word problems, for example, can help students with comprehension problems. Students can then practice the skills in real life examples without the videos for additional experiences with the mathematical skills involved (Bottge, Heinrichs, Chan, Mehta, and Watson, 2003; Bottge, Rueda, Serlin, Hung, and Kwon, 2007).

Mnemonics can help middle school students with learning disabilities and memory or organizational problems learn mathematical facts as well as procedures for word problems. Students can create a sentence, for example, to help them memorize the order of metric prefixes- kilo, hector, deka, meter/gram/liter, deci, centi, and milli. Teachers can model steps for word problems using mnemonic prompts and then have the students practice with guidance and finally on their own. In one study, participants used a real life story situation for the mnemonic clues; the results indicated that the process mnemonics helped the students memorize and then use the steps required to solve problems successfully (Manalo, Bunnell, & Stillman, 2000). Manipulative materials, often used in elementary mathematics classrooms can also be used effectively with middle school students, especially those with attention, memory, and processing disorders. Two research studies demonstrated the value of manipulative materials for teaching algebraic equations to middle school students with LD. The researchers suggested that manipulatives are beneficial for students without LD who may be struggling with the more abstract ideas typically addressed at the middle school level (Butler, Miller, Crehan, Babbitt, & Pierce, 2003; Witzel, Mercer, & Miller, 2003). In studying surface area and volume, for example, students can work on the formulas using boxes, cans, balls, and other common objects.

Study Skills

Teaching mathematics study skills and test-taking strategies for high stakes mathematics tests is critical for students with LD but can also be valuable for students without disabilities. First, the classroom assessment procedures implemented by teachers can foster appropriate differentiation of instruction and remediation geared toward the

standards assessed on the end-of-year tests. The preparation provided in this way can include drill and practice as well as higher-level problem solving skills. Feedback from these informal assessments can then be used to encourage students, demonstrate progress to them, and build confidence for the formal testing process (Yeh, 2006).

Specific practice on test-taking skills can benefit students with LD and others who may have difficulty on tests. Students with reading, visual processing, attention, and organizational problems will benefit from a review of typical mathematics test directions they may encounter. They could practice following the directions on teacher made tests so they will be more familiar. Other suggestions such as underlining or highlighting key words in the directions prior to starting the test, estimating solutions to problems, and checking that all questions have been answered are also important to review with students during the year and prior to the tests (Hallahan, Lloyd, Kauffman, Weiss, and Martinez, 2004).

Summary and Conclusions

The recommendations presented in this article are summarized in the following table.

Table 1

Differentiating Instruction: Summary of Modifications for Learning Disabilities

Characteristics	Modifications
Reading difficulties	<ul style="list-style-type: none"> Collaborate with special education teacher Use multimedia examples and presentations Review and practice with typical test instructions Teach students to estimate and check all answers
Writing difficulties	<ul style="list-style-type: none"> Collaborate with special education teacher Assess for error patterns and problem areas Teach students to estimate and check all answers
Oral language deficits	<ul style="list-style-type: none"> Collaborate with special education teacher Assess for error patterns and problem areas Use step-by-step strategies for problem solving
Visual processing deficits	<ul style="list-style-type: none"> Collaborate with special education teacher Assess for error patterns and problem areas Incorporate explicit instruction to clarify lesson Use step-by-step strategies for problem solving

	Review and practice with typical test instructions
Auditory processing deficits	Collaborate with special education teacher
	Incorporate explicit instruction to clarify lesson
	Use step-by-step strategies for problem solving
	Use concrete, manipulative materials to clarify
Memory problems	Collaborate with special education teacher
	Assess for error patterns and problem areas
	Incorporate explicit instruction to clarify lesson
	Use multimedia examples and presentations
	Create mnemonic strategies for memory tasks
	Use concrete, manipulative materials to clarify
Attention problems	Collaborate with special education teacher
	Incorporate explicit instruction to clarify lesson
	Use multimedia examples and presentations
	Use concrete, manipulative materials to clarify
	Review and practice with typical test instructions
	Teach students to estimate and check all answers
Organizational problems	Collaborate with special education teacher
	Assess for error patterns and problem areas
	Incorporate explicit instruction to clarify lesson
	Use step-by-step strategies for problem solving
	Create mnemonic strategies for memory tasks
	Review and practice with typical test instructions
	Teach students to estimate and check all answers

Although differentiation can be complex, these ideas will assist students with learning disabilities and other students struggling with mathematics. Simply beginning with just a few modifications can make a significant impact on student progress, test performance, and most significantly mathematics understanding. The strategies are important for the success of students with LD and will also be helpful reminders for the whole class.

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