

21. Give tasks involving only one new concept or skill so students can experience success.
22. Practicing test directions and taking self-timed tests can help prepare students for standardized math tests. Practice marking bubble sheets if this is a problem.
23. There is no quick fix for dyscalculia. Help students stay motivated through helping them keep charts to track their progress and by rewarding small gains.
24. Individuals with dyscalculia need self-understanding of their strengths and weaknesses. Always start by asking if they know what works best for them. Then help them develop additional strategies.
25. Be an advocate for students with math disabilities. As students mature, teach them to be advocates for themselves.

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What Teachers Need To Know About Dyscalculia (Mathematical Disability)

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Dyscalculia is a genetic, neurological disorder that affects an individual's ability to do mathematics. A discrepancy exists between the individual's general cognitive level and ability to comprehend and do mathematics (Mazzocco, 2005). Between 5 to 8 percent of individuals, in all age groups, may have some form of dyscalculia (Geary, 2004).

Characteristics of Dyscalculia

Some people with dyscalculia can perform basic mathematical tasks (e.g., basic facts; addition, subtraction, multiplication, division; count money), but cannot apply these simple tasks to higher level mathematics. Other individuals understand higher level mathematical concepts almost intuitively, but cannot learn basic tasks. Still others can do the basics and/or higher level mathematics, but cannot apply mathematics to real-life or new situations (Farmer, Riddick, & Sterling, 2002). Sometimes, people with dyscalculia have problems in all three areas.

Dyscalculia manifests itself in many forms:

1. **Verbal dyscalculia**—difficulties remembering and naming mathematical terms and symbols.
2. **Practognostic dyscalculia**—difficulties using manipulatives or pictures when applying mathematical concepts.
3. **Graphical dyscalculia**—problems with writing mathematical terms, symbols, etc.
4. **Lexical dyscalculia**—problems with reading the vocabulary and symbols of mathematics.
5. **Operational dyscalculia**—difficulties with mathematical operations (i.e., addition, subtraction, multiplication, division).
6. **Ideognostical dyscalculia**—difficulties with mathematical ideas or concepts (Kosc, 1974).

An individual can have one, a few, or all forms of dyscalculia, resulting in different characteristics and challenges. As a result, individuals with dyscalculia often do mathematics very slowly and laboriously with extreme fatigue and frustration. In addition, achievement in mathematics is significantly below students' potentials when considering intelligence and performance in other academic areas (National Center for Learning Disabilities, 2007). It is sometimes difficult to differentiate between students who have problems in mathematics due to dyscalculia and those who have difficulties for other reasons. For example, a poor mathematical background, ineffective instruction, low intelligence, lack of prerequisite skills, poor language skills, math anxiety, and other factors can cause mathematical deficits. Teachers and parents will need to critically analyze students' characteristics and backgrounds to help determine if students truly have dyscalculia. Fortunately, effective instruction for students with dyscalculia is beneficial to students with other math challenges and so teachers can begin helping students immediately.

Dyscalculia and Dyslexia

Dyscalculia is a mathematical processing problem, while dyslexia is a language processing problem. However, problems with language processing can lead to problems with mathematics. An individual with dyslexia might have problems comprehending mathematical language or reading math word problems. Also, people with dyslexia usually have problems with directionality and sequencing, which can cause difficulties because math requires one to work in a specific direction and order. Additionally, someone with dyslexia can have deficits in other cognitive/metacognitive processes (e.g., attention, visual-spatial processing, auditory-processing, memory) that can inhibit their ability to do mathematics efficiently (Tomey, Steeves, & Gilman, 2003). It is possible to have both dyslexia and dyscalculia (Badian, 1999).

Mathematical Learning Style

Some people have **quantitative** learning styles while others have **qualitative** styles. Students with quantitative styles are organized and like to break things apart to learn in a sequenced, logical, part-to-whole manner. On the other hand, students with qualitative styles are more intuitive and more likely to focus on whole-to-part, visual/spatial aspects of mathematics. They like to perceive patterns and relationships to solve problems without following the usual steps.

Students with quantitative styles tend to learn better when instruction is very direct, structured, and sequential. Students with qualitative styles tend to learn better through inductive, visual-spatial, holistic instruction. For example, a teacher might teach characteristics of geometric shapes to students with quantitative styles through explaining explicitly and modeling the characteristics of the shapes as the students manipulate the figures and take notes. Conversely, a teacher might teach characteristics of geometric shapes to students with qualitative styles by providing solid three-dimensional shapes and having students explore them to deduce the characteristics of each shape.

Teachers and tutors should observe students to determine which style is dominant and build upon students' strong points and help them compensate for their weak ones. Keep in mind that both kinds of mathematical thinking are desirable and that some students have mixed styles (Sharma, 1990).

Assessment of Dyscalculia

Assessment should involve multiple sources of data (e.g., tests, observations, work samples, interviews) and be done by a team of experts (e.g., psychologist, teachers, math education specialist, parents, self). An evaluation should paint a total picture of a student's strengths and weaknesses as well as show breadth and depth of a wide range of mathematical skills,

behaviors, and understandings (National Council for Learning Disabilities (NCLD) (2007).

Most Beneficial Type of Instruction

Instruction should be based upon the *Curriculum and Evaluation Standards* of the National Council of Teachers of Mathematics (NCTM). These standards are based upon the principles of equity, curriculum, teaching, learning, assessment, and technology. The equity principle states that all children can learn mathematics; however, equity is not synonymous with treating each student exactly the same. Each individual should benefit from appropriate high expectations, a challenging curriculum, and effective instruction.

Multisensory instruction that includes visual, auditory, tactile, and kinesthetic modalities is best. Cumulative, sequential teaching of skills with immediate applications is important, as is diagnostic teaching in which teachers informally assess learning as they teach. Instruction should focus on deep understandings as well as how to do procedures. Tasks should be on the appropriate level along with instruction that fits unique learning styles (NCTM, 2000).

Strategies for Intervention

Many teachers have found the following strategies effective for working with students with dyscalculia as well as other mathematical challenges. In fact, many of the ideas are good for all students; they are of critical importance for students with dyscalculia.

1. Prioritize mathematical goals for students. Differentiate between what they need to know and what would be nice to know.
2. Seat students near the focal point of instruction and actively engage them in multisensory learning. This means that they are seeing concepts modeled, listening to concepts being explained, talking about concepts, and using movement and touch (e.g., finger writing on a rough surface; using their bodies to form shapes) to learn.
3. Teach students multisensory study skills to use for homework. For example, they can tape record your instructions about how to do a particular type of procedure (or record the procedure in their own words) and listen to the tape/repeat the procedure orally as they work the problem.
4. Always present only a small amount of new material and make sure that new concepts build on old ones, using this sequence:
 - a. Initially, use concrete objects or manipulatives (e.g., counters, shape blocks, geoboards, play money) to teach concepts and skills.
 - b. Next, use pictures and diagrams to represent concepts and skills.
 - c. Last, present concepts and skills abstractly. Keep in mind that students may need to go back to concrete objects or visuals for difficult or unusual tasks.
5. Let students use manipulatives to work problems and demonstrate answers even when other more mathematically abled students no longer need to do so.
6. If students fail to master a skill or concept, find a new way to teach it. Do not repeat methods that did not work.
7. On the other hand, know that students with dyscalculia will often need to drill on skills and over-practice them for the skills to become automatic.
8. Teach mathematical vocabulary, signs, and symbols with concrete examples. Stress the meaning of mathematical language rather than just memorization.
9. Make sure that students are talking and writing about mathematics. Set up cooperative groups in which students actually use mathematical language in real-life situations. Ask them to explain mathematical ideas or difficulties they may experience in math journals.
10. Seek a tutor who is an expert in principles of teaching/learning as well as mathematics and has excellent rapport with students.
11. Make sure that the inability to learn basic math facts does not keep an individual from moving on to higher level mathematics. Provide fact charts, number lines, and calculators.
12. Use error analysis to figure out why students get wrong answers. Do they miss basic facts, use incorrect operations, work in the wrong direction, or copy incorrectly? Then help students work on these specific errors (e.g., circle the operation sign, put a red dot on the side of the paper to start).
13. Do not allow students to practice errors. Monitor students as they work so errors can be caught quickly.
14. Use memory tricks to help students remember. For example, "Please excuse my dear Aunt Sally" helps students remember the steps of equation-solving (i.e., parenthesis, exponents, multiplication, division, addition, subtraction).
15. If students have problems copying the problems from the text or board, give them photocopies on which to record answers.
16. When students have difficulty understanding mathematical word problems, read them aloud and help them code the important parts. For example, students can underline the needed details, cross out irrelevant ideas, and circle the question.
17. Teach students a variety of multisensory strategies to solve word problems. For example, they can create a picture/model or act out a problem.
18. Include numerals and mathematical symbols for handwriting practice.
19. Encourage students to work math problems on graph paper to make lining up numbers and symbols easier.
20. Give students extra concrete experiences, so they will know if their answers make sense. Encourage students to always ask themselves "Does this make sense?" when they find a solution to a problem.