



NetNews

an online newsletter devoted to adult literacy

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LDA of Minnesota

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Dyscalculia Defined

The two previous issues of *NetNews* have covered dyslexia and dysgraphia (reading and writing disabilities). The focus of this issue is **dyscalculia**, or math disability. Most of the attention over the years has been on reading and writing difficulties, thus leading to the belief that math difficulties are not very common or serious. However, it has been estimated that about 6% of school-age children experience significant math difficulties. Although this is far less than the estimated 20% incidence rate for reading difficulties, today's world calls for strong mathematical knowledge and reasoning or "numeracy skills".

"Numeracy" problems can significantly interfere with daily living and vocational opportunities in the adult population.

As with any area of disability, dyscalculia ranges from mild to severe. It too falls under the special education category of *specific learning disability* and impacts the area of mathematics. There is not a single type of dyscalculia; it is as varied and complex as dyslexia and dysgraphia. Problems may manifest themselves in the following ways:

- Difficulty recognizing number patterns
- Difficulty understanding math concepts
- Difficulty understanding math language
- Difficulty learning and retaining math facts
- Difficulty learning and retaining math procedures
- Poor calculation skills
- Poor problem solving skills
- Visual-spatial confusion

A parallel math example to the current reading research finding that phonemic awareness is an essential pre-reading skill is the importance of **number sense**. This pre-math skill is the understanding that numbers have order, items in the world can be counted, and counting determines concepts like equal (or same), greater than (or bigger), and less than (or smaller). Number sense is thought to be an indicator of future math success. Therefore, if it's possible that an adult learner - especially a non-native English speaker from a preliterate culture - has not been exposed to or used a numerical system, then number sense must be assessed, instructed, and practiced in order for further math instruction to be meaningful and successful.

Persons with reading disabilities may have related difficulties with math. Due to significant information processing problems, they too may have difficulties recognizing number patterns, organizing parts into wholes, math fact retrieval, number placement or column alignment, sequencing of steps, or being able to read and understand math language. As with reading instruction, math instruction for dyslexics needs to be direct, sequential, systematic, and multi-sensory with ample opportunities for meaningful practice.



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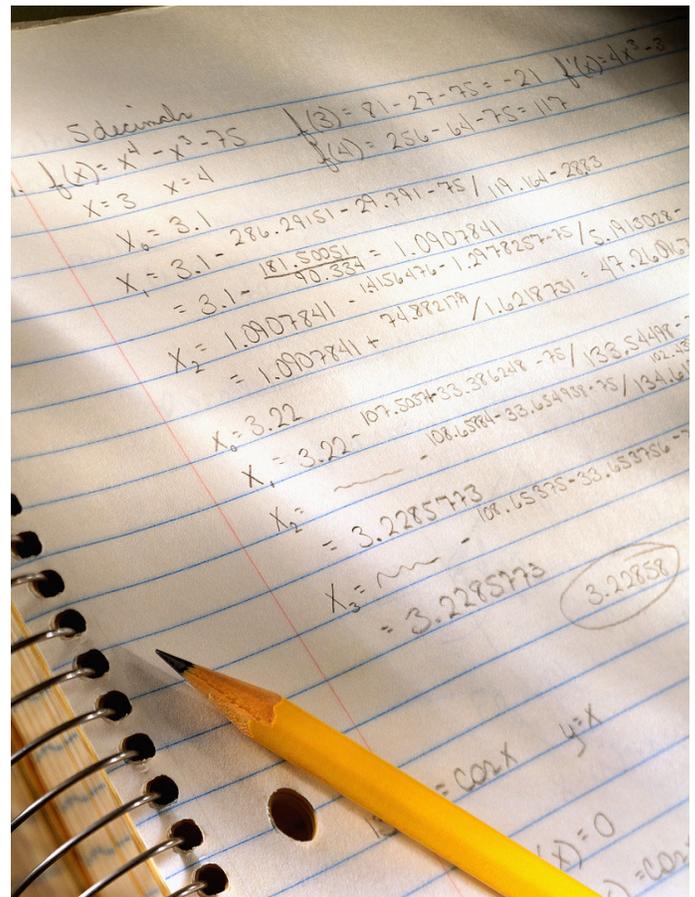
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Math Assessment

An example of a **formal** math assessment that includes measures of math calculation, math fluency, math problem solving, and math concepts is the *Woodcock Johnson III Tests of Achievement* (available through Riverside Publishing Company). Administration of subtests results in standard scores, percentiles, and grade equivalents for children through adults. Error analysis may determine strengths and weaknesses in math language (symbols and words), math operations (such as addition, subtraction, multiplication, division, regrouping, etc.), and the understanding of math concepts (such as order, time, money, distance, and number series). Another commonly used diagnostic math test is the *Key Math-Revised* (available through American Guidance Service, Inc.). Evaluators use this comprehensive math test to measure the understanding and application of math skills and concepts, although it is only normed for grades K-9. The *Tests for Adult Basic Education* (available through McGraw Hill Company) is a frequently used multi-level math assessment for adults that yields objective mastery, percentiles, and scale scores.

Informal assessment, such as math inventories or math placement tests, may be used to determine appropriate math materials. These assessments should measure both computation and problem solving skills. Adults often have strengths in problem solving despite computational difficulties because they have acquired a level of “math sense” via life experiences. In other words, they may not know how to compute a long division or fraction problem, but can figure out the part(s) using logic, estimation, or common sense. Their answers may not be exactly right, but close enough for everyday purposes. Adults often have other strengths in time and money matters due to everyday experience and vested interest!

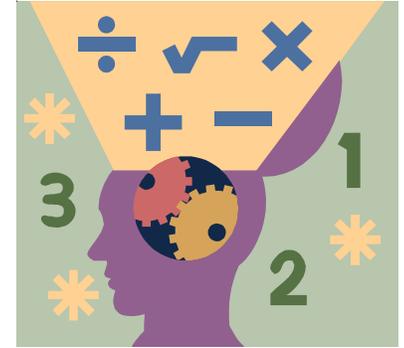
Early math skills can be assessed using very informal assessment. Adult learners can be asked to: (1) sort or count aloud a number of objects, (2) tell which amounts are the same, greater, or less than, (3) identify, copy, count, or write the numbers 1-10 or 1-20, (4) “take away” an amount or number and tell how much is left, (5) tell the time on analog or digital clocks, and (6) identify and count American coins and bills. The results will determine where to begin early math instruction.



Improving Number Sense

Number sense includes the skills of classification (recognizing patterns), one-to-one correspondence, seriation (counting), conservation (same or equal), flexibility and reversibility (more/less, bigger/smaller, $1+2=2+1$). **Manipulatives are essential at this stage of instruction so that new math learners can see and feel numbers.** Objects can be sorted or classified according to color, size, or shape. Objects can be aligned in order to see correspondence or the concepts of equal, more, or less. Objects can be used for grouping by 1s or 2s or 3s. Number sense activities using manipulatives can be presented individually, in pairs, in small groups or large groups. Examples of manipulatives include Cuisenaire rods, Unifix math materials, or everyday objects such as paper clips, pencils, crayons, building blocks, sugar cubes, buttons, or pennies. These hands-on or concrete activities can be linked with more symbolic representations such as lines, Xs, circles, dots, or pictures on a page. It is very important to teach that concrete amounts are the same as symbolic amounts which can be represented by abstract numbers. In other words, taking four red pencils and adding three blue pencils equals seven pencils total. This is the same as four circles plus three circles equaling seven circles or $4 + 3 = 7$ and $3 + 4 = 7$ as math facts.

Counting skills can be practiced orally, on paper, or with manipulatives. The instructor can tap or drum a certain amount while the learners count. Real items in the room can be counted - such as desks, tables, doors, outlets, etc. Learners can practice tracing or writing from 1-10, 1-20, or even 1-100. They can also be given a number series with missing numbers they must fill in. Adults also need to learn to count fairly soon by 5s (nickels), 10s (dimes), 25s (quarters), and 100s in order to use American money.



The use of manipulatives is not limited to this beginning level of instruction. Whenever a new concept such as adding, subtracting, fractions, or percent is being introduced, understanding should be developed through the use of hands-on or concrete/visual materials (think graph paper for decimals and percent and pizza for fractions).

Do you have questions about a particular learner who is having difficulties in class?

LDA of Minnesota can help! Please contact Marn Frank at 952-922-8374 x110 or email mf@ldaminnesota.org.

LDA of Minnesota's supplemental services grant provides Adult Basic Education instructors with information, resources and consultation about specific learner issues.



Improving Fact Knowledge

Persons with math difficulties often have trouble memorizing math facts for addition, subtraction, multiplication, and division. They often resort to counting on their fingers or using laborious methods of repeated addition and subtraction for multiplication or division. They seem unable to develop or use memory strategies on their own. They are often held back “until they know their facts”, but actually need to progress to more complex computation and problem solving so that they don’t fall further behind. In the meantime, they should be allowed to use a personal and portable facts chart. As they learn more of the facts, these known facts can be blacked out on their personal chart so that they rely more on their memory.

Teaching ideas to improve fact knowledge include:

- Provide regular practice in small doses: 15 minutes once or twice every day
- Provide a small number of facts to master, but also include mixed review practice of known facts
- Emphasize reversals or turn arounds: $4 + 3 = 3 + 4$; $8 \times 7 = 7 \times 8$
- Teach multiplication facts in this order: 0s, 1s, 2s, 5s, 9s, doubles (8×8), and then the remaining 20 facts (although the reverse has been taught)
- Include game or computer activities for extra practice
- Use rhymes, word associations, or visual memory aids: “8 X 8 went out the door in ‘64”
- Have learners self-chart their progress in fact knowledge

Many persons with dyscalculia significantly or primarily struggle with inconsistent and incorrect calculation (thus the name “dyscalculia”). They may benefit from instruction in alternative procedures such as expanded notation or partial sums (see examples in the next column).

Improving Computation

ADDITION

Expanded notation procedure:

$$\begin{array}{r} 35 \\ +56 \\ \hline \end{array} = 3 \text{ tens and } 5 \text{ ones} \\ = 5 \text{ tens and } 6 \text{ ones}$$

1. Add the ones and tens: 8 tens and 11 ones
2. Regroup the ones: 8 tens and 1 ten and 1 one
3. Put the tens together: (8 tens and 1 ten) and 1 one
4. Write the tens in a simpler way: 9 tens and 1 one
5. Write the answer in number form: 91

Partial sums procedure:

$$\begin{array}{r} 48 \\ +79 \\ \hline \end{array}$$

1. Add the ones: $8 + 9 = 17$
2. Add the tens: $40 + 70 = 110$
3. Combine the amounts: 127

MULTIPLICATION

Partial products procedure:

$$\begin{array}{r} 24 \\ \times 29 \\ \hline \end{array}$$

1. $4 \times 9 = 36$
2. $20 \times 9 = 180$
3. $4 \times 20 = 80$
4. $20 \times 20 = 400$
5. $36 + 180 + 80 + 400 = 696$

Other ideas to improve computation include:

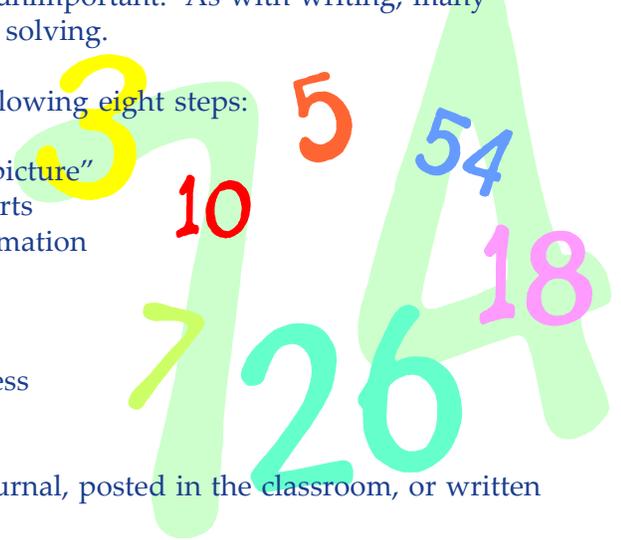
- Provide graph paper or turn notebook paper sideways to assist with number alignment
- Reduce the number of problems (odd or even gives an adequate sample) and talk through the problems/answers rather than just correct as right or wrong
- Highlight the operation to be performed
- Use a visual/auditory modeling strategy where (1) the teacher shows and verbalizes each step of the procedure, (2) the learner performs and verbalizes the same steps to the teacher, (3) the learner works independently with both sample problems and solutions available as reference
- Use math journals to document facts, definitions, procedures and steps, memory strategies, etc.

Improving Problem Solving

Math problem solving, like reading comprehension or writing, is a complex skill. It involves a combination of skills: number sense, fact knowledge, computational skills, reading skills for math language, and critical thinking skills such as determining important information from unimportant. As with writing, many learners need to learn and practice a specific process for problem solving.

A **process for teacher-directed problem solving** includes the following eight steps:

1. Read the whole problem carefully to get the “big picture”
2. Focus on the important information or relevant parts
3. Circle, underline, or highlight the important information
4. Verbalize the operations or draw a solution
5. Write a math sentence or equation (if appropriate)
6. Work the problem
7. Evaluate the answer for accuracy and reasonableness
8. Write the answer with the correct label



This sequence can be modeled and practiced, noted in a math journal, posted in the classroom, or written on bookmarks as a reference.

A list of **key math terms** paired with the associated operations is another good reference. Examples include:

- Sum, total, in all, altogether = ADD
- Difference, less than, left over, remaining = SUBTRACT
- Of, product, times = MULTIPLY
- Per, each, how many in each = DIVIDE

For adult learners who specifically need to pass the **GED math test**, consider teaching the test skills of estimation and a process of elimination. GED learners should still read the problem carefully, focus on the important information, think about a solution and work the problem (as outlined above), but they may be able to just use estimation or logic to figure out the best or matching answer from the multiple choices.

Math Accommodations

The most reasonable accommodations in today’s world for math difficulties or a math disability are the use of a calculator, a reduced math assignment, and extended time for math assignments and math tests. The calculator is an easily accessible tool that assists persons with calculation difficulties to complete math tasks accurately and quickly. It does not do all the work as the person still needs to be able determine the necessary information, select the operation(s), and evaluate the answer. A reduced math assignment or extended time allows the person to demonstrate their math knowledge without the pressure of too many problems or too little time to process and solve the problems.

In order to use a calculator on the GED math test, applicants must meet the criteria for a learning disability that specifically impacts the area of math. They must demonstrate at least average ability, evidence of an information processing problem, and significant difficulties in math calculation and math problem solving. However, a calculator is already allowed on the first part and according to Pat Rupp, Minnesota GED Administrator, is not necessary for the second part, which is mostly estimation. The certifying professional will have to be very specific as to how the information processing problem interferes to the point of the applicant needing a calculator for estimation.

LDA of Minnesota

The National Institute of Health reports that one out of every seven Americans has some form of a learning disability. A learning disability can affect one's ability to speak, listen, read, write, spell, reason, recall, organize information, and do mathematics. Statistics show that approximately ten-percent of the population has a learning disability. According U.S. Census data from 2003, this would be equal to 373,382 adults in Minnesota who face learning difficulties every day.

LDA of Minnesota is a private, nonprofit agency whose mission is to maximize the potential of children, youths, and adults with learning disabilities or related learning difficulties so that they and their families lead more productive and fulfilled lives. Since the beginning of LDA's 38-year history, agency efforts have enabled thousands of people in the Twin Cities' metropolitan area and Greater Minnesota to learn critical basic skills, increase the likelihood of successful job training, improve employability, and enhance their quality of life.

Become a member of LDA!

Many adults you teach each day have learning difficulties and even learning disabilities. A membership to LDA will help to keep you up-to-date on the latest information in the field! As a member of LDA, you will receive:

- Access to the latest information and research on learning disabilities
- Complimentary subscriptions to LDA's local and national newsletters
- A chance to connect with others who have similar interests

Member information:

Name

Address

City / State / Zip

Phone

Email Address

I am interested in:

Individual Membership \$30
 Journal Subscription (members only) \$30
 Journal Subscription (non-members) \$60
Subtotal \$_____

LDA relies on the generosity of our members and the community to provide information and services that advance our mission.

I want to help LDA, I have enclosed a contribution to support LDA's mission \$_____

Total \$_____

Method of payment:

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Visa Mastercard

Card number

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Signature

Contributions to LDA are tax deductible

So that we may better serve you, please consider providing us the following OPTIONAL information.

I am a:

Person with Learning Disabilities

Professional Family member Other

*Please mail completed application
along with payment to:*

LDA of Minnesota

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LDA is a private, non-profit, educational agency that specializes in helping children, youth, and adults with learning disabilities or other learning difficulties maximize their potential so that they and their families may lead more productive and fulfilled lives.

