Mathematics for Students with Deafblindness or Visual Impairment and Additional Disabilities

Date: October 21, 2009
Time: 1:30-3:30 PM
Location: TETN Network Broadcast #35066

Presented by
Holly Cooper, Ph.D., Education Consultant
Texas School for the Blind and Visually Impaired
Deafblind Outreach
hollycooper@tsbvi.edu

Developed by
Texas School for the Blind & Visually Impaired
Outreach Program
Mathematics Curriculum Focal Points
Similar to science, Math has different "branches." These are the categories of Math offered to school aged students according to the National Counsel of Teachers of Mathematics (NCTM)

- Numbers and operations
- Geometry
- Measurement
- Algebra
- Data Analysis, probability and statistics

Content Area: Number Sense
Understanding the meaning of numbers and the way numbers are used

- Counting
- Dates and time
- Identification such as phone numbers
- Location such as room numbers
- Keeping score or voting
- Steps in a task or items on a list

Figure 1  A picture of the number 109 on a door and corresponding Braille below it.
Content Area: Number Sense
Number sense is the main task in the pre-school and primary grades.

Figure 2  Braille peg board.

Content Area: Number Sense
Number sense skills include:

- One to one correspondence
- Counting
- Cardinality
- Comparison
- Ordering whole numbers

Figure 3  Unifix cubes showing ordinal numbers.
Content Area: Number Sense
Number sense skills include:

- Part to whole concepts
- Number line
- Adding to or taking away from
- Place value

Figure 4  Unifix cubes showing place value.

Content Area: Computation

- Addition
- Subtraction
- Multiplication
- Division
Content Area: Computation

Computation is typically the main content area in the early to middle elementary grades.

Students should have opportunities to move on to more advanced math such as geometry even if they do not have mastery of math facts.
Content Area: Computation
Some early computational skills include:

- “One more”
- Counting by 2’s, etc.
- Adding sets of objects
- Understanding which operation to choose to solve a problem
- Solving computation problems using a number-line
- Understanding of multiplication as repeated addition

![Figure 7 APH number line.](image)

Content Area: Computation
Some late elementary and middle school computational skills include:

- Negative numbers concepts
- Choosing appropriate method to solve a computation problem
- Following a standard algorithm
- Using computation in measurement problems
- Using computation in other real life problems such as computing taxes, interest, discounts, etc.
Content Area: Algebra
Early concepts in algebra include:
- Patterns
- What’s missing
- Creating rules that describe and predict patterns
- Identifying common mathematical patterns (odd/even)
- Connect understanding of pattern sequences to operations

Content area: Geometry
Early elementary skills
- Knowledge of shapes and space
- Ordering objects by shape or size
- Using divided shapes to understand fractions
- Analyze and compute aspects of shapes
Figure 10  Colored circles and squares for sorting.

**Content Area: Geometry & Measurement**

Map reading of large or small areas includes:

- Geometry
- Spatial relations
- Measurement

Figure 11  Schematic of new TSBVI campus.

**Content area: Measurement**

Early skills in measurement:

- Understanding same/different as it relates to quantity and size
- Understanding more/less of a size
- Ordering objects by size
- Understanding time including before/after as well as future and past
• Measuring by laying out multiple copies of an object for comparison
• Using tools for measurement

Figure 12  Ruler next to can of soup.

Contend Area: Data Analysis
Early data analysis skills:
• Sorting objects by known or observable attributes
• Representing data in picture and bar graphs

Figure 13  APH grid board with manipulatives.
Piaget’s Developmental Stages
Remember Piaget?

Sensory Motor Period
Birth to 24 months
The child learns through the senses and through exploring, playing and experimenting with materials.

Piaget’s Developmental Stages
Pre Operational
Ages 2 through 7 years
The child develops symbolic thought, and gains experience based on direct observation. “The hallmark of the preoperational stage is sparse and logically inadequate mental operations.” The emergence of some logic based on observation. The child’s observations and conclusions may be based on lack of experience and may not be correct i.e.: the two sizes of containers with the same amount of water (conservation).

Piaget’s Developmental Stages
Concrete Operations
Ages 7 through 12
The child develops the ability to solve problems through mental thought based on direct observation, logic and experience. True presence of logical thinking. However the problem solving can primarily be done when actual objects can be observed. These kids benefit from use of manipulatives.

Piaget’s Developmental Stages
Formal Operations
Ages 12 and up
The student is capable of abstract thought without the presence of concrete objects or demonstration using concrete objects.
Development of Mathematics Related Skills
Let’s look at math skills from kindergarten to the earliest development.

Development of Math Related Skills
Math Skills for age 5
• Locates correct number of items from a set of 10
• Locates front, back, left, right
• Reads and writes numerals to 3
• Counts orally to 19
• Understands “yesterday,” “today,” and “tomorrow.”
• Shows which group has more, less, same (up to 10)
• Reads numbers on clock face
• Tells which number comes before and after a given number
• Names days of the week in order
• Reads and writes numbers to 19
• Counts orally to 50, then 100
• Reads and writes numerals to 49
• Locates days of week on calendar

From HELP Checklist

Development of Math Related Skills
Math skills for age 4
• Matches coins
• Identifies long, longer, longest in group
• Makes groups of 4 to 10 objects
• Locates biggest, smallest
• Counts orally to 10
• Names first, middle, last in a group
• Names penny, nickel and dime

From HELP Checklist
Development of Math Related Skills

Math skills for age 3

- Counts orally to 3
- Sorts according to shape, size, length
- Locates big and little objects in a group of 2
- Arranges objects from smallest to largest
- Makes sets of 1, 2 and 3 objects
- States which of 2 groups has more, less, many few
- Sorts shapes
- Completes 3 to 4 piece puzzle
- Stacks graduated rings in correct order
- Points to larger or smaller of objects
- Understands concept of two
- Sorts colors and points to several colors when named

From HELP Checklist

Development of Math Related Skills

Math skills for age 2 (24 to 36 months)

- Matches objects to pictures
- Sorts objects
- Assembles 4 nesting blocks
- Places triangular piece in formboard
- Matches shapes: circle, square, triangle
- Matches identical simple pictures of objects
- Matches colors: black and white

From HELP Checklist

Development of Math Related Skills

Math skills for age 12 to 24 months:

- Shows understanding of color and size
- Places round piece in form board
- Nests two, then three cups
- Matches objects
- Places square piece in form board

From HELP Checklist
Development of Math Related Skills
Math skills for age 9 to 12 months:

- Places cylinders in holes in container or puzzle board
- Stacks rings
- Moves to rhythms

From HELP Checklist

Development of Math Related Skills
Math skills for age 9 to 12 months:

Lilli Nielsen tells us that in this period children become aware of quantity by comparing similar objects such as spoons on a ring.

![Active learning materials including collections of formica samples, thread spools on elastic and small balls of different textures.](image)

Development of Math Related Skills
Math skills for age 6 to 9 months:

Children experiment and act on objects:

- Searches for objects with eyes or hands
- Picks up objects
- Puts objects in container
- Begins to move about independently exploring space
Development of Math Related Skills

Math skills for age 3 to 6 months:
First 6 months: Observing Objects and Properties
- Recognition of familiar people
- Visually follows moving objects

Development of Math Related Skills

Math skills for age birth to 3 months:
- Shows distress at scrambled face
- Visually follows objects

Figure 15  Face with eyes and noses reversed relative to mouth.
Math Activities
For students functioning at the birth to six or nine month level:
• Objects in a tub or container to explore
• Containers to put objects in
• Multiples of similar items: spoons, cups, pumpkins
• Begin use of object calendar

Figure 16  Objects in a small bowl.

Math Activities
For students functioning at the nine to 15 month level:
• Blocks to stack
• Rings on a spindle
• Nesting cups
• Shape fitting toys
• Object calendar sequencing
Math Activities
For students functioning at the 12 to 24 month level:
- Photos of familiar people, objects
- Sorting by color, then shape (use 3 dimensional items)
- 1 piece shape puzzles
- Locations: inside, outside, on, under (play hiding games, reinforce language)

Math Activities
For students functioning at the 24 to 36 month level:
- Calendars with pictures or tactile symbols
- Puzzle with 3 or 4 interlocking pieces
- Stringing beads or copying patterns of colored pegs
- Board games: matching colors
Math Activities

For students functioning at the 36 to 48 month level:

- Matching numerals to a set of objects up to 5
- Arranging objects in order by size, length (Montessori materials)
- Puzzles with interlocking pieces
- Tactual learners: sorting a variety of objects
Math Activities
For students functioning at the 48 to 60 month level:
- Counting games using dice
- Putting items or pictures in sequential order or order by size
- Counting and matching numerals to sets up to 10
- Sorting or matching coins

![Figure 22 APH Game kit, a simple board game.]

Math Activities
For students functioning at the 5 to 6 year level:
- Arranging numbers in order
- Counting objects up to 20
- Using a conventional calendar
- Early addition concepts

![Figure 23 Flash card for addition and manipulatives.]
Math Activities
For students functioning at the 6 to 7 year level:

- Using a calendar
- Beginning use of a clock
- Games using addition, subtraction, more complex rules

Figure 24  APH clock.

Links to Interesting Resources on line games and activities
Balls (1-5)
http://www.senteacher.org/FileDetails/4/Teacher.xhtml

SENSwitcher software
http://www.northerngrid.org/ngflwebsite/sen/Menu-L.htm

Big Calculator
http://www.oatsoft.org/Software/big-calculator

Mathematics instruction for students with significant disabilities
Students should have opportunities for a variety of math learning.
- Opportunities to gain skills in problems solving
- Opportunities to learn skills which are functional in other settings
- Variety of materials and media
- Opportunities to succeed
An analysis of current practices
According to Diane Browder’s analysis of current practice:

- Students with mild to moderate cognitive disabilities receive math instruction which focuses primarily on computation (arithmetic).
- Students with moderate to severe disabilities receive math instruction primarily in money counting and telling time.

Mathematics instruction for students with significant cognitive disabilities
Math instruction should not:

- Keep instructing students in the same skills until they develop “mastery” (Students may get stuck with only counting or arithmetic activities)
- Teach math concepts and skills only in functional situations (baking brownies is not enough to learn math)

Adapting Lessons for Grade Level Access to the Curriculum

- Identify the curriculum focal point for the lesson (review textbook, TEKS, and conference with math teacher)
- Identify concepts the lesson reinforces
- Present problem in real life context
- Identify group activity which reinforces concept
- Identify part in which students with disabilities participate
- Don’t expect students with disabilities move at the same pace

Figure 25 Beads and string for pattern duplication.
Math in the Classroom

- Teaching similar concepts in a variety of contexts allows for repeated exposure leading to generalization of skills.
- Teaching mathematics in all curriculum focus areas allows students to build skills in areas beyond number sense and computation.
- Teaching mathematics curriculum focus areas allows students to build logical thinking and problem solving skills.
- Some students may achieve higher levels of understanding in areas outside of the traditional mathematics exposure areas, such as algebra and data analysis.
- Logical thinking and problem solving skills developed in all math curricular content areas can improve problem-solving skills in daily life situations.

Figure 26  APH grid board with manipulatives.

Figure 27  Children's recipe book and measuring spoons.
Observations from Teaching

- Mathematics has a limited symbol set compared with literacy, so it can be easier to learn the symbols or recognize them visually.
- Students with language or hearing differences which may impact their literacy skills may achieve at a much higher level in mathematics.
- Students whose etiology is prematurity may achieve significantly below their literacy level in math and benefit from additional exposure to math concepts.
- Math skills and concepts are used in all areas of life and competency in these skills may contribute significantly to quality of life in adulthood.

DATA CHARTS

<table>
<thead>
<tr>
<th>MALE</th>
<th>Doll</th>
<th>Head</th>
<th>Chest</th>
<th>Waist</th>
<th>Inseam</th>
<th>Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>72&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>23&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest</td>
<td></td>
<td>40&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist</td>
<td></td>
<td></td>
<td>32&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inseam</td>
<td></td>
<td></td>
<td></td>
<td>32&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Figure 28 A data chart.

Figure 29 APH Setting the Stage for Tactile Understanding, thermal card depicting a house and model of house.
Mathematics Resources

Web Resources

Functional Academic Curriculum for Exceptional Students (F.A.C.E.S.)
On Region 12’s website
http://www.esc12.net/faces/

National Association for the Education of Young Children
Early Childhood Mathematics: Promoting Good beginnings
http://www.naeyc.org/about/positions/psmath.asp

National Council of Teachers of Mathematics
Curriculum Focal Points Pre-K Through Grade 8

TEA Pre-Kindergarten Curriculum Guidelines (“TEKS-like” objectives)
http://www.tea.state.tx.us/curriculum/early/prekguide.html

TEKS Vertical Alignment for TAKS-Alt

Books


This project is supported by the U.S. Department of Education, Office of Special Education Programs (OSEP). Opinions expressed herein are those of the authors and do not necessarily represent the position of the U.S. Department of Education.