

## **DIFFERENTIATED INSTRUCTIONAL STRATEGIES FOR MATHEMATICS For Students Who are Deaf or Hard of Hearing**

Team members working with students who are deaf or hard of hearing need to carefully consider each student's unique needs and learning style, as well as the demands of the task. Strategies are offered to provide a starting point for thinking about possible adaptations. It is important to remember that all team members should have input into decisions regarding instructional strategies.

### **Having a hearing loss may affect skill development in mathematics for a number of reasons.**

Mathematical concepts can be learned by children who are deaf or hard of hearing in the same sequence and manner as by their hearing peers (Meadow, 1980). Various factors may prevent children who are deaf or hard of hearing from successfully constructing mathematical knowledge:

- They may lack general vocabulary and the basic mathematical vocabulary needed to be able to understand math concepts/processes. Hearing children are exposed to language from birth and have an understanding of everyday language. This serves as a base for developing an understanding and use of mathematical language. It is more difficult for children who are deaf or hard of hearing to acquire language and learning from their environment *incidentally* (from overhearing conversations of others in their environment, on TV, on the radio). Without this incidental learning, a child who is deaf may not develop even beginning math concepts such as “in front of/behind” or “heavy/light” without being formally taught them.
- Communication with other may be difficult. If the child and others in his or her environment cannot communicate with each other effectively, they will not be able to engage in mathematical processes such as problem-solving, developing logic and reasoning, and communicating mathematical ideas. Problem-solving is especially difficult for children who are deaf as a sound language base is needed for putting observations into words or making predictions. Without communication skills, the child can be isolated in the learning environment and unable to participate in group activities and discovery (Ray, 2001).
- Cognitive development may be delayed. Research shows that children who are deaf or hard of hearing have normal intellectual potential (Meadow, 1980). However, for normal cognitive development, particularly in a mathematical sense, a child must be introduced to a diversity of mathematical experiences along with a rich language base (Ray, 2001). This does not always occur in the home and in the educational setting.

Meadow, K. (1980). *Deafness and child development*. Berkely, CA: University of California Press.

Ray, E. (Nov., 2001). *Discovering mathematics: The challenges that deaf/hearing-impaired children encounter*. ACE Papers, Issue II.

## **Ways to help students who are deaf or hard of hearing succeed in mathematics**

The following strategies are designed to promote access to mathematics content based on the Standards of Learning for students who are deaf or hard of hearing. It is important to remember that each child has unique needs and that decisions regarding instructional strategies should be based upon current and accurate information about the child's sensory functioning and on team input.

### **Instructional and Environmental Strategies**

- Provide an enriched learning environment that will promote a wide range of meaningful mathematical experiences with opportunities for exploration and problem-solving.
- Be sure that there is someone for the child to interact with in the learning environment who can effectively provide not only the vocabulary to label objects but also a language model for expressing concepts and ideas, using the child's mode of communication..
- Partner with parents. Maintain on-going communication between the home and teachers so that math vocabulary and concepts are reflected and reinforced in as many different situations as possible. Make families aware of the limitless opportunities in the home to explore and discuss math concepts during daily routines, and make sure that the parents are able to communicate effectively in the child's chosen mode.
- Make use of multimedia approaches for visual representation of course content. Overhead projectors or powerpoint presentations are preferable to blackboards, as the teacher does not need to turn his or her back to the students. This is especially important for students who are relying on speechreading, signing, cuing, and/or use of residual hearing for receptive communication.
- More than one mode of presentation should be used for concepts such as fractions. These may include manipulatives, verbal, pictorial, and symbolic modes. Encourage students to translate between sign language, English and particularly the language of mathematics, and to make connections between all modes presented.
- Word problems may be introduced initially as informal stories with math facts through dramatization, using an overhead and manipulatives, and then translating the action into a math sentence. Use of pictures, drawing sets, and visualizing or pantomiming the action in a problem can also be used by students to move from the concrete to more abstract representations of the problem.
- When using visuals, allow time for the child to view the board, overhead, or objects, then to watch explanation/instruction given by the teacher or interpreter, and only then, allow students to offer responses. A hearing person can view visuals and listen at the same time. Children who are deaf or hard of hearing and rely on visual communication through sign language, cued speech, or speechreading must process information sequentially rather than simultaneously.

- Preteach vocabulary for coming math lessons in context. Collaboration with the speech/language pathologist in this effort can be beneficial. Remember, many children who are deaf or hard of hearing do not learn words incidentally.
- For students who sign, ensure that all involved are consistent in the signs being used. Conceptually based signs should be used and inventing new signs for new vocabulary should be avoided.
- Word problems may be especially difficult for some students who are deaf or hard of hearing because of the literacy level needed to comprehend the problem and what is being asked of the student. Having the interpreter sign the problem may be an appropriate accommodation for some students.
- Encourage students to process information at a deeper level through questioning.

## **Resources**

Pagliaro, C. (Jan/Feb, 1998). There's no place like home – for math. *Perspectives in Education and Deafness*, vol. 16, no. 3. Accessed in full text at <http://clerccenter.gallaudet.edu/products/perspectives/jan-feb98/math.html>  
This article gives ideas for partnering with families to help integrate math concepts into everyday living in fun ways. Includes list of math resources.

Ray, E. (Nov, 2001). Discovering mathematics: The challenges that deaf/hearing-impaired children encounter. *ACE Papers*, Issue 11. Accessed in full text at <http://www.ace.ac.nz/doclibrary/acepapers>

Smith, M. (1999). Bibliography for teaching mathematics to deaf and hearing impaired students. Accessible at <http://math.buffalostate.edu/tac/pages>

TecEds Reviews, Laurent Clerc National Deaf Education Center, Gallaudet University. Accessible at <http://clerccenter2.gallaudet.edu>. Describes 15 software programs used in teaching math to children and rates each for use with children who are deaf or hard of hearing.

*Deaf Prep Mathematics Curriculum*, a pre-college mathematics curriculum to be used with deaf students to remediate deficiencies prior to entering the mainstream college classes,. Produced by Pikes Peak Community College and available through the PEPNet Products Catalog, U.S. Department of Education, Office Special Education and Rehabilitative Services. PEPNet Resource Center, National Center on Deafness, California State University, Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8267, (888) 684 – 4695 (V/TTY toll free), [prc@csun.edu](mailto:prc@csun.edu)

Technical Sign Interview Series includes “Math”, “Math and Computer Science”, and “Business Accounting” videotapes, on which deaf professionals discuss their occupations in American Sign Language. These tapes are designed to elicit the “deaf way” of describing complex actions and jobs. Produced by Western Region Outreach Center and Consortia, and available through the PEPNet Products Catalog, U.S. Department of

Education, Office Special Education and Rehabilitative Services. PEPNet Resource Center, National Center on Deafness, California State University, Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8267, (888) 684 – 4695 (V/TTY toll free), [pre@csun.edu](mailto:pre@csun.edu)

Mason, V. *Mathematics curriculum guide: Elementary/middle school*. Available through the Clerc Center Catalog, Laurent Clerc National Deaf Education Center, Gallaudet University, Washington, DC., <http://clerccenter.gallaudet.edu> , (800) 526 – 9105 (V/TTY). Guide emphasizing building skills and student self-confidence in analyzing and solving math problems; learning objectives organized by school year and content area.