Susan R. Easterbrooks, EdD, is a professor of deaf education in the Department of Educational Psychology and Special Education at Georgia State University (GSU). In the field of deaf education for almost 40 years, she has published over 50 articles, chapters, and books. She and her colleagues at GSU are developing an evidence-based literacy curriculum for deaf and hard of hearing preschoolers through the support of several grants from the Institute of Education Science.

clues from research:

effective instructional strategies leading to positive outcomes for students who are deaf or hard of hearing

By Susan R. Easterbrooks and Brenda H. Stephenson

In 1999, the National Reading Panel investigated arguments regarding how best to teach reading. The members of the panel examined thousands of articles on literacy development and identified six key factors in teaching reading. According to the National Reading Panel (2000), these factors were:

- Phonemic awareness
- Alphabetics (i.e., letter knowledge, phonological awareness, phonics)
- Vocabulary
- Text comprehension
- Fluency
- Motivation

Further, the passage of No Child Left Behind in 2001 obligated teachers to use scientifically proven practices, or evidence-based practices, supported by research that is both valid and compelling (Graham, 2005). Although the goal for educators has always been student learning, No Child Left Behind has renewed emphasis on student outcomes. In many states, students' test scores are tied to teacher pay as well as the granting of tenure (Winerip, 2011). This shift of focus requires teachers to implement strategies that will have the greatest impact on student learning.

In 1999, the Association of College Educators-Deaf & Hard of Hearing initiated a review of the literature surrounding practices in the areas of literacy, mathematics, and science. The associations' researchers identified 20 strategies regarded by the profession to be best practices in literacy, in mathematics, and in science instruction for deaf and hard of hearing students prior to and surrounding the beginning of the current millennium (Easterbrooks & Stephenson, 2006). Then the researchers sought to determine the evidence base for these practices, summarizing them as *weak*, *developing*, *conflicting*, *or strong*. (See Easterbrooks &

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TABLE 1.

Strategies for Teaching Deaf and Hard of Hearing Students

Prior to 2000, Ratings of Their Evidence Base, and Master Teachers' Impressions of Benefit and Likelihood of Use

STRATEGY	RATING OF THE BODY OF EVIDENCE*	MASTERS TEACHERS' RATINGS OF BENEFIT**	MASTER TEACHERS' LIKELIHOOD OF USE
TEN LITERACY STRATEGIES			
1. Independent reading	Developing	86%	83%
2. Technology	Minimal	76%	70%
3. Phonological awareness and phonics	Conflicting	46%	40%
4. Metacognitive strategies	Strong	89%	89%
5.Writing to promote reading	Strong	89%	78%
6. Scaffolding content-area reading materials	Weak	83%	8%
7. Shared reading and writing	Strong	62%	52%
8. Meaning-based vocabulary instruction	Strong	89%	89%
9. Morphographemic-based vocabulary instruction	Developing	65%	64%
10. Fluency	Developing	76%	64%
TEN MATHEMATICS AND SCIENCE STRATEGIES			
1.Teachers who are skilled communicators	Strong	92%	92%
2. Use of student's first language	Developing	78%	80%
3. Content knowledge and skills (highly qualified)	Developing required by law	54%	60%
4. Cognitively engaged students	Strong	84%	80%
5. Visual organizers	Strong	92%	97%
6. Authentic problem solving	Developing	78%	71%
7. Technology	Weak	86%	74%
8. Signs for specialized content vocabulary	Weak	86%	80%
9. Critical thinking and problem-solving skills	Developing	54%	74%
10. Mediating text	Weak	92%	80%

**From Easterbrooks & Stephenson (2006) ** From Easterbrooks, Stephenson, & Mertens (2006)*

Stephenson, 2006, for a full discussion of the rating system). For example, the body of research to support the strategy of "independent reading" was found to be developing, while the research supporting "technology" was found to be minimal, and research supporting "meaning-based vocabulary instruction" was found to be strong. (See Table 1 above.)

In a follow-up study (Easterbrooks, Stephenson, & Mertens, 2006), master teachers were asked to indicate whether or not they found the 20 identified strategies beneficial (see definitions in Easterbrooks, Stephenson, & Mertens, 2006) and if they were likely to use those strategies.

The results showed that teachers of deaf and hard of hearing students appeared to be conflicted over the instruction of phonological awareness and phonics, were unlikely to scaffold reading skills using content area reading materials, were not convinced of the value of shared reading and writing, and were ambivalent about the need to be highly qualified in a content area. As a group, they did not employ collaborative, case-based, real-world, authentic problem-solving, and they were ambivalent about teaching higher-order critical thinking and problem-solving skills.

Further, only seven of the 20 strategies

Brenda H. Stephenson, MS, is a lecturer in the Education of the Deaf and Hard of Hearing Program in the Department of Theory and Practice in Teacher Education at the University of Tennessee. She worked for 23 years at the Tennessee School for the Deaf as a teacher and elementary principal before moving to the university. She teaches classes in speech and curriculum development and supervises practicum students and interns.

The authors welcome questions and comments about this article at *seasterbrooks@gsu.edu* and *bsimmon1@utk.edu*, respectively.

Left: A science teacher implements inquiry-based instruction with her first graders as they explore plant life.

examined had a strong practice or evidence base. Perhaps because so little was known beyond personal experience and belief, master teachers were not uniformly in support of strategies with a strong history of practice. At the time we studied these practices, we could find no causal research and only minor experimental or quasi-experimental evidence as proof of the effectiveness of the strategies. Since that time, however, some practices have developed a stronger evidence base, while others still remain without the backing of research needed to support their implementation as evidence-based practice.

Other Efforts to Examine Evidence

At least two other attempts to examine the evidence base for teaching strategies used in deaf education have occurred. Luckner and Handley (2008) examined the literature from 1963 to 2002 in the area of reading comprehension and found 52 articles that provided a "tentative evidence-based practice" (Thompson, Diamond, McWilliam, Snyder, & Snyder, 2005, p. 17) for five instructional practices:

1. Using explicit comprehension strategy instruction (e.g., predicting or summarizing)
2. Teaching students story grammar (e.g., characters, setting, plot, conclusion)
3. Modifying Directed Reading Thinking Activity (Schirmer, 2000; Stauffer, 1969)
4. Activating background knowledge (e.g., through visual aids or mental imagery)
5. Using well-written, high-interest text (i.e., high quality literature [p. 28])

Luckner and Cooke (2010) examined the literature from 1967 through 2008 in the area of vocabulary knowledge and acquisition and found 10 articles of 41 that included an intervention. They found evidence for the following strategies to promote vocabulary acquisition:

- Maintaining quality/quantity conversation and interactions with others, which provide opportunities for multiple exposures to a word
- Using computer-controlled applications for vocabulary enhancement
- Providing semantic organization of vocabulary instruction
- Using graphic organizers
- Pursuing explicit and extensive vocabulary instruction
- Reading and being read to
- Instructing in inferential strategies

Finally, following the Luckner and Cooke (2010) format, Luckner and Urbach (2011) examined the literature from 1970 through 2009 in the area of fluency and found only six studies on the topic of fluency are literacy in deaf and hard of hearing readers, only four of which included interventions. Most of their recommendations took the form of suggested questions for research and they concluded:

> *Fluency is a critical aspect of teaching reading that has not been explored fully in the field of education of students who are deaf and hard of hearing. An unfortunate result is that professionals may not be assessing or teaching the skill, which may contribute to students experiencing difficulty becoming skilled readers*. (p. 10)

The findings of these research summaries mirror many of the strategies that were developing an evidence base in 2000, but we still do not find strong causal evidence (i.e., a scientific study including a control and an intervention group that demonstrated a particular strategy yields positive learning outcomes for students).

Update on Research

Although the National Reading Panel clearly identified motivation as a key factor in learning to read, this topic receives less attention in the reading literature than the other reading factors identified. In fact, when the National Reading Panel's list of important factors in teaching literacy are discussed, it is often under the moniker "The Fab Five" and by this is meant phonemic awareness, phonics, vocabulary, text comprehension, and fluency (Fang, 2008); the topic of motivation is nowhere to be found.

Yet we have evidence that lack of motivation is a barrier to reading comprehension, but we have no evidence on how to improve motivation. Further, motivation, or lack thereof, is an issue that influences learning in general, not just in the area of literacy, with self-efficacy, interest, mastery goal orientation, and engagement being greater in female second language learners and avoidance-coping and effort withdrawal being greater in male second language learners. In addition, younger students appear more motivated than

older students. (Yeung, Lau, & Nie, 2011)

In recent years, there has been an explosion of research, yet additions to the evidence base have been inconsistent across the 20 practices. Nevertheless, evidence has been discovered to support strategies for successful teaching in literacy and math. Below we describe the evidence that has been added to the knowledge base.

Literacy: Strategies for Success

USE TECHNOLOGY AND MOTIVATING INSTRUCTIONAL MATERIALS

Various technologies and instructional materials have recently been found to increase motivation and attention in deaf and hard of hearing learners in the context of language learning and literacy tasks. For example, computer models provide effective representations of speech (Massaro & Light, 2004), and in Thailand, computers effectively translate between sign language and text (Dangsaart, Naruedomkul, Cercone, & Sirinaovakul, 2008). Mediated use of ASL stories on video has improved math vocabulary (Cannon, Fredrick, & Easterbrooks, 2010), and mediated use of a multi-media package for teaching morphosyntax (i.e., grammar) has demonstrated positive outcomes (Cannon, Easterbrooks, Gagne, & Beal-Alvarez, 2011). The use of multi-media technology may increase attention through the incorporation of imagery, which is associated with good reading instruction, and may support retention and memory during academic tasks (Easterbrooks, 2010).

INTRODUCE AND TEACH THE ALPHABETIC CODE

There is conflicting evidence about the importance of phonological awareness for deaf and hard of hearing children (Mayberry, del Giudice, & Lieberman, 2011). Children with at least some degree of functional hearing have been able to master the phonological code (Easterbrooks, Lederberg, Miller, Bergeron, & Connor, 2008; Hyde, Punch, & Grimbeek 2011) and develop phonological awareness (Guardino, Syverud, Joyner, & King, 2011; Johnson & Goswami, 2010; Syverud, Guardino, & Selznick, 2009) that can be enhanced by the use of visual supports, such as Visual Phonics or Cued Speech (Narr, 2008; Smith & Wang, 2010; Trezek, Wang, Woods, Gampp, & Paul, 2007). Although we know less about what is needed to teach the alphabetic code to deaf and hard of hearing children with no functional hearing, there is recent evidence that supports its potential (Beal-Alvarez, Lederberg, & Easterbrooks, 2011).

BREAK WORDS INTO MEANINGFUL PARTS

One way that children in early grades can learn to decode words is through mastery of what linguists call

derivational and inflectional morphology (i.e., the mastery of base words, prefixes, and suffixes). Several researchers have found evidence that it is easier for deaf and hard of hearing students to decode words by segmenting them into their component morphological parts than it is to decode words through the alphabetic principle (Gaustad & Kelly, 2004; Nunes, Burman, Evans, & Barros, 2010; Nunes, Burman, Evans, & Bell, 2010). Mastery of grapheme-morpheme correspondence to morphological representation, whether through spoken or fingerspelled morphology (i.e., children would learn to say or fingerspell and attach meaning to those sounds or fingerspelled configurations). Deaf and hard of hearing children who use both spoken language and sign language demonstrated that they can learn English morphosyntax from carefully structured instruction that includes frequent targeted practice (Cannon, Easterbrooks, Gagne, & Beal-Alvarez, 2011; Merchant, de Villiers, & Smith, 2008; Nunes, Burman, Evans, & Barros, 2010).

Science and Math: Effective Strategies

SKILLED COMMUNICATION

Effective communication is critical in any classroom, but the importance of the teacher's communication competency with deaf and hard of hearing students has even greater implications in mathematics and science instruction. Much of the research about communication and instruction with deaf students is directed at the use of ASL (Ansell & Pagliaro, 2006; Lang et al., 2007; Lang & Pagliaro, 2007; Pagliaro & Kritzer, 2010). One study conducted with young deaf and hard of hearing children determined that the frequency and quality of mediated learning, i.e., learning that is scaffolded by a more knowledgeable individual, such as an older peer, a parent, or an effective teacher had a significant impact on the child's learning in mathematics (Pagliaro & Kritzer, 2010). Another found that teachers who were able to use more conceptually accurate signs provided greater understanding in science (Lang et al., 2007). Competence in sign and careful sign selection are critical because they support higher order thinking in science and mathematics.

CONTENT CERTIFICATION

There is no question that high levels of content knowledge, mandated by No Child Left Behind, are needed for instruction with deaf and hard of hearing students (Benedict, Johnson, & Antia, 2011); Lang & Pagliaro, 2007; McIntosh, Suben, Reeder, & Kidd, 1994; Wang, 2011). In some states, deaf education licensure spans pre-

kindergarten through grade 12, yet teachers may not have the content knowledge to support all those levels. In other words, dual certification in both a content area and deaf education is needed to afford quality instruction and increase student performance. "Teachers with mathematics degrees/certification appear to be better prepared to teach content," affirmed Lang and Pagliaro (2007, p. 458). The same holds true for teachers in inclusion settings when teaching knowledge of concepts and vocabulary in content areas (Benedict, Johnson, & Antia, 2011).

MEDIATE—OR EXPLAIN—THE TEXT

Deaf and hard of hearing students have difficulty with printed text, and instruction in science and mathematics remains text-based. As a result, many deaf and hard of hearing students lack the level of science knowledge needed to comprehend abstract concepts. Paul and Wang (2006) stated that combining oral or sign literacy with scientific inquiry might help deaf and hard of hearing students develop better scientific conceptual knowledge. Wang (2011) suggests a recording of class discussion paired with the use of inquiry-based instruction to provide practice at home, which would allow students to revisit information presented in class and process the content for increased understanding. Other effective mediation strategies include visual scaffolds and technology (Adamo-Villani & Wright, 2007; Leander, 2009; Wang, 2011).

Looking Back...Looking Ahead

The evidence base for six strategies for literacy, science, and mathematics instruction of deaf and hard of hearing students has increased in significant ways. Still, the level of evidence is limited. Perhaps the new wave of technology-savvy individuals with doctorates in deaf education, educated through the National Leadership Consortium on Sensory Disabilities, will provide further rigor to the evidence base by engaging in multi-site, multi-state collaborative research.

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