Computer-Mediated Intersensory Learning Model for Students with Learning Disabilities

By Soonhwa Seok, Boaventura DaCosta, Carolyn Kinsell, John C. Poggio, Edward L. Meyen

Abstract

This article proposes a computer-mediated intersensory learning model as an alternative to traditional instructional approaches for students with learning disabilities (LDs) in the inclusive classroom. Predominant practices of classroom inclusion today reflect the six principles of zero reject, nondiscriminatory evaluation, appropriate education, least restrictive environment, procedural due process, and parental and student participation. These practices guide the amended Individuals with Disabilities Education Act (IDEA) of 2004. For nearly 35 years the act has championed for the rights of children with disabilities. The act mandates that students with LDs are educated in the general education classroom (Hock, Deshler, & Schumaker, 1999).

Those with LDs are expected to reach a mastery level of the subject matter in the inclusive classroom (Kameenui & Carnine, 1998). Among other things, society now expects all learners of the digital generation to be able to manipulate and process information, and to learn to apply it in their daily lives (Gilbert & Driscoll, 2002). These high expectations place increased demands on students with LDs leading to a need for instructional alternatives to help them succeed.

Keywords: Computer-mediated Intersensory Learning Model; Learning Disabilities; Human Cognition; Intersensory Hemispheres; Multiple Intelligences

Learning disabilities (LDs) have been a popular research topic since Samuel Kirk coined the term at the University of Arizona in 1963 (Hunt & Marshall, 2004). Students with LDs struggle with performance discrepancies and underachievement in the classroom (Deshler, Schumaker, Lenz, Bulgren, Hock, Knight, & Ehren, 2001). To ameliorate or accommodate students’ performance deficits, researchers have attempted to design instructional and remedial models in addition to existing assessment tools (Mellard, Barth, & Deshler, 2004). For example, Lancaster, Schumaker, and Deshler (2007) developed and validated an interactive hypermedia version of the self-advocacy strategy for students with LDs by using video and audio segments, tests, and graphics. Effective instructional and learning models are characterized by the following elements: (a) describe students’ present performance levels, (b) present problem-solving tasks, (c) give feedback on students’ performance, and (d) enhance students’ academic motivation.

Computer-mediated instructional and learning models will help close performance gaps for students with LDs and minimize their unnecessary struggle in the classroom; particularly in this digitally inclusive age where advancements in technology allow anyone to use computers as mindtools from anywhere and at any time. A mindtool is a computer application that can be used to engage learners in critical thinking about the subjects they are studying (Jonassen, 1996). Research indicates that using computers as mindtools for learning enhances the academic achievement of students at all levels (Jonassen, 2000). Computer-based learning has been shown to have positive effects on academic disposition to specific subjects, learning and teaching, and in the use of computer technology as pedagogy in a digital society (Eisert & Furell, 1995; Kulik, 1983; Kulik, Banger, & Williams, 1983; Kulik & Kulik, 1986, 1987).
According to Swanson and Deshler (2003), the characteristics of intervention models that enable students with LDs to be most successful include “questions, sequencing, segmentation, skill modeling, organization, explicit practice, use of small-group settings, indirect teacher activities, and technology” (p. 124). Based on the work of Jonassen (1996), Davies (1997) explains that in terms of computer-integrated learning, the aforementioned characteristics can be enhanced to include: features of higher-order thinking; critical, creative, and complex thinking skills; and collaborative use of mindtools. The computer-mediated learning model has implemented these characteristics as the following factors: (a) the student is able to communicate with the computer through interface tools (Ciavarelli, 2003) by using his mind along with visual, auditory, motor, and touch senses (Jonassen, 2000); (b) the most effective user interface design pursues the practice of visual-auditory-motor sequencing, organization, and segmentation to reduce learning errors by reducing load on short-term cognitive processes (Sec 508 of the American Rehabilitation Act, 2006; World Wide Web Consortium, 2005); (c) educational software and instructional learning programs enable students to practice and solve problems either individually or in group settings (Lockard & Abrams, 2003); (d) the computer plays a role as a friendly tutor or a mindtool and gives corrective feedback on students’ performance (Jonassen, Carr, & Yueh, 1998); (e) the computer presents problem-solution sets that are appropriate to the students’ academic level, and motivates students through problems and practices that they can solve and challenge (Meyen, Poggio, Seok, & Smith, 2006).

### Common Deficits of Students with Learning Disabilities

By nature, learning difficulties suggest that students have disorders in learning and information processing related to verbal, written, and behavioral language usages, such as reading, writing, speaking, listening, and numeracy (Deshler, 2005; Hunt & Marshall, 2004). Learning disabilities are viewed as disorders of psychological processing in the central nervous system (Smith, Polloway, Patton, & Dowdy, 2004).

Generally, information processing models are composed of the sensory registers (sensory memory), immediate memory (short-term or working memory), and the long-term memory (Anderson, 1983; Raymond, 2008; Stone & Reid, 1994; Seok, 2008). Processing information and learning from new information are critical cognitive components of learning (Hunt & Marshall, 2004). We perceive, attend to information, think about how to learn and organize information and memorize (Hunt & Marshall, 2004). Deficiencies in information processing are the reason for weaknesses in working memory and long-term memory, the organization of information, the auditory or visual perception of language, meta-cognition, and attention (Catts, 1993). Those with LDs generally experience deficits in aural and visual processing of language (Galaburda & Livingstone, 1993; Livingstone, 1999). They also have limitations in phonological processing (Freund, 2005) and usually experience linguistic skill deficits, such as phonemic awareness (Smith et al., 2004) and poor phonic skills (Freund, 2005). Phonological-linguistic processing is the psychological ability to perceive and decode (Hunt & Marshall, 2004; Smith et al., 2004) and to “receive, transform, remember, and retrieve the sounds of oral language” (Freund, 2005, p. 12). Phonological processing skills are reciprocally related to phonological sensitivity, phonological analysis, phonological synthesis, phonological coding in working memory, isolated naming, and serial naming (Freund, 2005; Wagner, Torgesen, & Rashotte, 1994). The deficits in information-reading processing affect cognitive performance in terms of speed and accuracy of information processing, knowledge acquisition, and the use of “cognitive and meta-cognitive strategies” (Margalit, 1990, p. 11).

While the importance of information processing models cannot be refuted, brain-based research also deserves some attention. Particularly in the case of intersensory brain network and models which suggest possible alternative solutions for those with LDs.

### Hemispheric Brain Functions in Information Processing

There is a myth that only the left hemisphere controls language-related information (Banich & Nicholas, 1998; Bates & Roe, 2001). Yet both the right and left hemispheres work together, in a complementary fashion, to process language mutually and in parallel (Banich & Nicholas, 1998; Bate & Roe, 2001). Their mutual language processes include speech perception, decoding print, understanding word meanings, understanding sentences and discourse, and analyzing syntax. Both hemispheres of the brain engage in each language process to varying degrees and are also complementary to each other (Beeman & Chiarello, 1998; Rayman & Zaidel, 1991; Sperry, Gazzaniga, & Bogen, 1969).
As far as speech perception and phonetics are concerned, the right hemisphere tends to make a distinction in favor of the low frequencies, while the left hemisphere is more in charge of the higher frequencies of vocal sounds (Beeman & Chiarello, 1998; Ivy & Lebb, 1998; Molfese, 1980; Ross, 1981). As far as phonology—decoding written words is concerned, both the right and left hemispheres process written texts in tandem (Beeman & Chiarello, 1998). The text decoding process of the right hemisphere provides considerably more stored memory and recall of visual representation. Examples are font and case of text influence (Baynes & Eliassen, 1998; Beeman & Chiarello, 1998). In contrast, the decoding process of the left hemisphere is more involved in abstract representation. Other examples include word and letter recognition (Beeman & Chiarello, 1998; Chiarello, 1988) and the conversion of text to speech (Zaidel & Peters, 1981).

As far as semantics is concerned, the left hemisphere makes closely connected meanings active (e.g., scissors: cut), whereas the right hemisphere processes distant meanings, such as jokes, inferences, and metaphors (Beeman, 1998; Beeman & Bowden, 2000; Beeman & Chiarello, 1998; Burgess & Lund, 1998; Chiarello, 1998; Koivisto & Laine, 2000). The horizontal portion of intraparietal sulcus and inferior frontal gyrus in the left hemisphere are activated in processing numerate symbolic data (Dehaene, Molkko, Cohen, & Wilson, 2004). Table 1 summarizes the aforementioned hemispheric brain functions.

### Reading Problems and the Right and Left Hemispheres

Learning disabilities have been associated with deficits in discrimination abilities, figure–ground perception, spatial orientation, copying of designs, fine motor abilities, right-left orientation, visual and auditory sequencing, visual–auditory matching, auditory–visual integration, word identification in noisy situations, story retelling, interpreting words and phrases, syntactic knowledge, knowledge of grammatical rules, the ability to define words, minor articulation difficulties, use of prosodic cues, production and repetition of multi-syllabic words and complex phrases, rapid naming of objects, phonological awareness, verbal labeling, rhyming, word segmentation, and listening comprehension (Kavale & Forness, 1995, p. 20).

It can be inferred from Kavale and Forness (1995) that the processing, cognitive, or learning deficits of students with LDs are caused by many different areas of both hemispheres. Students with LDs, specifically reading disability, demonstrate less activation in the less functioning brain areas, while they experience more activation in other areas in order to compensate for the loss (Hudson, High, & Otaiba, 2007). Bakker (1990) has suggested a balance model to illustrate the performance of both hemispheres of readers with reading problems while developing reading skills. This neuropsychological model explains that the alteration hemispheres function from right to left as reading skills advance (Lambert, Naikar, Malahan, & Aitken, 1999). The right hemisphere perceives information in the reading processes at the beginning of reading. When reading involves advanced syntax and semantics, the area of control shifts from the right hemisphere to the left (Bakker, 1990). The right hemisphere is related to reading perception and the left side to linguistic abilities.

To help substantiate Bakker’s balance model, Donders and van der Vlugt (1984) studied the eye movement patterns of students with reading problems while they were engaged in reading, numerical, and perceptual assignments. Results showed that older readers with reading problems used the left hemisphere. In support of Bakker’s balance model, Lambert et al. (1999) argued that children with normal reading skills used the right hemisphere where visual–spatial intelligence is located (Dryer & Lambert, 1999).

### Intersensory Brain Network

Research has shown that intersensory holistic activities can be enhanced (Birch & Belmont, 1964; Birch & Lefford, 1963). For example, the visual cortex is located in both hemispheres of the brain and closely influences the auditory, motor, and senses in both hemispheres because they are connected (Glickstein, 2000; Macaluso, 2006). The visual cortex is also in charge of other cognitive processes.

Auditory–visual skills can be developed in a complementary manner. The two skills can be better developed by memory and atten-

<table>
<thead>
<tr>
<th>Linguistic Elements</th>
<th>Right</th>
<th>Left</th>
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<tr>
<td>Phonetics</td>
<td>Sound of Low Frequency</td>
<td>Sound of High Frequency</td>
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<tr>
<td>Phonology</td>
<td>Visual Presentation</td>
<td>Abstract Presentation</td>
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*Table 1. Complementary Functions in the Right and Left Hemispheres*
tion skills (Senf, 1969; Senf & Feshbach, 1970). Therefore, if we can facilitate the development of both hemispheres, students with LDs can learn better and can close the performance gaps they typically experience in the inclusive classroom (see Figure 1).

Perception, information processing, attention, motivation, meta-cognition, cognition, and memory are typical deficit areas for students with LDs. They are caused in different areas in the brain. The brain networks are divided, based on their distinctive functions as recognition, strategic, and affective networks (Rose & Strangman, 2007). The recognition network, which recognizes the auditory, visual, and tactile senses, is in the back of the hemispheres. The strategic network is located at the front of the hemispheres, in charge of the cognitive, mindful process, and motor movement. The affective network is centered between and dispersed across the hemispheres (Rose & Meyer, 2002). We argue that perception and cognition are tasks related to the recognition networks. Information processing and meta-cognition are the tasks of the strategic network, whereas attention and motivation are the tasks belonging to the affective networks.

Vygotsky (1978) postulated the following three prerequisites for learning: (a) recognition of knowledge of upcoming learning, (b) application of methods to acquire the knowledge, and (c) engagement with task. Similarly, Rose and Meyer (2002), in their work on brain networks identified: (a) a recognition network, (b) a strategic network, and (c) an affective network.

We further argue that meta-strategies function to organize the perception of information in the recognition network by using meta-cognitive strategies in the strategic network, including the ability to focus, attention span, and motivation that are stimulated in the affective network (see Table 2).

### Multiple Intelligences Theory

Traditionally, special educators have believed that the learning achievement of students with disabilities can be improved if more appropriate and effective learning and teaching strategies are implemented. Individuals learn in different ways and demonstrate certain strengths. If their learning strengths and preferences can be more fully developed, the learning gap will be closed.

Based on Gardner’s multiple intelligence theories (2006), Rose and Meyer (2002) argue that students have various multifaceted learning abilities and potentials and that if they have deficits in a specific area(s), they will be compensated for by the strength in others. Using nine intelligences, Gardner (2006) argues that every individual has different strengths and weaknesses in his/her intelligence although the potential of the intelligence is unchanged. The nine intelligences and their locations in the brain are as follows: (a) musical intelligence, which is mostly developed in the right hemisphere; (b) bodily kinesthetic intelligence; (c) linguistic intelligence, which can be found in Broca’s area and both hemispheres; (d) spatial intelligence in the posterior regions of the right cerebral cortex; (e) logical-mathematical intelligence which can be found in the left hemispheres; (f) interpersonal; (g) intrapersonal; (h) naturalist; and (i) existentialist intelligences (Gardner, 2006). Multiple intelligence theory implies a student’s learning gap may be closed by employing learning strategies that resonate with the student’s strengths.

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<tr>
<th>Locations</th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
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<tbody>
<tr>
<td>Functions</td>
<td>Cognitive Mindful Information Processing</td>
<td>Attention/Motivation</td>
<td>Perception/Cognition, Sensing/Vision/Touching/Auditory</td>
</tr>
<tr>
<td>Information Processing</td>
<td>Involvement/Motivation</td>
<td>Recognition of Information</td>
<td></td>
</tr>
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</table>

Table 2. Brain Networks, Their Locations and Functions in the Both Hemispheres
Computers and Intersensory Learning

As discussed, the two hemispheres of the brain both have auditory, visual, motor, and tactile senses. If learning models can be developed that reflect stimulation of all the senses in both hemispheres learning can be enhanced for those with LDs by using the complementary brain functions. As mindtools, computers play an important role in instructional design and the development of programs to facilitate students’ multi-sensory latent abilities in the digital age (Jonassen, 2000).

Technology is a ubiquitous and integral part of schooling in the digital information society and must be used efficiently and effectively for all students to meet their needs. A computer-implemented curriculum provides adaptable learning goals, procedures, and learning materials that can fulfill the needs of diverse learners, with or without disabilities (Rose, Hitchcock, & Meyer, 2005). Thus, computers as mindtools can improve all students’ cognitive abilities and problem-solving skills (Jonassen, 2000; Maccini, Gagnon, & Hughes, 2002), and enhance learning opportunities, especially for those with disabilities, by increasing their access to the general education curriculum (Rose & Meyer, 2002). Computers also increase motivation, intra- and inter-personal skills, as well as learning outcomes for all students, including those with disabilities (Berman & Chiarello, 1998; Lock & Carlson, 2000; Mathews, Pracek, & Olson, 2000). Computers have infinite patience and significant potential to assist those with LDs. For example, computer-integrated strategic instruction has been found to improve the writing skills of students with disabilities (Glazer & Cury, 1998; Montgomery & Marks, 2006), and computer-integrated social studies instruction can lead to better learning outcomes (Boone, Burke, & Fore, 2006; Higgins, Boone, & Lovitt, 1996).

Through visual, auditory or tactile modes, students interact with software when they are engaged in computer-based activities. For instance, students with LDs may learn by using voice and text interfaces when they convert text to speech with the use of the mouse. The student may enjoy hearing the voice and may want to listen to the text once more. Likewise, computers can be used to stimulate all of the student’s senses. Computers also allow students with a specific LD to interact and engage in a task at their preferred pace by using specialized user interfaces.

Furthermore, students employ learning strategies in order to achieve knowledge, solve problems, and achieve higher-order thinking skills (Center for Research on Learning, 2007). Computers can teach learning strategies (Jonassen, 2000) by presenting information in ways that reduce cognitive load (Norman, 2002; Rasmussen, 1986). Learning strategies enable students to more actively engage in learning tasks as the strategies themselves teach the student meta-cognitive skills and how to apply what they have studied to their learning (Center for research on learning, 2007; Jonassen, 2000).

Software, Learning Strategies, and LDs

No single learning strategy or computer program is a panacea for those with LDs. However, based on the work at the Center for Research on Learning for the past 30 years (Center for Research on Learning, 2007), a series of well-designed research-based instructional models have been developed. These models recognize a number of effective learning strategy characteristics.

Learning Strategy Characteristics

The first characteristic of well-designed learning strategies is that the strategy addresses the way students learn, lead the students to solve problems, and enable the students to apply their learning in a real-life situation (Center for Research on Learning, 2007; Jonassen, 2000). Effective strategies allow students to use their minds and ultimately solve problems. Students acquire the skills necessary to improve their knowledge base and enhance visual representation of their learning content when they use the effective strategy. They recall and retrieve information by developing questions and having insights about the text-based knowledge (Jonassen, 2000). They acquire the meaning of both unknown and new words (Center for Research on Learning, 2007).

The second characteristic of effective learning strategies is that they allow students with LDs to develop strategies that help them store and retrieve existing knowledge, modify it, and at some later time, retrieve what they have learned (Center for Research on Learning, 2007).

Computers can be used to implement these two strategies by employing learner-friendly user interface designs and in the selection of appropriate algorithms (Jonassen, 2000). The basic concept for the software or program applications is that: (a) the computer mediates the student’s active engagement in the task; (b) the computer provides feedback on the student’s performance with positive and negative implications; and (c) the computer aids students with
these strategies because the computer is a tool that makes practice possible (Jonassen, 2000).

The third characteristic of effective strategies is that students can represent their thoughts about what they have studied in writing (Center for Research on Learning, 2007), listen to what they have written, check for errors, and get corrective feedback. In addition, computer-mediated learning can use all the traditional effective strategies researched and used by researchers. The examples are tutorials, hypermedia, drills, simulations, games, tools and open-ended learning environments, tests, and finally web-based learning (Hunt & Marshall, 2004). Figure 2 illustrates computer-mediated learning whereby the learning task is conceptualized as an object, the learner as a learning subject, and the computer as a mediator of instruction.

![Figure 2. Computer-mediated learning model for learners with LDs](image)

**Software for the Learning Disabled**

There is a plethora of software currently available with effective user interfaces. A number of these are presented as examples of multisensory learning tools. These examples have similar visual, auditory, and motor interface designs and include drill-and-practice software and educational games.

Wiggleworks (Scholastic Inc., 1996) allows students with LDs to read in divided linguistic units, such as “segments, words, phrases or sentences” (Freund, 2005, p. 265) so the skills of phonemic awareness, phonics, fluency, basic and higher-level vocabularies, and reading comprehension can be more easily achieved (Scholastic Inc., 2006). The written text in the form of the visual interface can all be converted from text to speech and highlighted. The visual interface (font size, graphics, and background color) and the speech output can be customized (Scholastic Inc., 2006). These user-friendly customizations enhance the motivation of students with LDs to practice, which facilitates learning. Wiggleworks stimulates both hemispheres of the brain by using the linguistic unit reading strategies and multiple user-interface options. The “word identification strategy” is used for this software. The strategy employed is for the students with LDs to effectively translate the unidentified word(s) and then recognize them in their text (Center for Research on Learning, 2007).

**textHELP Read & Write Gold** (Mindnautilus.com Corporation, 1999) is a writing tool for students with LDs. The program allows writers to mark important concepts, sort out outlines, develop sound comments and design annotations (Mindnautilus.com Corporation, 1999). It can be applied to the Self-Questioning Strategy developed by the Center for Research on Learning (2007). This strategy enables students to develop self-motivation for their readings. Using the Self-Questioning Strategy, students coin problems and try to solve the problems while they are reading (Center for Research on Learning, 2007). It also uses the Error Monitoring Strategy (Center for Research on Learning, 2007), which allows students to monitor grammar and linguistic mistakes in their writing. These learner-friendly functions enable students with LDs to enhance their memory and organization skills. Furthermore, students with LDs can design their own user interface, so the motivation to write is enhanced. The software is equipped with text-to-speech conversion so that the writers can hear what they have written. Students recognize their semantic (word meaning) and syntax (punctuation, grammar, and spelling) mistakes while they hear their writing read aloud, thereby enhancing word and sentence recognition.

**MS Office Excel, Inspiration, and MS Windows’ built-in calculator** can be used as assistive learning tools for students with LDs. They can learn, collect data, draw charts, calculate, and organize data. These learning tools stimulate the visual senses.

**Sunburst Building Perspective Deluxe** (Computer Products for Education, 1997) is an educational game for students working together or individually. The software enhances intra/interpersonal intelligence through collaborative work. Students with LDs can solve geometric, spatial, and three-dimensional problems with their peers and in the process increase their higher-order thinking, sequencing, and problem-
solving. Students with LDs will improve higher order thinking skills, sequencing, and reasoning skills (Computer Products for Education, 1997). The software can also be applied to the strategic math series, which enhances basic math skills (Center for Research on Learning, 2007).

Information processing involves more than working memory; drill-and-practice software is used to enhance students’ memory abilities. Inter/multi-sensory computer-engaged meaningful tasks enhance the strength of students with LDs in the activated parts of the brain. Eventually, activation of both hemispheres becomes easier with practice.

When the computer is implemented into multi-sensory learning for students with LDs, the expected learning behaviors fall within four domains: language, perception, cognition, and disposition. This idea is loosely based on Gagne’s five types of learning outcome (Wager & Gagne, 1988), intellectual skill, cognitive strategies, verbal information, motor skill, and attitude (Wager & Gagne, 1988).

The domain of language includes the sub domains of phonemic awareness, phonetic abilities, phonics skills, decoding competency, and phonological performance. The perception domain covers the sub domains of visual, auditory, and motor receptions. The cognition domain includes the sub domains of information processing, memory enhancement, organization of information, higher order thinking, reasoning, and problem-solving. Table 3 depicts the behavioral outcomes as a result of computer-mediated learning.

**Conclusion**

The Education for All Handicapped Children Act, Section 508 of the American Rehabilitation Act, the Technology-Related Assistance for Individuals with Disabilities Act of 1988 (PL 100-407), and the Individuals with Disabilities Education Act (IDEA) of 2004 all have a critical influence on technology integration and prevalence in the classroom (Ofiesh, 2004, p. 266). When computer-adapted instruction and educational software are used for the best practice of instructional development, students’ learning outcomes are more gainful and productive (Hasselbring & Williams, 2000; Hudson, Lignugaris-Kraft, & Miller, 1993). Judicious application of instructional design can lead to significant improvements in software for students with LDs by enhancing the total learning experience, including intersensory learning. Computer-adapted instruction and educational software, and judicious application of instructional design may help level the playing field in the inclusion classroom for students with LDs.

**Soonhwa Seok** has an M.A. and Ph.D. degree in curriculum and instruction. Dr. Seok has interests in educational communication and technology with applications for teaching English as a second language and special education. Most recently, as a post-doctoral researcher, Dr. Seok has examined intersensory learning models, assistive technology, and motivation and feedback for students with learning disabilities. Additionally, she has served as a peer reviewer for conference proposals, presented on web accessibility, and published articles on distance education and special education technology.

**Boaventura DaCosta** has a B.S. in computer science and an M.A. and Ph.D. in instructional systems design. Among his research interests in cognitive psychology and information and communication technology innovations, he is also interested in how games can be used in learning. Complementing his work as a researcher, he has worked in the commercial and government training sectors for the past 15 years as a software engineer.

**Carolyn Kinsell** holds a Ph.D. in instructional technology and a certification in human performance. Her career expands over 18 years in which she has focused on the application of training that spans from analysis, to the development of virtual environments, to defining requirements and solutions for human performance standards; and, more recently, to research and development of training applications. She has worked closely with the military to include Cryptologists, Intelligence Specialists, Naval Diving and Salvage experts, to Force XXI Battle Command Brigade and Below (FBCB2) Joint Capabilities Release (JCR). She has also supported commercial clients such as Cingular and North America Honda, to name a few.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Behavioral Outcomes</th>
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<tbody>
<tr>
<td>Language</td>
<td>Phonemic Awareness, Phonetic Skills, Phonics skill, Decoding Skill, Phonology, and Semantics.</td>
</tr>
<tr>
<td>Cognition</td>
<td>Processing Information, Enhancing Memory, Organizing information, Higher Order Thinking, Reasoning, Sequencing, and Problem Solving.</td>
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Table 3. Behavioral Outcomes from the Computer Involved Learning
John Poggio is the co-director of the independent Center for Educational Testing and Evaluation and a professor of educational psychology and research at the University of Kansas. He has been involved with the Kansas legislature and the Kansas State Board of Education to coordinate the design and development of tests that are administered annually to all Kansas K-12 regular and special education students in reading, mathematics, writing, social studies, and science. He has also been involved and directly responsible for the evaluation and development of proposed teacher evaluation tests and systems.

Edward Meyen is a Budig professor of special education and co-director of the eLearning Design lab at the University of Kansas. His research interests are in the development of e-learning tools for use by educators in K-12 and post secondary education. His current work is in developing online tools to enhance the blending of assessment with instruction that is aligned with curriculum standards K-12 Education.

References


