Using Technology to Promote Expression and Self-Concept

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Abstract

Developmental theory indicates that healthy cognitive development is dependent upon participation in the dynamic process of communication. Individuals with severe disabilities, such as cerebral palsy and ALS, contend with the double impact of speech and motor impairment, lacking operative channels for self-expression. The critical nature of self-expression and interaction is well known among special educators and researchers alike, with established linkages between communication disabilities and several student problems such as poor social interactions, low self-esteem, negative peer perceptions, and behavior problems. A review of research concerning human development and the role of technology in restoring self-expression, as well as the authors' personal perspectives are presented to advance the argument that technology should increasingly be used to promote positive self-expression for all students, and not exclusively as a conveyor of content to improve achievement.

INTRODUCTION

We had a jar with a butterfly.
We opened the lid and it flew to the sky.
And there are things inside my head
Waiting to be thought or said,
Dreams and jokes and wonderings are
Locked inside, like a butterfly jar.
But then, when you are here with me,
I can open the lid and set them free.

Moss, 1989

Imagine for a moment that you have lost the ability to speak and the ability to manipulate a pencil with your hand. What would become of those persistent thoughts that unremittingly develop, multiply and accrue in your mind? How will your ideas escape the confines of your imagination and reach the world surrounding you? Would the quality of your ideas diminish if starved of the opportunity to be challenged, amended and affirmed? Englebart (1963) recognized that the effect that an individual has on society is contingent upon what can be communicated to the world through his "limited motor channels." To appreciate the riches that individuals with disabilities can offer when able to communicate ideas, one need merely bear in mind that the immense contributions to quantum physics made by Stephen Hawking, afflicted with the

complications of ALS since the age of 21, were only possible with the aid of an adapted computer and a voice synthesizer.

Yet it is not for the benefit of society alone, or the hope of discovering a Nobel Laureate that one should consider the worth of self-expression. In the words of eleven-year-old Hero Joy Nightingale, an individual with profound Apraxia and incapable of voluntary sound, "I cried long and bitter tears the day I realized I was disabled but since my disability mutes my voice, no one knew the significance of the day to me" (Nightingale, 1997). Nightingale's retelling is a poignant reminder that individuals with speech and motor disabilities are quite literally robbed of a voice.

Special educators and other professionals who work with individuals with disabilities have long known the importance of using assistive technologies to unlock the thoughts, feelings, and emotions of individuals who are afflicted with a speech or language disorder that inhibits their verbal communication. The term "assistive technology device" refers to "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" whereas an "assistive technology service" refers to "any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology device" (Technology-Related Assistance for Individuals with Disabilities Act of 1988 as amended in 1994). A more specific type of AT for individuals with speech and communication disabilities is augmentative or alternative communication (AAC). Augmentative or alternative communication technology includes "electronic and non-electronic devices that provide a means for expressive and receptive communication for persons with limited or no speech" (Chapter 33, Section 1401 [25]). Using adaptive and assistive technology, individuals with disabilities can reclaim opportunities for communication and self-expression.

Over the past decade, assistive and educational technologies have grown in number and sophistication and have become ubiquitous in many schools. Woven into the fabric of every day life, these technologies are used by all students, not just those with disabilities. The perceived line separating assistive technology and conventional technology is becoming more and more blurred (Fisher, 1999). Technology education teachers (vs. educational technology) have appreciated that one of the primary benefits of using powerful simulation and development programs (e.g., CAD) is that students become involved in the creative process and are able to express themselves in ways simply not possible in traditional school tasks (Peterson, 2001). While many teachers intuitively sense this same outcome when their students are using computers to create a multimedia project, for example, they often devalue the experience, dismissing it as simply that their students "like computers," or a quirk of students in "that video game generation" (Hiroyuki, 1998).

In contrast with research efforts in the special education arena, studies with students in the general education population have focused on student achievement gains – long considered the "Holy Grail" of educational technology research. Researchers have sought ways to manipulate instructional treatments and instructional media with the hopes of generating student achievement gains (e.g., Cronbach & Snow, 1977; Kulik & Kulik, 1991). Even studies that have focused on the impact of computer-assisted instruction on low-performing, at-risk students have used achievement as the main dependent measure (Hannafin, 2004; Hannafin & Sullivan, 1996; Ross and Rakow, 1981). Overlooked as a research concern for the general education population are the more basic needs of expression and communication. In the following section, we examine the literature in educational and assistive technology and seek to demonstrate that the arguments

used for enabling and empowering students with disabilities, as exemplified so powerfully in the cases cited earlier, are just as relevant and persuasive when applied to all students.

Educational and Assistive Technology Research – What We Probably Know

Language and Cognitive Development

Developmental theorists have argued for years that healthy cognitive development is dependent upon self-expression and communication. One of Piaget's fundamental insights was that social transmission stimulates an individual's personal construction of knowledge (Siegler, 1991). Piaget deduced that humans store information in mental organizations called schemes. When individuals are introduced to new information, they create or identify new, more appropriate, schemes for the storage of that information (Piaget, 1972; Piaget, 1980). Consequently, for learning to occur, learners' active experiences should include both the physical manipulation of objects and the mental manipulation of ideas (Ginsburg and Opper, 1987). In schools the mental manipulation of ideas depends upon social interactions with teachers and student peers. Learners, in other words, need opportunities to paraphrase information, ask questions for clarification, test their ideas, and expand on information through expository writing (Woolfolk, 1998).

While Vygotsky's theories focus more specifically on the role of language in cognitive development, he also further advanced the importance of the sociocultural context for the developing mind (Vygotsky, 1978). Vygotsky believed that the evolution of cognitive development is a result of direct interaction with more capable members of society. Adults listen to children and provide guidance through language. The child draws on this leadership, advancing personal knowledge and understanding (Vygotsky, 1978). Today, developmentalists in the Vygotsky-inspired contextual approach embrace the idea that children's cognitive development is embedded in the context of social relationships and sociocultural tools and practices. "All students need to interact with teachers and peers in order to test their thinking, to be challenged, to receive feedback, and to watch how others work out problems," is how one of the more popular educational psychology textbooks on the market puts it (Woolfolk, 1998, p. 41).

Research supports the critical nature of self-expression and communication in learning in schools. Ross and Cousins (1995) found a positive correlation between explanation-seeking and student achievement, while Walker, Schwarz, Nippold, Irvin, and Noell (1994) identified a connection between language disabilities and behavior problems. This relationship may be attributed to the fact that students with communication disabilities often develop low self-concepts (Brinton & Fujiki, 1993; Drummond, 1976; Hummel & Prizant, 1993; Van Riper & Emerick, 1984).

While no one would argue with the value of self-expression, or with the importance of using technology to unlock the thoughts and feelings of students with severe disabilities, few ascribe the same importance to these outcomes among *general* education students. All students need to communicate and express themselves effectively to develop a healthy self-concept and to succeed academically. Given the type of knowledge that is valued in our schools, poor communicators are often misunderstood, ostracized and in great peril of academic failure. Many under-performing, at-risk students, however, are not lacking in ability as much as they lack an effective means of communication. These students often become lethargic, disinterested, disengaged, and eventually disenfranchised. They are in an academic environment they do not understand and, as importantly, are not understood (Selman, 2003).

Educational psychologists have identified the role that communication plays in student interest and motivation (Weber & Patterson, 2000). Children and students who continually lack opportunities for independent activity become passive and submissive. This learned helplessness has been linked to external locus of control and lack of motivation (Miserandino, 1996). Schiefele (1991) and Tobias (1994) resolved that interest consists of three dimensions: "perceptions of meaningfulness, involvement, and prior knowledge (cited in Weber and Patterson, 2000, p.23). Concerning the second dimension, Weber and Patterson explained, "the more active the role assumed by the learner in the completion of tasks, the more involved they feel" (p.23). Teasley (1995) found that when children talk to themselves or in pairs, they reason more effectively and perform better across academic tasks than when they do not talk to themselves or with a peer. This in keeping with the idea that communication is a critical element in cognitive growth and the concept that children learn from each other.

Self-Concept and Peer Perceptions of Children with Language and Speech Disabilities

With the push for inclusion and integration of students with disabilities, a number of scholars have studied peer perceptions of individuals with disability. These scholars discovered that peer perceptions of individuals with voice or language disorders are predominantly negative. Milich, McAninch and Harris (1992) conducted an analysis of research on stigmatization and peer interactions of individuals with disability. They found that even a small quantity of stigmatizing information alters peer perceptions of students with a disability. Lass, Ruscello, Harkins-Bradshaw, and Blankenship (1991) established that a sample population characterized speakers with voice disorders as having lower levels of intelligence than speakers without voice disorders. Similar studies by Gelacek and Neiman (1994) demonstrated that individuals with communication disorders were described as less confident and less attractive than individuals without communication disorders. Ruscello and Lass (1996) also found that individuals with communication disorders were perceived as less attractive than individuals without communication disorders. In addition, their research revealed that individuals with communication disorders are considered less honest than individuals without communication disorders.

Negative peer perceptions of individuals with disabilities can be altered to more positive ones, however. Lewis (1993) found evidence that students with disabilities who used computers to communicate cultivated more positive perceptions among their peers. Through technology, peers were better able to see the quality of thought and ideas that students with disabilities possessed.

Self-esteem and self-concept relate to both academic achievement and social interaction. Modification of one dimension invariably alters the other. Students draw self-esteem from interactions with peers and from academic performance. Academic achievement and social interactions are either enhanced or inhibited by self-esteem. Individuals with communication disorders are the targets of erroneous and often aversive perceptions (Gelacek & Neiman, 1994; Lass et al., 1991; Milich et al., 1992). It only stands to reason, that low-performing students in the general education world might experience stigmatization for similar reasons.

Drummond (1976) administered the Self-Concept and Motivation Inventory to students in first through fourth grade. Students were separated into two groups; one group consisted of students currently enrolled in speech therapy, the second group consisted of students with no speech or language disorders. Results illustrated that in general, students with speech disabilities had poorer self-concepts than students with adequate communication skills. Results were most consistent and most significant with male students and with older students. Diminished self-esteem and self-concept in students with language and communication disorders have also been

correlated with pullout programs and segregation (Rogers & Saklofske, 1985). Collectively, these results indicate that students with speech and language disorders are at risk for low self-esteem regardless of educational placement.

Haugland (1992) investigated the effect of developmental and non-developmental software on self-esteem, creativity and cognition. Developmentally appropriate software is loosely defined as software that is "open-ended and exploratory" (p.9). Children are allowed to control the program, encounter "concrete representations of people, animals and objects which function realistically" and practice "problem-solving through trial and error" (p.9). Non-developmental software would include the drill and practice type software. As Haugland summarized, " the computer controls the action, children are drilled to learn the correct answers" and representations of people and objects are "abstract and not portrayed in meaningful situations" (p.9). Three classes of four-year-old children were exposed to computers for one hour per day, three days per weekly, for one year. One classroom worked with non-developmental software, one classroom worked with developmentally appropriate software and the third classroom worked with developmentally appropriate software "reinforced with supplemental activities" including "art, language or manipulative activities" (p.10). Children in a 4th classroom received no computer exposure. Results indicated that children in all classrooms with computer exposure demonstrate significantly greater gains in self-esteem. But children exposed to non-developmental software also demonstrated "significant losses in creativity." These losses in creativity were found only for students exposed to non-developmental software raising obvious concerns about prolonged use of this type of software. Lewis (1993) found that for students with disabilities, computer use promoted self-esteem. Lewis attributed the increased self-esteem and self-concept in part to the restoration of control over environment and personal activities, a sense of accomplishment and respect from peers.

The established relationship between communication disorders and low self-concept led researchers to examine the effect of communication disorders on social interactions. Considering the role of language communication in social interactions, one can easily infer that language disorders affect social relationships. Research does in fact indicate a correlation between communication disorders and diminished social relationships. Bryan's (1991) meta-analysis of thirty studies examining the social relationships of individuals with disability found that such individuals have fewer social relationships, and those relationships are likely to be less satisfying, than those of their peers. Even more disturbing, twenty-four of thirty studies demonstrated that individuals with disability are susceptible to social rejection by others (Bryan, 1991). Brinton and Fujiki (1993) studied the origin of diminished social relationships for individuals with disability. Their results reveal a correlation between lower self-concept and diminished social relationships. Their research establishes that lower self-concept impedes both the quality and quantity of social interactions.

Research has also exposed the relationship between communication disorders and aberrant behavior (Walker et al., 1994). This link can be attributed to the confirmed deficiency in opportunities and skill in social interaction for individuals with language and communication disabilities (Brinton & Fujiki, 1993; Hummel & Prizant, 1993; Walker et al., 1994).

The implications of this research are profound and of consequence for arenas beyond schools. The pervasiveness of computers in the workplace, for example, demands strong collaborative and communication skills for employees. "In such complex work environments, workers must work collaboratively with other people and must also utilize the specialized knowledge of others in order to do their jobs. New organizational infrastructures are being

formed to greatly enhance and extend what any single individual or organization can accomplish" (Molnar, 1997, p.67). In order to succeed in such an environment, individuals with disabilities need opportunities to develop and strengthen social skill through positive interactions.

Computers help define the problem, but they also offer a solution. Dickinson (1986) investigated social relationships of first- and second-grade students in general education classrooms while writing with different media. Computer compositions increased opportunities for social interaction and added a social dimension to the writing process. Observations established that students displayed enthusiasm and interest in others' work when writing with the computer. Dickinson cites the ability to clearly see another person's work on the as a stimulus for the dialogue on planning, discussion of ideas and peer editing which occurred. In contrast, experiences with pen and paper were more solitary. Several studies also have demonstrated that students with communication disabilities, using word processing software and accompanying speech synthesizers improved self-concept and promoted social interactions (Erickson, Koppenhaver, & Yoder, 2002; Holzberg, 1994; Holzberg, 1995; Lewis, 1993).

At-Risk Students and Computer-Based Instruction in General Education Settings

Educational researchers investigating general education settings have, perhaps understandably, focused on cognitive outcomes when investigating the impact of computers. Achievement of at-risk students has been an area of particular interest. In a typical example of this research genre, Hannafin and Sullivan (1996) studied the impact of two computer-based instructional interventions on students with differing ability levels (high achievers and low achievers) on student achievement as measured on a posttest. Similar studies predominated in the earliest research conducted in this relatively young field.

Early advocates of computer-based instruction believed that computers in the classroom would make student learning easier and more efficient while increasing motivation to learn. Papert (1980) for example, believed that computers would provide students with new ways to learn, think, and grow intellectually. Schacter and Fagnano (1999) later noted that the Internet and subsequent advances in communications could revolutionize teaching such that the world would become the classroom for all students. Kulik and associates' meta-analyses (Kulik & Kulik, 1991; Kulik, Kulik, & Bangert-Drowns, 1985) provided two syntheses that investigated the effects of computer-based instruction on K –12 students' achievement and found an effect size of between .30 and .47 standard deviations in favor of computer-based instruction. Early studies by Hannaford (1987) and Niemic and Walberg (1985) reported on beneficial achievement and motivation effects for all students and in particular, at-risk and mildly disabled students who worked in computer-based instructional programs.

Other outcomes besides achievement have been investigated though to a lesser extent. Salomon and Perkins (1987) coined the phrase "effects with technology" to describe non-achievement measures outcomes such as increased motivation, time on task, and engagement. These effects with technology have been investigated but to a lesser extent than "effects of technology" or student achievement. Many researchers, for example, routinely measured participant satisfaction with the instructional treatment. Swenson and Anderson (1982) argued that the greatest educational benefit of computer-assisted instruction was increased motivation. Many studies were conducted to determine how the use of computers to teach a given subject could affect student motivation to return to that same subject at a future time. Seymour, Sullivan, Story and Mosley (1987) studied students' continuing motivation to perform a future geography

task when it was offered on the computer or in paper-pencil format. An overwhelming 97% of all participants expressed a desire to do subsequent tasks on the computer rather than in paper-pencil format. Kinzie, Sullivan, and Burdel (1992) reported that a group of ninth-grade students who were given computer-assisted instruction on a science topic indicated a strong preference for instruction on the computer and an increased interest in studying science if the science instruction was to be conducted on the computer. These results indicate that computer-assisted instruction appeals to some students over other forms of instruction.

More recently, the scope of inquiry has expanded and extended to emphasize learner meta-cognitive skills when using computers. Several researchers have studied the interactions between learners and sophisticated computer programs while they attempt to learn complex concepts. The emphasis is not on learning gains as much as it is on identifying ways to use the computer to scaffold instruction for students and examining the strategies students employ while performing higher-order tasks in ill-defined, open-ended learning environments (e.g., Jonassen, 2002, and Hannafin, Land, and Oliver, 1999). *Alien Rescue* (Liu & Berra, 2005; Liu, Williams, & Pedersen, 2002) and *River City* (Ketelhut, 2007) are two recent examples where simulations and three-dimensional multi-user virtual environments (MUVEs) illustrate the complexity of understanding and analyzing the interactions between learner and environment. Each product has been accompanied with extensive, ongoing, design-based research efforts that recognize other outcomes more broadly conceived than traditional (posttest) achievement measures.

Some research in general education has directly addressed student communication, self-expression, and self-concept. Jones and Selby (1997) advocated that computers be used as a form of therapy for at-risk students to allow them greater opportunities to express themselves and communicate. They noted that at-risk student frequently have social adjustments that impair their cognitive functioning. Katims, Diem, and Carlson (1996) reported that at-risk high school students, after working on intelligent tutoring systems (ITS) for a full year, reported significantly more positive perceptions about technology, their school, and about themselves as learners, and were more motivated to learn. Students reported that their teachers could spend more time with them individually (contradicting the commonly cited "depersonalization" argument against computer use). They also reported feeling better about themselves and more secure in making mistakes with one student stating "I can ask questions and make mistakes…and no one knows it except the machine. I like that" (p. 100). Another student noted, "It (ITS) makes school more interesting. I try to get the right answers with the computer. It's better than just the teacher talking all period long."

Hannafin, Burruss, and Little (2001) observed low-achieving students learning with *Geometer's Sketchpad,* a dynamic geometry program (Key Curriculum Press, 1993) and found instances where students who typically fail at traditional school tasks felt empowered after working independently in a new instructional task. The researchers argued that such environments hold great promise for challenged students as an alternative to way of connecting with them. Johnson (1996) proposed an alternative assessment of technology according to the needs of the individual students, parents and community. He suggested that technology should provide "meaningful contributions" to fulfill educational needs. Proper assessment should "determine if the use of technology is making our children better citizens, better consumers, better communicators, better thinkers - better people."

PERSONAL PERSPECTIVES – WHAT WE THINK WE KNOW

Breathing equals life, and life equals communication.
It is that simple.

Mirenda, 1993

Language, along with other cognitive skills, is a significant part of what makes us human. Language stands apart in several ways, however, from cognitive skills like spatial reasoning, the ability to form social relationships, logical-mathematical reasoning, musical ability, and the like. For one, all normally developing children learn to speak at least one language, and many learn more than one. The same cannot be said of other cognitive skills. Not everyone becomes proficient at complex mathematical reasoning, and most people cannot play a musical instrument. Yet, because nearly everyone is capable of learning to speak and understand language, it seems simple. In fact, language is perhaps the most complex of all human cognitive abilities (Crain, 2000; Crain & Lillo-Martin, 1999).

Students with language or speech disabilities constitute a substantial portion of the special education population. These students face obstacles that go beyond their physical disability. Peers are more likely to have lower perceptions of their abilities and even their character. Simultaneously, these students are more likely to have low self-esteem. Any one of these factors may lead to lower school achievement. All of them combined create a tremendous barrier to achievement. To counter these issues, special educators have made a considerable effort to use assistive technologies to facilitate cognitive development for such students with promising, even remarkable results.

It is our contention that students labeled at-risk in the general education population share characteristics, albeit, perhaps to a lesser extent, with students identified as language or speech impaired. At its simplest, both populations exhibit difficulty in communicating with others. The at-risk students, unfortunately, have not received the same assistance, nor have their poor communication skills been appropriately identified.

While the research in educational technology in general education has tended to focus on improving achievement, such as identifying interventions and learner traits that improve test scores (e.g., Cronbach & Snow, 1977). And in fairness, this effort has more or less mirrored K-12 values – at least to the extent that values are reflected in how computers are used in schools. We contend that both researchers and practitioners need to learn what special educators have known for years; that computers are a powerful tool that can and should be used to encourage student communication and self-expression.

We have observed instances where students have experienced powerful personal breakthroughs using computers that had little to do (directly) with the intended instructional outcomes. What follows are two such cases from our observations. In both instances, the student's views of who they were -- their self-concept -- was profoundly changed for the better. First, we take a look at "Leonard," a second-grade student dealing with a severe handicap on a daily basis. We note how assistive technology empowered him and, literally, provided him voice. Second, we acquaint you with "Marcus," an at-risk seventh-grade student, who finally experienced both the joy of understanding concepts that had eluded him for years and more importantly, a sense of pride and connection to the community after using a computer-based geometry program.

Leonard

Leonard has cerebral palsy and lacks the muscle control to speak clearly and the motor control to write legibly. Three years ago Leonard was in second grade. Not surprisingly, Leonard struggled mightily to find avenues to communicate with his classmates, teachers and friends. He was sullen and withdrawn. His classmates were respectful, primarily due to the classroom climate created by his teacher, but they treated Leonard differently. Quite unconsciously, they routinely excluded him from much of the normal social activity and banter that is typical in a second-grade class. They were not being malicious or mean, they just did not think about making the extra effort to engage Leonard.

This all changed, however, when Leonard received an adaptive keyboard and display monitor, providing him for the first time with a reliable outlet for expression. Suddenly, all of us in the classroom could watch his thoughts and ideas spill out across the computer screen. His classmates could acknowledge and affirm him – and he them; they could laugh together, experience sadness with him. They finally understood him. They suddenly saw him as a persona and playmate.

Marcus

Marcus, a low-performing seventh grader accustomed to failure, usually sat bored and disinterested in geometry class. His teacher tried to engage him, but nothing seemed to work. He seemed resigned to the fact that he would probably fail the course. He gave the impression that his main goal was simply to try to stay out of trouble - but that was difficult, very difficult. However, when Marcus was provided the opportunity to work independently on structured geometry activities using the *Geometers' Sketchpad* (1993) software program, he became a different student. Using the *Sketchpad*, he manipulated onscreen shapes, made observations and drew inferences. The difference this time was that he was using a dynamic, graphical, virtually text-free program where reading deficiency did not encumber him. "Ooh, look at that!!" Marcus excitedly observed as he resized a pair of opposite (vertical) angles by dragging one of the shared sides. "That angle got big! So did the other one! I wonder if I can make these angles NOT equal!" As Marcus proceeded to test his "hypothesis," -- that vertical angles were not always equal -- he was eventually proving to himself that they, in fact, always were. Marcus' experience (and others like it) was observed during a study that examined student and teacher empowerment during the implementation of a student-centered learning environment (Hannafin, Burruss, & Little, 2001). Perhaps the most powerful outcome for Marcus was his newfound ability to succeed at some level; to express his understanding; and to communicate that understanding to others. We believe that Marcus' joy in finally connecting with the content in a sense gave him a voice and unlocked part of him for the first time.

We have experienced many other instances where students who do not perform well on traditionally-assessed school tasks such as end of unit exams, excel when provided opportunities to demonstrate their understanding through alternative performance measures. When allowed to be creative and express themselves in a multimedia project, or other performance-based measure, these students frequently surprise their teacher and classmates.

Reflections

Stories like Leonard's and Marcus' are emotional and moving. Their stories allow us to see and even feel their sense of relief and joy. No one would argue against using computers to assist students with such communication disorders. The less compelling case deals with Marcus and

students like him. Marcus did not need a computer to unlock his thoughts and feelings, not in the literal, physical sense anyway. Yet Marcus' feelings of joy and liberation, while less poignant and dramatic, were no less real. The link between self-expression and self-concept is well established in the special education arena, yet it is all but ignored when dealing with students like Marcus.

It is also well established in the special education research that their peers view students with communication disorders, often ignored and marginalized, as unattractive. We believe the same phenomenon is at play in the classroom with at-risk students. Students begin to separate by ability in the fourth grade, when the content becomes more complex requiring more sophisticated skills like abstraction and synthesis and with less recognition and recall. The gap then continues to widen throughout middle high school and portends a downward academic spiral (Pogrow, 1999). The plight of at-risk students is a tragic story and exploring ways to help them has widespread implications.

Can computers help improve expression and self-concept for at-risk students? And even if they can, are those outcomes legitimate educational ends? We certainly believe they are, but our aim is not to so much to convince, as it is to encourage more systematic investigation. Perhaps it is time to consider student self-concept and communication as primary outcomes in the context of open, student-centered computer-supported environments. As early as 1994, Kozma argued that researchers looking for achievement gains in computer-supported environments might be ignoring other, as important, outcomes. Clearly, not all outcomes are measurable on a multiple-choice exam. Complex social and cognitive interactions - some intended and some not – occur in open learning environments and Kozma called for researchers to begin to look elsewhere for benefits in other domains – perhaps emotional or affective.

Well-designed computer-based instructional materials that are graphics-rich and embed scaffolding tools, we believe, hold great promise. But curriculum like the student-directed program described in Marcus' case, for example, that was custom-developed for the host school to meet the state-mandated content standards, is not available to all middle school teachers. It is unlikely in our current standards-obsessed culture that many teachers have either the time or inclination to develop such resources. It is possible, however, that school-university partnerships and software vendors could develop such resources. We call for them to do so.

References

Americans with Disabilities Education Act of 1990. (1990). Retrieved August 1, 2007 from http://www.ada.gov/pubs/ada.htm

Brinton, B., & Fujiki, M. (1993). Clinical Forum: Language, social skills, and socio-emotional behavior. *Language, Speech, and Hearing Services in Schools, 24,* 194-198.

Bryan, T. (1991) *Assessment of children with learning disabilities who appear to be socially incompetent.* Annual Conference of the Council for Exceptional Children; Atlanta. Cited in Taylor, G. (1991) Curriculum Models and Strategies for Educating Individuals with Disabilities in Inclusive Classrooms. Charles C. Thomas: Springfield.

Crain, S. (2000). *Language and brain*. Linguistic Society of America. Retrieved August 3, 2004 from http://www.lsadc.org/

Crain, S., & Lillo-Martin, D. (1999). *An introduction to linguistic theory and language acquisition.* Oxford: Blackwell Publishers.

Cronbach, L. J. and Snow, R. E. (1977). Aptitude and Instructional Methods. New York: Irving Press.

Dickinson, D.K. (1986). Cooperation, collaboration and a computer: Integrating a computer into a first-second grade writing program. *Research in the Teaching of English, 20.* 357-378.

Drummond, R. J. (1976). Self-concept of children with speech disabilities. (ERIC Document Reproduction Service No. Ed. 171 413).

Englebart, D. [1963]. "A Conceptual Framework for the Augmentation of Man's Intellect." in *Vistas in Information Handling*, Vol. 1, P. Howerton, ed., pp. 1-29. Spartan Books, Washington, D.C.

Erickson, K. A., Koppenhaver, D. A., & Yoder, D. E. (2002). *Waves of words: Augmented communicators read and write*. Toronto: ISAAC Press.

Fisher, S.K. (1999). *"Assistive Technology" Transition and School-Based Service*. Edited by Sharon deFur and James Patton pro-ed. Austin; 1990.

Gelacek, M. T., & Neiman, G. S. (1994, November). *Listeners' perceptions of females with hoarse and normal voice quality.* Paper presented at the meeting of the American Speech-Language-Hearing Association, New Orleans, LA.

Ginsburg, H. P. & Opper, S. (1987). *Piaget's Theory of Intellectual Development (3rd Edition)*. New York: Prentice Hall.

Hannafin M. J., Land, S., & Oliver, K. (1999). Open learning environments: Foundations, methods, and models. In C. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory*. Mahwah, NJ: Erlbaum.

Hannafin, R. D., Burruss, J. D., & Little, C. (2001). Learning with dynamic geometry programs: Teachers' and learners' perspectives. *Journal of Educational Research*, 94(3) 132 - 144.

Hannafin R. D. (2004). Achievement differences in structured vs. unstructured instructional geometry programs. *Educational Technology Research & Development*, 52(1), 19 – 32.

Hannafin, R. D. & Sullivan, H. J. (1996). Learner preferences and learner control over amount of instruction. *Journal of Educational Psychology*, 88(1), 162-173.

Hannaford, A. E. (1987). Computers and exceptional individuals. In J. D. Lindsey's (Ed.) *Computers and Exceptional Individuals.* Columbus, Ohio.

Haugland, S. W. (1992). "The effect of computer software on preschool children's developmental gains." *Journal of Computing in Childhood Education, 3*(1), 15-30.

Hawking, S. (1993). *Black holes and baby universes.* Bantam Books, New York.

Hiroyuki, T. (June, 1998). *What expertise do teachers require to facilitate pupils' self-expression with multimedia?* Proceedings for the Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications, Freiburg, Germany.

Holzberg, C.S. (1994). Technology in special education. *Technology and Learning*, 14(7), 18-21.

Holzberg, C. S. (1995). Technology in special education. *Technology & Learning*, 15(5), 18-23.

Hummel, L., & Prizant, B. (1993). A socioemotional perspective for understanding social difficulties of school-age children with language disorders. *Language, Speech, and Hearing Services in Schools*, *24*, 216-224.

Johnson, *D. (1996). Evaluating the impact of technology: The less simple answer from now on. Educational Technology*, *5*, (5). Retrieved March 1, 2006 from http://www.fno.org/jan96/reply.html

Jones, A. & Selby, C. (1997). The use of computers for self expression and communication. *Journal of Computing in Childhood Education, 8*(2-3), 199 – 214.

Jonassen, D. H. (2000). *Computers as Mindtools for Schools: Engaging Critical Thinking*. Columbus, OH: Prentice-Hall.

Katims, D. S., Diem, R. A., & Carlson, P. (1996). Technological interventions and student attitudes: A case study of secondary students identified as at-risk. *The High School Journal, 80*(2), 95 – 102.

Ketelhut, D. J. (2007). The impact of student self-efficacy on scientific inquiry skills: An exploratory investigation in River City, a multi-user virtual environment. *The Journal of Science Education and Technology, 16* (1), 99–111.

Key Curriculum Press (1993). *Geometer's Sketchpad*. [Computer program]. Berkeley, CA.

Kinzie, M. B., Sullivan, H. J., & Berdel, R. L. (1992). Motivational and achievement effects of learner control over content review within CAI. Journal of Educational Computing Research, 8(1), 101-114.

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development*, 42(2), 7-19.

Kulik, J., Kulik, C., & Bangert-Drowns, R. (1985). Effectiveness of computer-based education in elementary schools. *Computers in Human Behavior 1*, 59-74.
Kulik, C. & Kulik, J. (1991). Effectiveness of Computer-Based Instruction: An Updated Analysis. *Computers in Human Behavior 7*, 75-94.
Lass, N. J., Ruscello, D. M., Harkins Bradshaw, K., & Blankenship, B. L. (1991). Adolescents' perceptions of normal and voice-disordered children. *Journal of Communication Disorders, 24*, 267-274.
Lewis, R. (1993). *Special Education Technologies. Classroom Applications*. Pacific Grove, CA: Brooks/Cole.
Liu, M., & Bera, S. (2005). An analysis of cognitive tool use patterns in a hypermedia learning environment, *Educational Technology Research and Development, 53*(1), 5-21.
Liu, M., Williams, D. & Pedersen, S. (2002). Alien Rescue: A problem-based hypermedia learning environment for middle school science, *Journal of Educational Technology Systems*, *30*(3), 255-270.
Milich, R., McAninch, C. & Harris, M. (1992) Effects of stigmatizing information on children peer relations: Believing is seeing. *School Psychology Review, 21* (3) 400-409.
Mirenda, P. (1993). AAC: Bonding the uncertain mosaic. *Augmentative and Alternative Communication, 9*, 3-9.
Miserandino, M. (1996). Children who do well in school. *Journal of Educational Psychology. 88*(2), 203-210.
Molnar, A. R. (1997). Computers in education: a brief history. *T.H.E. Journal, 24* (11), 63-68.
Moss, J. (1989). *The Butterfly Jar*. Bantam Books: New York.
National Aphasia Association. (2004). Retrieved August 4, 2004 from http://www.aphasia.org/NAAfactsheet.html
Nightingale, H. J. (September, 1997). *From the window, first edition*. Retrieved March 1, 2006 from http://www.fromthewindow.org.uk/
Niemiec, R. P. & Walberg, H. J. (1985).Computers and achievement in the elementary schools. *Journal of Educational Computing Research, 1*(4), 435 – 450.
Office of Technology Assessment, U.S. Congress, Informational Technology and its Impact on American Education, Washington, DC, (1982), pp.128-133.
Panel on Educational Technology, President's Committee of Advisors on Science and Technology. (1997, March). *Report to the President on the use of technology to strengthen K-12 education in the United States* [Online]. Available: http://www.ostp.gov/PCAST/k-12ed.html Schacter and Fagnano (1999)
Papert, S. (1980). *Mindstorms: Children, computers, and powerful Lies*. New York: Basic Books, Inc.
Peterson, R. E. (2001). Establishing the creative environment in technology education: Creativity doesn't just happen by change; the prepared environment nourished it. *The Technology Teacher, 61*(4), 7-10.
Piaget, J. (1972). *The psychology of the child*. New York: Basic Books.
Piaget, J. (1990). *The child's conception of the world*. New York: Littlefield Leonards.
Pogrow, S. (1999). Systematically using powerful learning environments to accelerate the learning of disadvantaged students in grades 4 – 8. In C. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory*. Mahwah, NJ: Erlbaum.
Rogers, H. & Saklofske, D.H. (1985). Self-concepts, locus of control and performance expectations of learning disabled children. *Journal of Learning Disabilities. 18.* 273-278.
Ross, J.A. & Cousins, J. B. (1995) Impact explanation seeking on student achievement and attitudes. *The Journal of Educational Research 89*(*2*), 109-117.
Ross, S. M. & Rakow, E. A. (1981). Learner control versus program control adaptive strategies for selection instructional support on math rules. Journal of Educational Psychology, 73, 745-753.

Ruscello, D. M., & Lass, N. J. (1996, November). *Attitudes toward dysarthria: Examination of an educational training program.* Paper presented at the meeting of the American Speech-Language-Hearing Association, Seattle, WA.

Salomon, G. & Perkins, D. N. (1987). Transfer of cognitive skills from programming: When and how? *Journal of Educational Computing Research,* 3 (2) 49-69.

Schacter, J. & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research*, *20,* 329-43.

Schiefele, U. (1991) Interest, learning and motivation. *Educational Psychologist, 26* 299-323.

Selman, R. L. (2003). *The promotion of social awareness: Powerful lessons from the partnership of developmental theory and classroom practice*. New York: Russell Sage.

Seymour, Sullivan, Story & Mosley (1987).

Siegler, R. S. (1991). *Children's thinking*. Englewood Cliffs: Prentice Hall.

Swenson, & Anderson, R. P. (1982) ,The Role of Motivation in Computer-Assisted Instruction., *Creative Computing, 8*(10), 134-39.

Teasley, S.D. (1995) The role of talk in children's peer collaborations. *Developmental Psychology, 31*,(2) 207 - 220.

Technology-Related Assistance for Individuals with Disabilities Act of 1988; P.L. 100-40720 U.S.C. Chapter 33, Section 1401.

Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of Educational Research, 64,* 37-54.

U.S. Department of Education, Office of Special Education and Rehabilitative Services. (2002, March). "Annual Report to Congress on the Implementation of the Individuals With Disabilities Education Act, Various Years, and Unpublished Tabulations; and National Center for Education Statistics, Common Core of Data Survey." Retrieved August 3, 2004 from http://nces.ed.gov/programs/digest/d02/tables/dt052.asp

Van Riper, C., & Emerick, L. (1984). *Speech correction: An introduction to speech pathology and audiology (7th ed.).* Englewood Cliffs, NJ: Prentice-Hall.

Vygotsky, L.S. (1978). *Mind in society: The development of higher mental process.* Cambridge, MA: Harvard University Press.

Walker, H. M., Schwarz, I. E., Nippold, M. A., Irvin, L. K., & Noell, J. W. (1994). Social skills in school-age children and youth: Issues and best practices in assessment and intervention. *Topics in Language Disorders, 14*(*3*), 70-82.

Weber, K. & Patterson, B. (2000). Student interest, empowerment and Motivation. *Communication Research Reports,* (*17*)1, 22-29.

Woolfolk, A. (1998) *Educational Psychology.* Boston: Allyn & Bacon.