PREMIER REFERENCE SOURCE

Communication Technology for Students in Special Education and Gifted Programs

Joan E. Aitken, Joy Pedego Fairley & Judith K. Carlson

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The editors dedicate this book to their life partners.

Rodger D. Palmer

Michael K. Fairley

Alex Kay Thompson

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Foreword

I suspect like many scholars, I began working on scholarship related to disability for a personal and practical reason. I had just started my doctoral work in the early 1980s with a focus in interpersonal and relational communication. Not long before this time, my cousin in another state had endured a terrible car accident and he was now experiencing paraplegia. I followed the news coming from different family members during my cousin's hospitalization and rehabilitation stays. The news was mostly about his physical condition--the nature of his injuries, his medical treatment, and prognosis for his recovery. There was honestly little mention of anything else. I wondered how he was doing psychologically and emotionally. Given my field of study, my mind started to turn to applied questions as I wondered about his life and how it might change. I wondered, did he have friends to support him? A girlfriend? How were the people in his life reacting and handling everything? I also started thinking about how I would (or should) interact with my cousin. Should I call him or visit? What should I say? Maybe more importantly, what should I not say?

Being a person who studied communication, I figured that the best way for me to address these questions was to hit the books. I scoured the literature and found information on physical adjustments to disability, independent living (a movement that was gaining steam at the time), and some fledgling comments about legislation that were being debated in Washington guaranteeing certain rights to persons with disabilities. However, I was more interested in the interpersonal part of all of this—what would help persons with disabilities in their everyday lives?

I found literature that seemed more geared toward the nondisabled, particularly an Attitudes Toward Disabled Persons scale that was being used to measure attitudes of different groups of people toward persons with disabilities. That just did not get at what I wanted to know. As I looked at the literature, it was fraught with disconnects. For example, one glaring problem was that researchers seemed to be talking *about* people with disabilities, but not *with* them concerning their own experiences. I found a couple of articles in my own field talking about self-disclosure, specifically prescribing that people with disabilities self-disclose to help nondisabled people feel less uncertain and hence more comfortable around them. That made some intuitive sense, but again this was from the perspective on the nondisabled persons—how would the prescription to self-disclose affect the person with the disability?

This question set me on the road to studying the social implications of disability, especially from the perspective of those experiencing disability themselves. I came to realize in my own work that becoming disabled was a process of cultural adjustment as one needed to adjust physically, psychologically, and socially (Braithwaite, 1990, Braithwaite & Braithwaite 2008). Another disconnect in the literature concerned that lack of focus on the social networks of persons with disability. It became important to realize and address that an individual person's disability is experienced and negotiated by a social web of family, personal, and community relationships, including schools and the medical community (e.g., Canary, 2008).

This volume, *Communication Technology for Students in Special Education Programs* edited by Joan E. Aiken, Joy Pedego Fairley, and Judith K. Carlson shines a light on the disconnects that often appear in Special Education, where the emphasis is on communication disorders, by expanding the view to include the social aspects of disability, specifically communication education to help those with different types of disability adjust and successfully manage interaction and relationships as members of this communicative culture. The authors in this present volume share a commitment to the latest assistive technologies but within the larger goal of encouraging and facilitating effective communication and relationships, yet the editors seek to bridge the disconnects they see in research and practice that takes an interdisciplinary approach, bringing those with expertise in special education, educational technology, and communication together. Authors in this volume help envision a future where approaches to research, teaching, and support for people experiencing disability come together in collaborative ways to provide resources for special education teachers and those committed to the lives and well being of persons experiencing disability and their social networks.

Dawn O. Braithwaite
University of Nebraska-Lincoln, USA

Dawn O. Braithwaite *(Ph.D., University of Minnesota) is a Willa Cather Professor of Communication Studies at the University of Nebraska-Lincoln. Her research focuses on how people in personal and family relationships communicate and negotiate family transitions and challenges. She studies family rituals, dialectical contradictions and change, and communicating social support for stepfamilies, voluntary kin, and people with disabilities. Dr. Braithwaite is the author of 80 articles in journals such as Journal of Social and Personal Relationships, Journal of Applied Communication Research, and Communication Studies, and has authored numerous chapters in scholarly books. Her five books include volumes with Leslie Baxter: Engaging Theories in Interpersonal Communication and Engaging Theories in Family Communication; and Handbook of Communication and People with Disabilities (with Teresa Thompson) and Case Studies in Interpersonal Communication (with Julia T. Wood). She was awarded the National Communication Association's Brommel Award for Outstanding Scholarship in Family Communication and the University of Nebraska College of Arts & Sciences Award for Outstanding Research in the Social Sciences. She is a Past President of the Western States Communication Association and has received the association's Distinguished Service Award. Dr. Braithwaite served on the Board of Directors of the Consortium of Social Science Associations in Washington DC. She was Director of the National Communication Association Research Board, before serving as the National Communication Association's President in 2010.*

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Preface

Communication technology offers new and increased opportunities for individuals with special needs. Technology facilitates such diverse possibilities for individuals as providing assistive communication for a child with cerebral palsy, increasing mobility for a child with a physical disability, improving social access for an adult with special needs, engaging a youth with attention-deficit hyperactivity disorder, or offering exploration on the Internet for a student with a behavior disorder.

For many people concerned about children and adults with exceptionalities, they learn about communication technology through teachers, social workers, therapists, and people who have similar needs. This book attempts to pull together ideas about using technology based on the experiences and expertise of teachers, researchers, and other professionals.

The purpose of this book is to provide ideas for enhancing education for students with exceptionalities. We hope to provide ideas and perspectives for educators and other service providers, parents, and future educators who work with students with special needs. We have brought together scholars from an interdisciplinary approach to the book's content.

The chapters provide an array of formats, including theoretical ideas, case studies about using communication technology for students who qualify for special education, research reports, opinion pieces, reviews of literature, and product information. The manuscript acceptance rate for this book was 42%. So, in these 26 chapters, you will find both scientific research and anecdotal experiences designed to give you a balance of ideas and perspectives.

SECTION 1: FOUNDATIONS AND THEORY-BUILDING

Chapter 1: An Overview of Inclusive Education in the United States

Mokter Hossain, University of Dhaka, Bangladesh and University of Nevada, USA

This chapter gives an introductory perspective to special education in the United States from someone who is from outside the USA. The author provides a foundation for the chapters that follow. In addition, it is interesting to see the elements the author identifies as important or unique in the USA system. How do a nation's laws and regulations affect the way special education services are approached and provided? How has special education evolved in the United States and elsewhere?

Chapter 2: Technology to Facilitate the General Education Curriculum

Cindy K. Sherman, University of Maryland, USA
Susan De La Paz, University of Maryland, USA

In *Effects of Technology in the Classroom*, Sherman and De La Paz discuss the use of information and communication technology (ICT) in the classroom and its benefits to students, both academically and socially. They report on studies that have shown where technology has improved academic skills as well as fostered collaborative learning and enhanced peer interaction.

In addition, the authors review specific information and communication technology for students with special educational needs. They discuss narrative analysis and how to use some specific programs (e.g., *TextEase2000,* Virtual History Museum, mPower). Reading, writing, historical facts, and collaborative skills can be learned through such programs. The authors discuss new possibilities regarding the use of communication technology and address the social and academic benefits of using this technology.

As you read this article you may want to consider the following: How effective is ICT in improving the overall quality of a struggling writer's compositions? Can ICT replace traditional classroom instruction? Does the use of technology affect how students feel about learning? What instructional supports are needed from the teacher to ensure student success in using instructional software? What are the positive implications for other learning contexts?

Chapter 3: Integrated Technology for Culturally Competent Communication in Urban Schools

Maura Wechsler Linas, University of Kansas, USA
Joan E. Aitken, Park University, USA

Linas and Aitken discuss strategies teachers can use to improve their communication with urban students. Many teachers perceive problems with students, when in fact they are reacting to cultural communication differences. Technology can be used to improve interaction. How can you tell the difference between cultural influences in communication and influences from a disability? In what ways can technology bridge faculty-student communication?

Chapter 4: Understanding Students with Special Needs Self-Disclosure in Internet Chat Rooms: Applying the Communication Privacy Management Theory to Internet Communications

Narissra Maria Punyanunt-Carter, Texas Tech University, USA
Stacy L. Carter, Texas Tech University, USA

This book chapter proposes a research agenda for determining, describing, and depicting special needs students' self-disclosure behaviors via the Internet in regards to the Communication Privacy Management Theory (formerly known as the Communication Boundary Management Theory). Internet, computer-mediated communication, chat rooms, self-disclosure, and The Privacy Management Theory are all identified and summarized. The theory is presented for its usefulness and significance studying self-disclosure in Internet chat rooms among individuals with disabilities. In addition, future research directions using the theory to study individuals with special needs' self-disclosure in Internet chat rooms are presented. Research presented in this chapter provides an overview of the impact of self disclosure on the Internet that will assist parents, teachers, and others who interact with individuals with disabilities.

The topic discussed in this chapter–application of the Communication Privacy Management Theory (CPMT) to examine self-disclosure via the Internet–offers a new perspective and significantly adds to the literature on self-disclosure in computer-mediated communication venues. The authors did a thorough job explaining the CPMT. Given the complexity of this potent approach to analyzing self-disclosure, it offers a rich array of research possibilities to examine self-disclosure in an alternative format, i.e., Internet chat rooms.

Some disabilities have characteristics of language impairments that impact the ability to develop and maintain interpersonal relationships. For example, individuals with Autism Spectrum Disorder, particularly those with Asperger Syndrome, have deficits in pragmatic language leading to problems with social interactions. As you read the chapter, consider how students might enhance their social interactions via digital communication. With the explosion of computer-mediated communication avenues--e.g., Facebook, Twitter—how do these ideas apply to other digital contexts?

Chapter 5: Using Spatial Constructivist Thinking Theory to Enhance Classroom Instruction for Students with Special Needs

Prince Hycy Bull, North Carolina Central University, USA

The emphasis in this chapter is on Spatial Constructivist Thinking Theory, which is the integration of pictures, animations, videos, color schemes, abstract plans, applets, graphics, and formatted text in a multimedia presentation to represent verbal and auditory concepts. Additional discussion revolves around Multiple Intelligences Theory and Constructivist Theory. What are some example projects and multi-media applications that interest you?

SECTION 2: ASSISTIVE TECHNOLOGY

Chapter 6: Wheelchairs as Assistive Technology: What a Special Educator Should Know

Judy L. Carroll, Munroe-Meyer Institute, USA

This innovative chapter gives important information about wheelchairs. The topic is unique in the book as it provides a focus for educators on how a wheelchair might affect a student as well as how the teacher can contribute to the management of this technology. The information is specific and valuable. How can you use this information to improve your interaction with students who use wheelchairs?

Chapter 7: Trial and Error with Assistive, Accessible, Augmentative Technology

Arthur W. Blaser, Chapman University, USA

In *Trial and Error with Assistive, Accessible, Augmentative Technology*, Blaser discusses his experiences with text to speech programs in teaching undergraduate university students. As you read this chapter, you may want to consider how some forms of instructional technology "level the playing field" between people with and without disabilities. You may also want to consider how some new technology can increase barriers and how individuals and organizations can facilitate or frustrate access.

Chapter 8: Voice/Speech Recognition Software: A Discussion of the Promise for Success and Practical Suggestions for Implementation

Andrew Kitchenham, University of Northern British Columbia, Canada
Doug Bowes, SET-BC, Canada

The authors discuss the promise and disappointment of assistive technologies and services, specifically speech recognition software. Helpful to students with special needs, assistive technologies can be used with all students. They may require an additional type of effort from the user, however. Student training and equipment maintenance are crucial for success.

In this chapter, the authors give practical advice and raise important issues about using technology. Even if you are already a user, the suggestions will improve your effectiveness with voice recognition software. What specific strategies can you use to increase the effectiveness of speech recognition software? How can a teacher ensure that a student doesn't see the process of learning and effectively using the software as an insurmountable task?

Chapter 9: A Guide to Assistive Technology for Teachers in Special Education

Harris Wang, Athabasca University, Canada

Everyone has the right to learn and to succeed in education. For people with certain disabilities, learning can be a challenging task, and proper use of certain assistive technologies can significantly ease the challenge and help the learners to succeed. For teachers in special education, identifying and understanding existing assistive technology is an important step towards the proper use of those technologies and success in special education.

In this chapter, Dr. Wang provides a guide for teachers about assistive technologies and their uses in special education. He discusses assistive technology for people with learning difficulties, assistive technology for persons with visual impairments and assistive technology for people with hearing difficulties. Since online learning with computers and the Internet is becoming a trend in distance education, the author also talks about assistive technology for distance education, with a focus on assistive technologies for Web-based distance learning, including assistive technologies for better human-computer interaction. How can you select more appropriate assistive technology for a given learner with a specific learning need?

Chapter 10: Assistive Technology: A Tool for Inclusion

Mary Spillane, Bellevue Public Schools, USA

In this chapter, Spillane gives specific ideas about using assistive technology to allow students to actively participate in all aspects of classroom instruction. The case study of a student with significant motor and communication impairments illustrates the application of these strategies in the general education setting. How do you plan to use assistive technology to promote inclusion in your classroom?

SECTION 3: PERSPECTIVES

Chapter 11: The Student with Complex Education Needs: Assistive and Augmentative Information and Communication Technology in a Ten-Week Music Program

Helen J. Farrell, The University of Melbourne, Australia

Farrell's work contains a great deal of interesting information and has an extensive reference list for the reader. This chapter gives a broad framework for a narrow case study in music. From an Australian perspective, the author explores research and theory from topics in several core academic disciplines that relate to the application of assistive and augmentative information and communication technology in programs in special education. Research and theory relating to qualitative inquiry and evaluation in special education are explored as well as ethical issues. Farrell discusses her findings from a five-student case study.

As you read the article, consider Farrell's inclusion of Gardner's Multiple Intelligences and her ideas regarding musical intelligence. How do you think the use of music with students can serve to enhance student learning?

Chapter 12: Communication Technology Integration in the Content Areas for Students with High-Incidence Disabilities: A Case Study of One School System

Anna S. Evmenova, George Mason University, USA
Michael M. Behrmann, George Mason University, USA

In *Communication Technology Integration in the Content Areas for Students with High-Incidence Disabilities*, Evmenova and Behrmann describe a case of how instructional and assistive technology is currently being integrated in content-based instruction in one large school system. From this chapter you will learn what low-tech and high-tech tools teachers use to enhance their teaching of students with learning disabilities and emotional/behavioral disorders. The top technologies used in elementary, middle, and high school settings in language arts, math, science, and social studies are discussed.

Evmenova and Behrmann offer an example of how technology integration is facilitated and supported in this model school system. Creative and innovative ways to use assistive and instructional devices and programs in academic areas are also provided. As you read this article, you may want to consider (a.) the status of existing research on assistive and instructional technologies for students with learning disabilities and emotional/behavioral disorders; (b.) existing technology-based tools to support students in reading, writing, math, science, social studies, and social skills learning; (c.) ways to facilitate and support an effective and extensive use of assistive technology in a school system; (d.) major low-tech and high-tech assistive technology devices and programs used by students with learning disabilities and emotional disorders in different grade levels across subject areas; (e.) the difference between instructional and assistive technology in special education; and (f.) emerging trends in technology integration based on teachers' creative ideas. How can you use the ideas presented?

Chapter 13: Signage as a Classroom Prompt: An Evidence-Based Practice?

Ian J. Loverro, Central Washington University, USA
David J. Majsterek, Central Washington University, USA
David N. Shorr, Central Washington University, USA

Loverro, Majsterek, and Shorr give insight into human response(s) during the use of positive, negative, or neutral signage to encourage desired behaviors. The article provides information to teachers and practitioners regarding the type of language that should be used when posting signage in their classrooms to promote positive and desired student behaviors.

The chapter is written in a reader-friendly style that uses pragmatic language rather than a formal research style of language. Teachers should immediately be able to put the information into use in their classrooms. What ideas can you implement for using signage to help students?

Chapter 14: Using Social Bookmarking to Make Online Resources More Accessible

Stein Brunvand, University of Michigan-Dearborn, USA

This chapter offers a strategy to make sure students are using the Internet effectively. Brunvand shows how this technique can make online resources an accessible reality for all learners. How can you use social bookmarking to make online resources more accessible?

Chapter 15: Reflections on Teaching Students with Special Needs in an Online Master's Program

Lora Cohn, Park University, USA

This article gives the perspective of a college faculty member working with students who have exceptionalities. Cohn finds that by adapting for students with special needs, she is able to improve instruction for all students. How can you apply the author's perspective to improve learning for all students in your programs?

Chapter 16: Using Tactile Prompts to Increase Social-Communicative Skills with Children with Autism

Judah B. Axe, Simmons College, USA

Although this chapter interprets "technology" in a broad context, Axe provides specific ideas about how to use tactile prompts for students with autism spectrum disorders (ASD). As social-communicative skills are a major indicator of general success for students with ASD, the strategies in this chapter gives help to those working with this increasing population. How can you use prompts to increase communication skills?

Chapter 17: Personal Reflections on the Educational Potential and Future of Closed Captioning on the Web

Sean Zdenek, Texas Tech University, USA

We think you will enjoy this chapter. It speaks to an important area of need for many people, including those from populations teachers don't readily think about because they are no longer in school, such as soldiers returning from overseas military duty and the elderly.

Teachers will find the information useful in meeting the needs of students with hearing loss, deafness, or no hearing loss. The chapter could be useful for some students who have auditory processing difficultly. The multiple Web references and citations make this article particularly appealing. We also appreciate the Web shot that was included within the text because it provides a perfect illustration regarding the author's perspective. If you are involved in Web work, how can you ensure that your site provides the best possible access for everyone who wants to use the site?

Chapter 18: Parental Communication About the Needs of Their Children: As Expressed in an Online Support Group

Joan E. Aitken, Park University, USA

Many students with disabilities have multiple exceptionalities. Sometimes a student with a disability has exceptionally high intelligence, creating unique challenges for adapting to the child's needs. This chapter examines an online support group for parents and families of students with double exceptionalities. A content analysis was conducted of more than 1000 emails from a listserv support group for parents, who seemed most concerned about the following: How to deal with professionals (e.g., teachers, physicians), family, testing, and diagnosis of disability, communicating with educators and the school context, Individualized Education Program (IEP) team meetings and reports, and family dynamics.

The findings suggest that the communication skills about which parents are most concerned are writing and reading. Less emphasis was placed on discussion regarding their children's listening, speech communication, and nonverbal communication. Additional concerns included diagnosis, parenting stresses, and communication with professionals. How could you go participate in a parent's group to gain insights into their concerns about services for their children? What can you do to increase your empathy and understanding of the family context?

SECTION 4: LEADING CHANGE

Chapter 19: Are You SMARTer Than a SMART Board™? How to Effectively Use This Technology Tool to Communicate in a Classroom with a Diverse Group of Learners

Mandi Sonnenberg, Rockhurst University, USA

Sonnenberg offers ideas about interactive white boards and how to use them effectively in classroom settings ranging from elementary schools through university classrooms. Many teachers still have little or no training in how to use this highly adaptable interactive technology. If you don't have access to a

Smartboard, what fundraising approach might you use to obtain the technology? Once you have access to the technology, how can you use the Smartboard to maximize effective instruction?

Chapter 20: Reading By Listening: Access to Books in Audio Format for College Students With Print Disabilities

Marni Gail Jones, Dickinson College, USA
Christopher L. Schwilk, Shippensburg University, USA
David F. Bateman, Shippensburg University, USA

The authors provide an incredible plethora of information for novice and experienced teachers and practitioners about the importance of using technology to assist students with special reading or print needs. The information on specific ideas about teaching strategies and resources is invaluable. Every teacher who instructs students with reading disabilities should have a copy of this chapter! We also found the case study section to be interesting as well as illustrative regarding various scenarios regarding student access to technology.

Topics of discussion include a definition of print disability, legal considerations, assistive technology, and reading while listening. The chapter gives information about more than a dozen specific technology packages and services, such as Kurzweil Readers, DAISY, Bookshare, and Digital Talking Books. The potential of such technology is considered in balance to the potential problems and setbacks.

Whether you are interested in school-age or life-long learning, this chapter will give you ideas you can use. As you read about the many options available to teachers and students of all ages, how will you ensure that students are able to use the services they need? What implications are there for students without diagnosed disabilities?

Chapter 21: Integrating Accessible Multiplication Games into Inclusive Classrooms

Cindy L. Anderson, Roosevelt University, USA

Anderson's chapter is straightforward regarding the design of the study. We were particularly impressed by the author's inclusion of student surveys to discover student impressions of the games and the helpfulness of their use in understanding math concepts. You may be interested in the snapshots of the games that were in use. They will help you understand how the games were played and lend insight into the student comments via the survey they participated in at the conclusion of the trial period.

There is an extensive literature review that can serve as a good resource to teachers and graduate students who are looking for additional information regarding the use of accessible math games. Additionally, the article provides a historical background of the concept of universal design, where and how it originated, and how differentiated instruction is essential to the success of students who would have, in the past, been sent to a resource room for daily math instruction.

Anderson provides an interesting study about using mathematical games for teaching. Although students who use the games and students who do not use the games all learn their multiplication facts, the use of gaming is an interesting way to involve students. When a study groups student data, there is no way to know if a specific teaching method is particularly successful with one individual student. For the student with a particular special need, do you think you could make learning more effective through the use of games?

Chapter 22: Do You See What I'm Saying? Ultrasound Technology as a Tool for Pronunciation Instruction

Bryan Meadows, University of Texas Pan-American, USA

This chapter is unique in the book and offers an excellent contribution. Even if you know nothing about this topic, if you have worked with student pronunciation, then you realize how extremely difficult this instruction is. What applications do you see as possible for helping students through this technology? You may want to do some research in your area to see if the technology can be made available for working in this way with students with disabilities.

Chapter 23: What Do You Do With a Digital Pen?

Judith Carlson, Rockhurst University, USA

Carlson provides an array of ideas about how teachers and students can use a digital pen to facilitate educational success. She discusses how the pen may be used to accommodate difficulties across content areas. Due to the cost factor and time required for set-up and maintenance, it is important that educators have a plan for appropriate implementation before investing in this technology. How can you make sure you are using this technology to its best advantage?

Chapter 24: Communication Technologies for Instructional Use: Linear and Nonlinear Tools Contributing to Student Learning

Seok Kang, University of Texas at San Antonio, USA

In this chapter about communication technologies as instructional tools, Kang discusses the effectiveness of communication technologies for teaching. Kang emphasizes that the efficiency of the tools depends on what and how they are used. Further, Kang addresses that learner characteristics and/or available facilities determine the effect of communication technologies as instructional tools. Kang introduces and assesses linear technologies such as Screenr® and Ispring® and nonlinear technologies such as Wimba®, Turning Technologies®, or Second Life®. Kang identifies advantages and possible disadvantages of the tools. Kang concludes that instructors can find the best-fit tools for their course objectives, materials, student ages, and difficulty levels. Which of these tools do you think would be the most useful to you? Do you find the forward rush of technology to be intimidating? What can you do to make sure you are using technology in the best ways possible?

Chapter 25: Teaching What We Don't Know: Failing to Adequately Prepare Teachers to Use Technology for the Benefit of Students with Special Needs

Joy E. Harris, University of Tampa, USA

Wendy Kaufman (2010), National Public Radio correspondent, recently reported that "one million (1,000,000) new technology-related jobs will be created over the next four or five years—an increase of about 10 percent." What this means is that today's teachers will be charged not only with preparing their students for these million new technology jobs but also for countless other jobs that heavily rely on technology. Harris discusses her perspective that teacher education (TE) programs are not adequately preparing their graduates to handle the task of educating typically-achieving students for the digital workplace. To make matters worse, the needs of students with exceptionalities are almost completely ignored by current TE programs.

Before you read this chapter, pause for a moment to think specifically about the technological literacy needs of students with exceptionalities in inclusive classrooms. Then, make a prediction of the number of hours you think that TE programs in general, spend educating teacher candidates how to help students with exceptionalities use technology effectively. Finally, predict the number of hours that TE programs, which specifically fall under the auspices of accrediting bodies, such as the National Council of Accreditation for Teacher Education (NCATE), require in this area. The answers may surprise you.

As you read the chapter, consider the following questions: What implications might there be for exceptional students growing up in a digital world when their teachers are not utilizing technology in pedagogically sound ways? What evidence exists that accredited teacher education programs produce teachers who are more highly prepared to teach students with exceptionalities in inclusive classrooms than non-accredited programs? How might teacher education programs be restructured so that the needs of students with exceptionalities are more effectively being met? What advantages might there be in infusing technology throughout teacher education programs as opposed to teaching technology in isolation? How many credit hours should teacher education programs require in the area of (a.) educational technology in general? (b.) educational technology for students with exceptionalities?

Chapter 26: Ten Hot Assistive Tech Websites That You Won't Want to Miss

Alex Thompson, Retired Consultant, USA

A search of the World Wide Web returns thousands of sites related to assistive technology. This final chapter provides an excellent starting point for your personal journey. These ten quality assistive technology websites create a roadmap for research into the complex field of assistive technology. What constitutes an important and useful website? What additional websites can you find that are particularly helpful?

ADDITIONAL INFORMATION

Finally, we have added abbreviations of many terms, a glossary of definitions, and information about the contributors. In this collaborative effort, the reviewers, authors, and editors have worked to provide you with up-to-date research, thoughts, and perspectives. We hope you will find important and useful ideas and information within these pages.

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Section 1
Foundations and Theory-Building

Chapter 1
An Overview of Inclusive Education in the United States

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ABSTRACT

Being a country of diversity, the United States has had a long tradition of research and practices in special education in the form of inclusion. Since passage of the Education for All Handicapped Children Act (EAHCA) of 1975, now referred to as the Individuals with Disabilities Education Act (IDEA) of 2004, a free appropriate public education has been available to all children with disabilities. However, inclusion of students with disabilities into general education classrooms has taken decades to be considered appropriate practice. Controversies, research, and legislation have shaped a collaborative relationship between general and special education. A wide range of political, epistemological, and institutional factors have facilitated a more child-centered public education. This chapter presents an overview of current issues and practices in the inclusion of students with disabilities in the U.S. The topics include: historical background; public laws that led to successful inclusion; categories and prevalence, and identification strategies; and inclusion practices for students with mild-to-moderate and selective significant disabilities for providing them equal and appropriate educational experiences in the mainstream classrooms.

INTRODUCTION

In today's schools students with disabilities who receive special education services are typically included in general education classrooms with their typically developing peers. Special education is not a place, but rather a set of instructional services. Further, *inclusion* is not just a place or a classroom setting either; it is a philosophy of education that integrates children with disabilities into educational settings in which meaningful learning occurs (Osgood, 2005). Inclusion means that all

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students, regardless of disability are included in the school community as valued members of the school. As valued members of the school, students with disabilities actively participate in the academic and extra-curricular activities of the school community; and they are given the instructional and behavioral support to succeed (McLeskey, Rosenberg, & Westling, 2009). Specifically, students with disabilities have access to the same educational opportunities as their peers. Unlike the dated practice of mainstreaming, in an inclusive classroom students are participating members of the general education classroom and do not belong to any other separate, specialized environment based on the characteristics of their disability (Halvorsen & Neary, 2009).

The period between 1900 and the 1970's is typically referred to as the *isolation phase*. Children with disabilities were segregated from their non-disabled peers for centuries. In the first half of the twentieth century, when the free public compulsory education began nationwide, students with moderate to severe disabilities were often denied the opportunity to receive equal treatment in the classrooms with their peers. Throughout the twentieth century educators, parents and activists have called for more equitable, *normal* treatment of these students.

Landmark legislation and litigation, significant political events, and the courageous advocacy of parents, teachers and educators shaped the *integration phase* of services for students with disabilities. The passage of the Education for All Handicapped Children Act (EAHCA) of 1975 made special education mandatory in the United States. Education for All Handicapped Children Act (EAHCA) was actually the first protection of American students with disabilities against discriminatory treatment by public education agencies (Wong, 1993). The Education for All Handicapped Children Act (EAHCA) of 1975 was modified several times to strengthen the protection of students with disabilities. It was renamed the Individuals with Disabilities Education Act (IDEA) in 1990 and reauthorized in 1997 and, again, in 2004. During this time the identification of integration of children with disabilities into mainstream life were paramount.

The current *inclusion phase* in special education was ushered in with the No Child Left Behind (NCLB) Act of 2001 and Individuals with Disabilities Education Act (IDEA) of 2004 reauthorization. The Individuals with Disabilities Education Act (IDEA) incorporates most of the No Child Left Behind (NCLB) requirements for students with disabilities. It emphasizes school accountability ensuring that students with disabilities have access to the regular classroom and are successful with the regular education curriculum. Together, Individuals with Disabilities Education Act (IDEA) and No Child Left Behind (NCLB) entitle all students to be included in the general education classroom to the greatest extent possible. Performance goals and indicators for students with disabilities were established to ensure expected outcomes. Schools are accountable for making sure students with disabilities achieve expected standards and that these students be included in district- and state-wide assessments (Hope, 2009; Gartland & Strosnider, 2004; Kleinert, Kennedy, & Kearns, 1999).

The term *inclusion* is not mentioned in any U.S. educational legislation, however. It is a practice that originated by special educators, disability activists, and the parents of children with disabilities. Inclusive practices are a merger between policy activism (Will, 1986), poor academic outcomes for children with disabilities in the late 1980's (Osgood, 2005) and more recent federal legislation. For decades, the central debate in the disability community focused on who should be considered disabled, how disability should be assessed and measured, and who should bear the responsibility for planning and providing an appropriate education for students considered disabled. Even, now in the twenty first century, controversies remain about the effectiveness of special education and appropriate use of inclusive practices.

The U.S. inclusive and special education supports and services are designed to meet the needs of all these students. Every general education classroom in the country has one or more students with disabilities. All public schools in the United States are responsible for instructing students with disabilities and other special needs (Friend & Bursuck, 2009). Intensity, structure, curriculum, collaboration, and monitoring/assessment have made the special education "special" in the United States (Kauffman & Hallahan, 2005). Now, about 75% of the students with disabilities spend all or part of their school day in the general education classrooms with their non-disabled peers. The remainder of the students with disabilities receive academic instruction in pull-out or self-contained classrooms or in residential or hospital placement (National Education Association [NEA], 2009). In addition, many students who do not have disabilities are getting additional support to succeed in the general education classrooms. Students who benefit from the inclusion and special education practices in the United States include students who are at risk for difficulty in school, students from diverse ethnic, cultural and linguistic backgrounds, students who are eligible for special education services under Individuals with Disabilities Education Act (IDEA) or Section 504, and even students who are identified as gifted and talented.

Establishing comprehensive inclusion practices is challenging, frustrating, time-consuming, and expensive, especially for the United States with its social, cultural, economic, religious, and ethnic diversity. This chapter presents a historical overview of successful inclusion practices for students with disabilities in the U.S.; including legislative actions supporting inclusion in the U.S.; prevalence and categories of students with disabilities in the U.S. classrooms; inclusion practices for students with mild-to moderate, and selective significant disabilities along with the intervention strategies for students of these groups for providing them equal and appropriate educational experiences in the mainstream classrooms followed by a conclusion that confers the impact of inclusion on public education system in the U. S.

LEGISLATIVE ACTIONS SUPPORTING INCLUSION IN THE U.S.

The United States, a country of social, ethnic, and linguistic diversity, has a long tradition of research and practice in special education and inclusive practices. The goal prescribed by special education legislation, Individuals with Disabilities Education Act (IDEA), is to provide all children with disabilities a free and appropriate public education. Moving from the goal of a free and appropriate education to meaningful inclusion has taken decades to achieve and is still a work in progress. A wide range of political, epistemological, and institutional factors have manipulated the practice of inclusion into the child-centered focus we see in today's classrooms. Several significant legislative and litigation events have propelled all children's access to a Free and Appropriate Public Education (FAPE). Other key issues such as efficacy, efficiency, community, legality, economy, power and identity, and axiology have shaped both the content and trajectory of the inclusion debates in the twentieth century.

The first law to address individuals with disabilities was passed in 1798. It dealt with the designation of a marine hospital to serve sailors with disabilities. This policy eventually resulted in the *Public Health Service* in the United States (Wong, 1993). The law was mainly designed to aid war veterans and focused primarily on disabilities related to the individual's service in the armed forces (Sheets, Wray, & Torres-Gil, 1993). In the 1920s, when free public compulsory education began nationwide, ironically, the universal attendance law was not applicable to students with disabilities. Students with disabilities were often denied the opportunity to receive their basic right of free public education. Only students with learning or behavior problems, mild-disability or minor physical impairments, whose needs were not considered extraordinary, were educated along with other non-disabled students in the public schools. Children with moderate disabilities were educated in separate residential schools, private agencies, or at home. Many children with significant intellectual or physical disabilities did not attend school at all (Kode, 2002).

During the first half of the 20th century, many states passed laws which prohibited students with disabilities from attending public schools (Yell, Rogers, & Rogers, 1998). Access to a U.S. public school education could be, and often was, withheld if a school district claimed it was unable to accommodate a student with special needs. This tradition of exclusionary practice was usually upheld in the courts. (McLeskey & Pacchiano, 1994). Many states passed laws that explicitly excluded students with certain types of disabilities from the public education system. The majority of students with disabilities were educated in segregated settings for most or all of the school day (McLeskey & Pacchiano, 1994). As a result of these legal practices only about 20% of children with disabilities received a free public education along-side their non-disabled peers (McLeskey, Rosenberg, & Westling, 2009).

Special education and inclusive practices emerged and grew rapidly in the late 20th century (Kode, 2002; Manton, Gu, & Lamb, 2006; Winzer, 1993*)*. Initially, mainstreaming was the preferred policy for integrating students with *mild disabilities* into general education settings. However, in a school that promoted mainstreaming, students with disabilities were assigned to special education classes with special education professionals. They were mainstreamed into general education classrooms and activities (art, PE, music, lunch, recess) for social integration with their non-disabled peers. In short, mainstreaming was part of a two system educational environment where special education and general education were separate. It should be noted that they were not concerned about creating separate but equal educational experiences. The practice of mainstreaming did not ensure active collaboration of students with disabilities with their non-disabled peers.

Until the mid 1980s, there was no guarantee that a child with a disability would receive an appropriate and free public education (Manton, Gu, & Lamb, 2006). The special education movement received a substantial boost when Public Law 94-142, the Education for All Handicapped Children Act (EAHCA), became a law in 1975 (Dorries & Haller, 2001). States did not need to be in full compliance with law until 1981. The Education for All Handicapped Children Act (EAHCA) of 1975 was the first U.S. federal legislation related to special education that took into account many of the early court decisions. Specifically, equitable assessment procedures were included in the legislation as a function of cases like Diana v CA Board of Education. Least Restrictive Environment (LRE) and Zero Reject emerged in Education for All Handicapped Children Act (EAHCA) in response to Mills v Board of Education and the PARC ruling. The original legislation was very sensitive and responsive toward the litigation efforts of the 1970's. The Education for All Handicapped Children's Act established the civil rights of students with disabilities and outlined the foundation on which current special education practices are built.

As with all legislation, the Education for All Handicapped Children Act (EAHCA) was not perfect. It was ground breaking and built a solid foundation for securing the education and privacy for all children with disabilities. The law was open to some interpretation and states were assigned the task of creating policy and guidelines for implementing the law (Williamson, McLeskey, Hoppey, & Rentz, 2006). In the early 1980's as states began full implementation of the Education for All Handicapped Children Act (EAHCA), it was clear that there was more work to be done.

The passage of the Education for All Handicapped Children Act (EAHCA) did not result in a termination of litigious efforts. In fact, litigious situations were commonplace as families and school districts struggled to interpret Least Restrictive Environment (LRE), Individualized Education Programs (IEPs) and related services. Subsequent legislation took into account the implementation struggles and included changes and revisions to future laws, specifically the Public Law 99-457, Education of the Handicapped Students Act Amendments (1986), Public Law 101-336, Americans with Disabilities Act (ADA) of 1990), Public Law 101-467, Individual with Disabilities Education Act of 1990, and its amendment in 1997, the No Child Left Behind Act (NCLB) of 2001. The evolution of education law is similar to how states and local districts have struggled to implement No Child Left Behind (NCLB). These challenges over assessment, Adequate Yearly Progress are now part of the dialog as the Elementary and Secondary Education Act (EASEA) or No Child Left Behind Act (NCLB) is undergoing reauthorization.

The Individuals with Disabilities Act of 1990 was an influential reauthorization of Education for All Handicapped Children Act (EAHCA). It strengthened the special education policy in the United States. It has had significant results in changing the way public schools refer, evaluate, identify, serve and discipline students with disabilities in the general education setting (Hope, 2009). Under Individuals with Disabilities Education Act (IDEA), children with disabilities, from age 3 to 21, are entitled to receive free and appropriate public educational services and support through their local school district. As a result of Individuals with Disabilities Education Act (IDEA), children with disabilities have been removed from segregated special education settings and integrated into general education classrooms and school activities (Dorries & Haller, 2001). According to the U.S. Department of Education (2002), Individuals with Disabilities Education Act (IDEA)

strengthens academic expectations and accountability for the nation's 5.8 million children with disabilities. Individuals with Disabilities Education Act (IDEA), also, bridges the gap that has too often existed between what children with disabilities learn and what is required in the regular curriculum.

Before Individuals with Disabilities Education Act (IDEA), 90% of children with developmental disabilities received an education in state institutions (U.S. Department of Education, 2000). During each of the 2001-06 school years, approximately six million students with disabilities received services under (IDEA) Individuals with Disabilities Education Act (U.S. Department of Education, 2007). According to the U.S. Department of Education (2002), the Least Restrictive Environment (LRE) mandate of Individuals with Disabilities Education Act (IDEA), accounts for the increased number of students with disabilities who attend colleges and universities. It is three times more when compared to pre-Individuals with Disabilities Education Act (IDEA) figures. The number of 20-year-olds with disabilities who are working successfully in the job-market has doubled (Dorries & Haller, 2001).

In 2004, Individuals with Disabilities Education Act (IDEA) and its provision of a free and appropriate public school education for all children with disabilities was once again reauthorized. This followed the re-authorization of Individuals with Disabilities Education Act (IDEA) in 1997 and is referred to as Public Law 108-446, Individuals with Disabilities Education Improvement Act (IDEIA) or Individuals with Disabilities Education Act (IDEA) of 2004. Individuals with Disabilities Education Act (IDEA) of 2004 is the most significant piece of legislation to assure that all children, regardless of their disability will be included in the Least Restrictive Environment (LRE) to the greatest extent possible (Swanson, 2008). Individuals with Disabilities Education Act (IDEA) of 2004 required local, state, federal and other education service agencies to have in effect policies and procedures which support the Least Restrictive Environment (LRE) mandate. Increased accountability for academic performance was included in the law. Individualized Education Program (IEP) provisions changed to assure that students were educated in the Least Restrictive Environment (LRE). Every level of public education must, also, provide the necessary support to meet the special needs of students with disabilities, to prepare students with disabilities for independent living and employment, and to ensure that the rights of children with disabilities and of their parents are protected (McLeskey, Rosenberg, & Westling, 2009). Individuals with Disabilities Education Act (IDEA) of 2004 replaces the old model for identifying children with Specific Learning Disability (SLD) and included a Response to Intervention (RTI) model (Kashima, Schleich, & Spradlin, 2009). The more dated discrepancy model used for identification is considered a "wait to fail" process. In this model children struggle in school over a period of time. If they are referred for special education assessment there must be a significant discrepancy between a child's intelligence quotient (IQ) (capacity to learn) and current achievement. This critical change to Individuals with Disabilities Education Act (IDEA) allowed states and local education agencies to provide "early intervening" services to students. RTI and the provision for early intervening services allowed schools to assist all struggling learners rather than wait until a child failed over a significant period of time. The law and the RTI provision allow schools and teachers to be more proactive in solving educational challenges (Klotz & Nealis, 2005). The components of Individuals with Disabilities Education Act (IDEA) reflect what all teachers and service providers should know and be able to do when teaching students with disabilities (Rosenberg, O'Shea, & O'Shea, 2006). In summary, the latest version of Individuals with Disabilities Education Act (IDEA) allows more flexibility for educators who work with students with disabilities and struggling learners. However, the law also calls for greater accountability in terms of academic progress and students' access to the general education curriculum with highly qualified teachers.

No Child Left Behind Act of 2001 (NCLB) is another comprehensive piece of legislation designed to improve the educational performance of all students in the United States. The Elementary and Secondary Education Act (ESEA) is the foundation of No Child Left Behind (NCLB). While No Child Left Behind (NCLB) does not specifically identify "inclusion" in its text, the law has nonetheless given an important boost to efforts to include children with disabilities into general classroom settings. No Child Left Behind (NCLB) mandates that the U.S. schools must be held accountable for educational outcomes for all students, including those within any category of disability(s). In this case, all means all. It affirms that all students need to have access to the general education classroom setting with a common curriculum if they are to successfully meet educational standards. Further, each and every student will be actively involved in the curricular and co-curricular activities and will be included in district-and state-wide assessment along with their non-disabled peers (Linn, Baker, & Betebenner, 2002). So, although inclusion was not a provision in No Child Left Behind (NCLB), the mandate to test all students and hold teachers and students accountable for educational outcomes opened the doors of general education classrooms. Logically, general education classrooms were the only setting that could help students reach these high standards.

No Child Left Behind (NCLB) mandates that states and schools set and meet high academic goals (Rollins, 2009). In ratifying No Child Left Behind (NCLB), the U.S. federal government asserted that some states were not doing enough to ensure that all students performed sufficiently, in particular those with special needs (Downing, 2004). Thus, the act requires states to reduce the discrepancy in performance between those groups of students who successfully achieve and those students who have had difficulties meeting standards due to their economic disadvantages, linguistic differences or disability status. It requires states to develop clearly defined goals, or proficiency standards, and then assess whether individual students and schools meet these goals. Although No Child Left Behind (NCLB) expects 100% proficiency by 2014, many educators assume that some students with disabilities will not be able to meet the same standards or at the same rate as their non-disabled peers (Ravitch, 2009; Robertson, 2009).

Section 504 of the Rehabilitation Act of 1973 (Public Law 93-112), and the Americans with Disabilities Act of 1990 (Public Law 101-336) are significant pieces of legislation that provide extended protections to children whose disabilities do not match the definitions under the Individuals with Disabilities Education Act (IDEA) statutes. Section 504 protects "students with: (a,) communicable disabilities; (b.) temporary disabilities arising from accidents; and (c.) allergies, asthma, or environmental illness" (McLeskey, Rosenberg, & Westling, 2009, p. 42). Section 504 also extends protections against discrimination beyond school settings to employment, social and medical services. It authorizes federal support for the rehabilitation and training of individuals with physical and mental disabilities. Unlike Individuals with Disabilities Education Act (IDEA), Section 504 does not require an Individualized Education Program (IEP) document for a student to be qualified with special needs. Under Section 504, a student is considered to have a disability if s/he functions as though having a disability (Rosenfeld, 1998). Fewer federal regulations, more flexibility of the procedures, and reduced procedural criteria required for school personnel can result in schools typically offering less assistance and monitoring with Section 504 (Rosenfeld, 1998; Russo & Morse, 1999). By eliminating barriers that exclude some students with disabilities from full participation in general education classrooms, Section 504 ensures appropriate educational services to children with any kind of disability.

The Americans with Disabilities Act (ADA) of 1990 provides nondiscriminatory protections to individuals with disabilities, in particular adults with disabilities. These include equal opportunity to participate fully in community life, equal opportunity to live independently, and accessibility to all buildings, homes, classrooms, offices, stores, and physical facilities. The Americans with Disabilities Act (ADA) applies to all segments of society--"education, employment, and recreation and only excludes private schools and religious organizations" (McLeskey, Rosenberg, & Westling, 2009, p. 43). Like Section 504, the Americans with Disabilities Act (ADA) uses a functional definition of disability. Without listing all possible conditions, Americans with Disabilities Act (ADA) defines a person with a disability as someone with a physical or mental impairment that limits participation in major life activities (Thomas & Gostin, 2009). Beyond education, the Americans with Disabilities Act (ADA) prohibits discrimination in employment, public accommodations, services operated by public and private entities, telecommunications, and miscellaneous provisions (Robb, 1992; Smith, 2001).

The concept of *inclusion* was first proposed in 1986 by Madeleine Will, the then-Assistant Secretary for the Office of the Special Education and Rehabilitative Services, under the U.S. Department of Education (Appl, 1995; Block & Vogler, 1994; Kubicek, 1994). Will (1986) termed her proposal, the *Regular Education Initiative* (REI) and underlined some unintended negative effects of special education "pull-out" programs and suggested some greater efforts to educate mild-to-moderately disabled children in mainstream general education classrooms. Will called upon general educators to become more responsible in educating students with disabilities and special needs in the regular classrooms (Jenkins, Pious, & Jewell, 1990). Whether her call for including students with disabilities was based on fiscal priorities or the well being of students with disabilities was fiercely debated (Reynolds, 1988). The timing of the initiative coincided with debates within the field of special education and disability studies. Specifically, many educators and researchers were dissatisfied with the results of efficacy studies measuring the educational outcomes for students with disabilities (Lipsky & Gartner, 1992). As a result ten years of debate surrounding inclusive practices followed. Through the broad concept of including, educating, and supporting students with disabilities in the general education classrooms with their non-disabled peers and preferably in the schools they would attend if not disabled, the inclusive education movement received a major focus and started to become popular in the U.S. news and public media (McLeskey, Rosenberg, & Westling, 2009). In recent years, inclusion is widely accepted, among U.S. general and special educators, disability activists, and parents of children with disabilities. The assurance of all civil rights to individuals regardless of their disabilities is also a focus in policy debates and applied practice. Thus, it is expected that *inclusion* continue to thrive and perhaps be more directly legislatively supported.

CATEGORIES AND PREVALENCE OF STUDENTS WITH DISABILITIES IN THE U.S. CLASSROOMS

Individuals with Disabilities Education Act (IDEA) of 2004 identifies a broad range of 13 categories of disability related to physical, social, cognitive, and sensory skills. It ensures every child with a disability will receive appropriate educational services (Porter, 2001). This includes children with disabilities such as autism, deaf-blindness, developmental delays, emotional/behavior disorders, hearing impairment, intellectual disability or mental retardation, multiple disabilities, orthopedic impairment, other health impairments, specific learning disability, speech or language impairment, traumatic brain injury, and visual impairments (Friend & Bursuck, 2009).

Currently, over six million school age children have identified disabilities. In 2002, the number of identified children crossed the six million threshold. More specifically, 11.4% of the U.S. school-age students (ages 3 to 21) are identified with disabilities. For purposes of simplification, some states use more general categories such as *mild-to-moderate disabilities* and *significant disabilities* or *high-incidence disabilities* and *low-incidence disabilities* respectively. The incidence rates of *mild-to-moderate* category of disabilities are relatively high and comprise a total of about 90% of all students with disabilities (U.S. Department of Education, 2007). This group includes most of the students with learning disabilities, speech or language impairments, mental retardation, emotional disturbance, autism, developmental delay and some students within other categories. However, the incidence rate of the *significant* category of disabilities is relatively low accounting for about 10% of all students with disabilities. This group includes students with visual impairment, blindness, deaf-blindness, multiple disabilities, or any severe disability.

According to statistics provided by the U.S. Department of Education (2007), in an average U.S. school with one-thousand students, approximately 114 students will be identified with a disability. Approximately 106 of those students will have mild-to-moderate disabilities while about 8 will have significant disabilities. This reveals that it is very likely that every U.S. classroom will have one or more students with a disability (NEA, 2009).

Table 1 represents the number of U.S. students, ages 6-21, identified with disabilities by Individuals with Disabilities Education Act (IDEA) by year and disability category in the fall of 2001 through the fall of 2006 school year. The table highlights learning disabilities as the most prevalent disability category followed by speech or language impairments, mental retardation or intellectual disabilities, emotional disturbance,

Table 1. Number of Students of Age Group 6-21 Identified With Disabilities Individuals With Disabilities Education Act (IDEA) By Year And Disability Category In Fall 2001 Through Fall 2006 School Year

	School Year					
Disability	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
	Number (Percent)					
Specific learning disabilities	2,878,319	2,878,554	2,866,916	2,839,295	2,782,837	2,710,476
	(49.11%)	(48.31%)	(47.43%)	(46.43%)	(45.53%)	(44.58%)
Speech or language impairments	1,093,222	1,110,858	1,127,913	1,149,573	1,156,906	1,160,904
	(18.65%)	(18.64%)	(18.66%)	(18.79%)	(18.93%)	(19.09%)
Mental retardation or intellectual disability	605,026	591,721	582,627	567,633	546,030	523,240
	(10.32%)	(9.93%)	(9.64%)	(9.29%)	(8.94%)	(8.60%)
Emotional disturbance	477,838	482,024	484,492	484,450	472,465	458,875
	(8.15%)	(8.09%)	(8.01%)	(7.93%)	(7.74%)	(7.54%)
Multiple disabilities	128,724	130,819	132,746	133,262	133,925	134,093
	(2.20%)	(2.20%)	(2.20%)	(2.18%)	(2.19%)	(2.21%)
Hearing impairments	71,225	71,962	72,023	72,599	72,407	72,559
	(1.22%)	(1.21%)	(1.19%)	(1.19%)	(1.18%)	(1.19%)
Orthopedic impairments	73,712	73,956	68,183	65,275	63,050	61,814
	(1.26%)	(1.24%)	(1.13%)	(1.07%)	(1.04%)	(1.02%)
Other health impairments	341,266	392,951	452,677	511,904	561,263	599,099
	(5.82%)	(6.59%)	(7.48%)	(8.38%)	(9.18%)	(9.87%)
Visual impairments	25,836	26,079	25,875	25,699	25,634	25,980
	(0.44%)	(0.44%)	(0.43%)	(0.42%)	(0.42%)	(0.43%)
Autism	98,589	118,846	141,142	166,473	193,810	224,565
	(1.68%)	(1.98%)	(2.33%)	(2.72%)	(3.18%)	(3.69%)
Deaf-blindness	1,608	1,600	1,664	913	755	723
	(0.03%)	(0.03%)	(0.03%)	(0.01%)	(0.01%)	(0.01%)
Traumatic brain injury	20,754	21,487	22,528	22,573	22,806	22,650
	(0.35%)	(0.36%)	(0.37%)	(0.37%)	(0.37%)	(0.38%)
Developmental delay	45,250	58,265	66,267	74,244	78,995	83,760
	(0.77%)	(0.98%)	(1.10%)	(1.22%)	(1.29%)	(1.39%)
All disabilities	5,861,369	5,959,122	6,045,053	6,116,379	6,113,471	6,081,890
	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)

autism, multiple disabilities, developmental delay, hearing impairments, orthopedic impairments, visual impairments, traumatic brain injury, and deaf-blindness respectively. Other health impairments cover a variety of disorders or diseases that include having limited strength, vitality or alertness that are caused by chronic or acute health problems such as Attention Deficit Hyperactivity Disorder (ADHD), asthma, diabetes, epilepsy, heart condition, hemophilia, lead poisoning, leukemia, nephritis, rheumatic fever, sickle cell anemia, etc. (Grice, 2002) These result in limited alertness with respect to the children's educational environment and sometimes adversely affect a child's educational performance.

Moreover, students who have not been identified with a disability, but may need additional support to succeed in the general education classrooms have benefitted from the inclusion and special education practices in the United States. This includes students who are at risk for difficulty in school, students from diverse ethnic, culture and linguistic backgrounds, students who are eligible for special education services under Individuals with Disabilities Education Act (IDEA) or Section 504, and even students who are identified as gifted and talented (McLeskey, Rosenberg, & Westling, 2009).

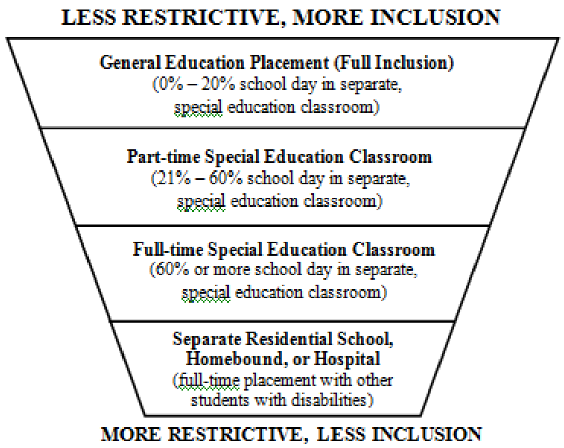
IDENTIFICATION STRATEGIES FOR STUDENTS WITH MILD-TO-MODERATE DISABILITIES

The concept of integrating children with disabilities into regular classrooms and educational settings and providing the support and adaptations to make them successful is a relatively new practice. Effective practices used in inclusive classrooms have been found to be beneficial for all students, including those with disabilities, those who struggle academically and socially and students without disabilities (Antonette, 2003). The first challenge, however, in planning appropriate inclusive structures and practices is to identify children with a disability and special needs and determine a suitable intervention program. There are general to specific strategies widely used to identify the type and level of disability. Until the 1990s, various traditional methods and standardized tests had been used by parents, pediatricians, classroom teachers, educators, physicians and concerned specialists to measure the existence and severity of a child's disorder or disability (Osgood, 2005; Ware, 2002). Measuring discrepancy level, screening, testing, observation, etc. were the most commonly used methods to measure a child's disability level. Sometimes, there had been discriminations and controversies about the accuracy and acceptance of these processes. Consequently, children with disabilities could be and very often were denied a free public education.

Fortunately, the Education for All Handicapped Children Act (EAHCA) of 1975 became the legislative landmark for special education in the United States. With the broader concept of Least Restrictive Environment (LRE), the Education for All Handicapped Children Act (EAHCA) became popular with disability activists and parents of children with disabilities as it ensured a free and appropriate public education to children with special needs (Williamson, McLeskey, Hoppey, & Rentz, 2006). The Least Restrictive Environment (LRE) aspect of the Education for All Handicapped Children Act (EAHCA) mandated that general and special educators would share accountability and responsibility for educating students with disabilities. It also entitles students with disabilities to be educated with their non-disabled peers to the greatest extent possible (Wong, 1993). The law, however, did not clearly state to what degree of disability the Least Restrictive Environment (LRE) would be applicable, so, in 2004, several litigations and reauthorizations determined the degree (Swanson, 2008).

The Individuals with Disabilities Education Act (IDEA) of 2004 entitles every child in the U.S. to a Free and Appropriate Public Education (FAPE) in the Least Restrictive Environment (LRE). The Least Restrictive Environment (LRE) is defined as one of the mandates of Individuals with Disabilities Education Act (IDEA) that govern a Free and Appropriate Public Education (FAPE) to all students with disabilities or special needs with their typical peers to the greatest extent possible. This means that students who have disabilities should have the opportunity to be educated with their non-disabled peers, should have full access to the general education curricular and co-curricular activities and to any other activity that their non-disabled peers would have access. Once placed in a setting with non-disabled peers the students should be provided with supplementary aids and neces-

Figure 1. Less restriction; the concept of inclusion in IDEA



sary services to achieve the expected educational goals. If the nature and severity of the student's disability prevent him/her from achieving these goals in a regular classroom setting, the student would be placed in a more restrictive environment, such as a special school or a homebound or a hospital program (Biklen, 1982; Dybwad, 1980; Turnbull, Turnbull, Shank, Smith, & Leal, 2002). In the Least Restrictive Environment (LRE), it is generally assumed that the more opportunity a student has to interact and learn with non-disabled peers, the less the placement is considered to be restricted (Kolstad, Wilkinson, & Briggs, 1997). Figure 1, adapted from McLeskey, Rosenberg, and Westling (2009), depicts that the less restriction yields more students be included in the general education placement which is considered as full inclusion.

To ensure a Free and Appropriate Public Education (FAPE), a team of professionals Multidisciplinary Teams (MDT) from the local school district meets with the parents of an individual student with disabilities to determine the appropriate placement and services and develop and modify annual goals. It may, also, be determined that a student needs other special supports such as counseling or testing accommodations. These are provided at no charge (Bolton, Quinn, & Nelson, 2004). The student's choices are recorded in a prescribed written document that is known as the Individualized Education Program (IEP). The Individualized Education Program (IEP) informs and guides the delivery of instructions and services required to fulfill the student's goals. It contains a student's current level of functioning, annual target, special education and related services, and the amount of participation in the general education environment (McLeskey, Rosenberg, & Westling, 2009). The parents become a part of the multidisciplinary team of the professions, and collaborate with them to become procedural safeguards for due process. The Individualized Education Program (IEP) enables the child with a disability to be involved in and make sufficient progress in the general education curriculum, as well as meet the child's other educational needs that result from the child's disability (Hope, 2009).

The U.S. federal and state education agencies, and the local school districts use Individualized Education Programs (IEPs) developed by the schools to determine the number of students requiring special education services. Funds are allocated to educate and support students with an Individualized Education Program (IEP). Finally, the school is required to implement the Individualized Education Program (IEP) and to meet the standards and requirements (Ahearn, 2006; Friend & Bursuck, 2009). A sample IEP document is shown in Figure 2.

INCLUSION PRACTICES FOR STUDENTS WITH MILD-TO-MODERATE DISABILITIES

As a result of Individuals with Disabilities Education Act (IDEA) of 2004, most children and youth with disabilities are now educated in their neighborhood schools in general education classroom settings with their non-disabled peers (U.S. Department of Education, 2007). The ser-

Figure 2. A sample Individualized Education Program (IEP) document

Name Daniel Doo	ID SE378	DOB 9/23/1992	Date of Meeting 7/12/2009

Communication Goals and Objectives

1) Annual Goal: Expressive Language

Daniel will improve his ability to make requests by using words/pictures/sign and will make a request using:
* words
* pictures
* sign

Objectives	Date	Progress	
1A. Context clues Daniel Doo will determine the meaning of unknown words by using context clues and the speaker's use of gesture and tone.	Beg: 7/12/2009	Date: Comments:	
	End: 7/12/2010	Date: Comments:	
Criteria for mastery: >= 7 Count On 80% of opportunities Measured on 5 sessions/days.		Date: Comments:	
Baseline:		Date: Comments:	
1B. Expressive Labeling D. will correctly label an object or a picture using an acceptable word approximation.	Beg: 7/12/2009	Date: Comments:	
	End: 7/12/2010	Date: Comments:	
Criteria for mastery: Correct On 80% of opportunities Measured on 5 sessions/days.		Date: Comments:	
Baseline: Shows picture and says "What is it?"		Date: Comments:	
1C. Manding: Words D. will make functional requests using his words when he needs/wants a target item 4 out of 5 times w/o prompting.	Beg: 7/12/2009	Date: Comments:	
	End: 7/12/2010	Date: Comments:	
Criteria for mastery: Wait Prompt On 80% of opportunities Measured on 5 sessions/days.		Date: Comments:	
Baseline:		Date: Comments:	
1D. Word Approximation D will correctly produce a word when given a verbal model 4 out of 5 times.	Beg: 7/12/2009	Date: Comments:	
	End: 7/12/2010	Date: Comments:	
Criteria for mastery: Correct On 80% of opportunities Measured on 5 sessions/days.		Date: Comments:	
Baseline:		Date: Comments:	

Not Evident (NE) Skill/behavior rarely or never demonstrated even with sufficient prompts or cues.
Emerging (E) Skill/behavior is demonstrated inconsistently, and progress is insufficient to meet mastery goal.
Sufficient Progress (SP) Skill is demonstrated consistently over time and is on track to meet mastery goal.
Proficient (P) Skill/behavior is demonstrated to the level specified in the student's IEP.
Not Attempted (NA) Skill/behavior was not attempted during the reporting period.

vices required for students with disabilities vary according to the nature of the disability and to the category. The degree that a student with a disability is included in the general education classroom or in the special education classroom is determined by the nature and degree of his/her disability.(Table 2)

At the elementary and secondary levels, the degree of inclusion also depends on the student's age and grade level. Figure 3 represents how inclusion differs for the students with disabilities by their age group (U.S. Department of Education, 2007).

Table 2. Percentage of Students Ages 6 Through 21 With Disabilities Receiving Special Education And Related Services In Different Environments By Disability Category In Fall 2003

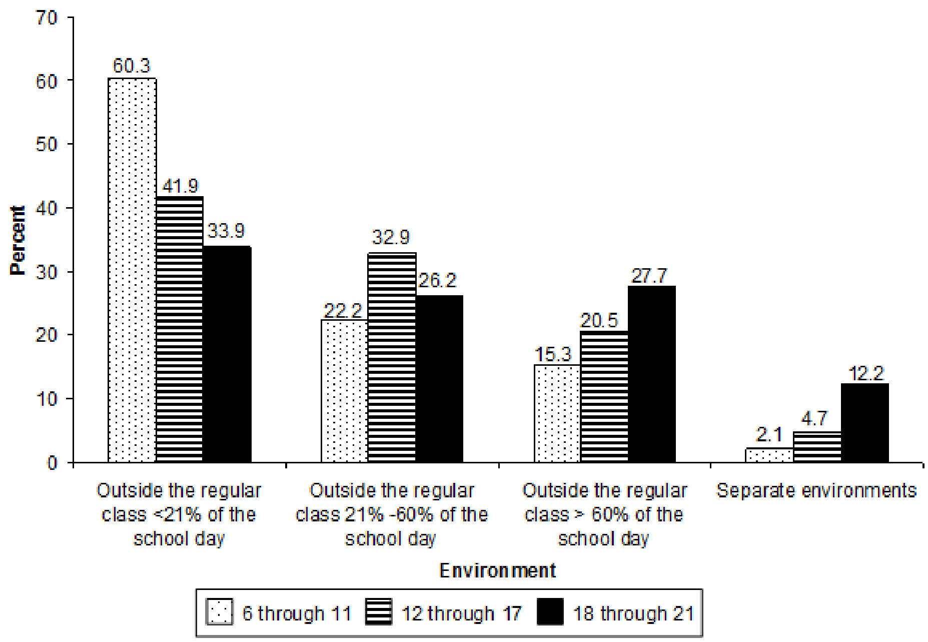
	Time outside the regular class			
Disabilities	**<21 percent of the day**	**21-60 percent of the day**	**>60 percent of the day**	**Separate environments[a]**
	Percent			
Specific learning disabilities	48.8	37.3	13.0	0.9
Speech/language impairments	88.2	6.8	4.6	0.4
Mental retardation or intellectual disability	11.7	30.2	51.8	6.3
Emotional disturbance	30.3	22.6	30.2	16.9
Multiple disabilities	12.1	17.2	45.8	24.9
Hearing impairments	44.9	19.2	22.2	13.7
Orthopedic impairments	46.7	20.9	26.2	6.2
Other health impairments	51.1	30.5	15.0	3.5
Visual impairments	54.6	16.9	15.6	12.8
Autism	26.8	17.7	43.9	11.6
Deaf-blindness	22.2	13.9	33.6	30.3
Traumatic brain injury	34.6	29.9	27.1	8.4
Developmental delay	51.2	28.2	18.6	2.0
All disabilities	49.9	27.7	18.5	3.9

[a]Separate environments include public and private *residential facilities*, public and private *separate schools* and *homebound/hospital* environments.

Source: U.S. Department of Education, 2007

Learning disabilities is the most prevalent category of mild-to-moderate disabilities. It ranges from 44% to 49% of all students with disabilities or about 5% of the school-aged population in the United States (U.S. Department of Education, 2009). Although it is still unknown what causes most learning disabilities, it is assumed that these disabilities are somehow related to abnormal brain function and cognitive skills deficits related to memory, attention, and/or metacognition (Fletcher et al., 2001). Students with learning disabilities may have difficulty in remembering information, using appropriate strategies to learn, and attending to important content (Mastropieri & Scruggs, 1997; Winebrenner, 2003). Learning disabilities are mainly identified in students with unexpectedly low academic achievement with about 80% of learning disabilities being in reading with the remainder in mathematics and written expression (McLeskey, Rosenberg, & Westling, 2009). Students with learning disabilities are identified by academic tests. Intervention strategies are designed according to grade level. At the elementary level, students with learning disabilities are given high-quality core instruction in the general education classroom, additional time to help them learn key academic content and differentiated instruction (Gibson, 2005; McLeskey, Rosenberg, & Westling, 2009). If the student with a disability continues to struggle, he/she is closely monitored and given additional integrated instruction in the academic areas needed. Classroom teachers frequently monitor the students' academic progress to ensure that they attend to and actively engage in tasks. The teachers also adjust their instruction based

Figure 3. Percentage of Students Ages 6 Through 21 With Disabilities Receiving Special Education And Related Services In Different Environments By Age Group In Fall 2003



on the students' performance. At the secondary level, students with learning disabilities require diversified instructions (McLeskey, Rosenberg, & Westling, 2009). Thus, whenever possible, they receive instruction through a co-teaching approach which combines the knowledge and skills of a general education and a special education teacher. Instruction focuses on critical content ensuring that all students learn the content in depth (Santamaria & Thousand, 2004). Teachers also use curriculum maps and unit plans to determine the content that students should learn (Jitendra, Edwards, Choutka, & Treadway, 2002). To frame and guide instruction, teachers use big ideas that help students learn and remember main concepts and facts related to the topic. To explicitly present important contents to students, teachers are encouraged to use intervention strategies such as graphic organizers and content-enhancement routines. When learning new information students with learning disabilities are provided additional support through *instructional scaffolding methods,* such as outlines, recommended documents, storyboards, or key questions. These instructional strategies promote cognitive, affective and psychomotor learning skills and knowledge. Additionally, students with learning disabilities at the secondary level are provided explicit strategies to increase their study skills, test-taking skills, receive assignment completion tips, and self-advocacy and follow-up instructions (McLeskey, Rosenberg, & Westling, 2009).

Speech and language impairment (SLI) is the second most prevalent category of students with disabilities that covers about 19% of all students with disabilities in the United States (U.S. Department of Education, 2009). Speech disorders include problems related to the verbal transmission of messages. Language disorders include problems in formulating and comprehending spoken messages. These disorders range from simple sound substitutions to the inability to understand or use appropriate language. Also included are specific communication disorders such as stuttering, impaired articulation, or voice impairment. These speech and language disorders are determined to adversely affect a child's educational performance (National Association of Parents with Children in Special Education [NAPCSE], 2004). Speech and language disorders are often identified by parents, pediatricians, and preschool teachers. Many students who exhibit minor speech or language disorders at an early age successfully overcome the problem with or without therapy. However, approximately half of these students continue to experience the speech or language problem throughout their elementary school years and even into high school and adulthood. Students who exhibit language disorders beyond their preschool years are more likely to be classified as having learning disabilities, intellectual disabilities, or emotional and behavior disturbance (McLeskey, Rosenberg, & Westling, 2009; Owens, Metz, & Hass, 2003). They could have trouble in expressing ideas, responding appropriately to questions and comments, using appropriate social language, initiating conversation with their peers, and demonstrating appropriate conversational participation (Justice, 2006). Nevertheless, about 90% of students with speech or language impairment are educated in general school classrooms (McLeskey, Rosenberg, & Westling, 2009). At the elementary level, teachers work collaboratively with speech and language therapists to help them achieve social skills. At the secondary level, teachers help students with speech and language disorders by allowing students adequate time to express their ideas, to ask questions, and to comment, by positively reinforcing students to use appropriate communication techniques, and by directly instructing students on key communication skills (McLeskey, Rosenberg, & Westling, 2009).

Mental retardation or intellectual disability is the third most prevalent category of mild-to moderate disabilities. Students within this category cover about 10% of all students with disabilities in the United States (U.S. Department of Education, 2009). The American Association on Intellectual and Developmental Disabilities (AAIDD) characterizes these groups of students having "significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills" (McLeskey, Rosenberg, & Westling, 2009, p. 119). Students with intellectual disabilities may have difficulty understanding non-verbal cues (e.g., body language, gestures), verbal interactions and social-communicative behaviors (Broer, Doyle, & Giangreco, 2005). Students with severe intellectual disabilities may exhibit challenging behaviors such as aggressive or stereotypic behaviors, self-injurious behaviors, or noncompliance. Intellectual disabilities originate before age 18, and are identified in students with significantly low scores on standardized intelligence tests and weakness in adaptive behavior. Providing necessary learning facilities and functional skills in the general academic curriculum are the major challenges of including students with intellectual disabilities in the general education classrooms. At the elementary level, general curriculum based academic skills are taught which include the skills identified on the Individualized Education Program (IEP) and functional skills whenever necessary (Ahearn, 2006). Students with intellectual disabilities are taught specific social behavior concerning how to interact appropriately with their non-disabled peers and how to respond appropriately with other students with disabilities. In some states, teachers develop general curriculum based specific objectives and use functional behavior assessment (FBA) and behavior intervention plans (BIPs) to improve more challenging behavior (McLeskey, Rosenberg, & Westling, 2009). At the secondary level, many students with intellectual disabilities become interested in specific subjects or skills. Thus, they are given special support to help them become successful in their interested areas which include educational settings, vocational settings, living facilities, and skills related to success in these settings (Kleinert, Miracle & Sheppard-Jones, 2007). Adolescent students at this level are also taught social skills focused on developing friendships and peer relationships, knowledge of sexuality, and skills for improving self-determination (McLeskey, Rosenberg, & Westling, 2009).

Emotional and behavioral disorder (EBD) is another major category of students with mild-to moderate disabilities which cover about 8% of all students with disabilities in the United States (U.S. Department of Education, 2009). Students with EBD have pervasive and emotional behaviors that differ significantly from appropriate age, culture or ethnic norms. Some students with EBD primarily express externalizing behavioral problems such as aggression, noncompliance and rule breaking. Other students with EBD exhibit internalizing behavior problems such as anxiety, depression, and social withdrawal. These behaviors affect their educational performance adversely. Token economies (Rosenberg, Sindelar, & Hardman, 2004) and social skill development programs (Meadows & Stevens, 2004) are also popular and effective in helping students with EBD develop social skills such as friendship making and dealing with frustration.

Autism Spectrum Disorders (ASD) is another category of mild-to-moderate disabilities that ranges from 2% to 3% of all students with disabilities in the United States (U.S. Department of Education, 2009) or 0.21% of the school-age population (McLeskey, Rosenberg, & Westling, 2009). Students with autism spectrum disorders (ASD) often exhibit several symptoms of the disability, including: significant limitations in expressive and receptive skills, difficulties in social reciprocity, repetitive, stereotypical, and ritualistic behaviors (Philofsky & Fidler, 2007; White & Hastings, 2004). The cause of autism spectrum disorders (ASD) remain uncertain, although it is assumed that they are the result of one or more nature-based factors such as genetic, neurobiological, and neurochemical irregularities. Most of the students with autism spectrum disorders (ASD) face lifelong and chronic disorders and ongoing problems with social interaction, job and independent life skills (McLeskey, Rosenberg, & Westling, 2009; Sansoti, 2010; White, Oswald, Ollendick, & Scahill, 2009). Thus, early intervention is required to help this type of student transition to postsecondary or higher-level education. At the elementary level, students with autism spectrum disorders (ASD) are instructed based on individualized needs that emphasize basic academic skills, social behavioral functioning, and language development. Applied behavior analysis (ABA), argumentative and alternative communication (AAC) strategies, and social skills instruction methods are used in teaching elementary students with autism spectrum disorders (ASD). In addition to basic academic, social, and language skills students with ASD in the high school grades or secondary level are given specialized instructions that focus on subject-area content, vocational training, and transition to post-school activities (McLeskey, Rosenberg, & Westling, 2009).

INCLUSION PRACTICES FOR STUDENTS WITH SIGNIFICANT DISABILITIES

There are only about 10% of school-age students with significant disabilities in the United States. These groups of students include severe physical disabilities or other health impairments such as visual impairment (about 0.4%), deaf-blindness (.01% to.03%), hearing impairments (about 1.2%), traumatic brain injury (about 0.37%), multiple disabilities (about 2.2%), or any severe disability. These groups of students have relatively mild to severe physical conditions; some have sensory and physical impairments, and many have serious medical conditions. Thus, these are the most challenging groups of students to educate within the public school settings. They are initially identified by their parents and/or physicians. After identification, educational personnel evaluate the student with a significant disability as to what kind of special education services or accommodations are necessary to educate them. The majority of students with a significant disability are educated in general education classrooms with supportive devices or special accommodations for most or part of the school day. However, some are best served by placement in separate schools or in special classes for most of the school day. Some students with full visual or hearing impairment are served in residential schools.

At the elementary level, most of the students with significant disabilities are taught with the general education curriculum. Some students with significant learning disabilities or severe-to-profound intellectual disabilities, though, need additional learning support, modified curriculum and systematic instruction. Many students with physical or multiple disabilities are provided assistive technology devices. When students with health impairments miss a number of classes, they are given additional support or instruction to make up their missed classes. These groups of students may have individualized health care plans (IHCPs) requiring collaboration between the classroom teachers, the physical therapists, occupational therapists, and school nurses. In addition to these strategies, these groups of students at the secondary level are given special instruction in content areas to promote their participation in the curriculum. They are given special consideration to their individual strengths and weaknesses as they consider future schooling or job possibilities.

CONCLUSION

Providing services to all students with disabilities with their non-disabled peers in the general education classrooms is a challenge for any country. In the United States at least one in every ten school going child is identified with some type of disability. Through the passage of a wide range of legislations including Education for All Handicapped Children Act (EAHCA) of 1975, Americans with Disabilities Act (ADA) of 1990, No Child Left Behind (NCLB) of 2001, Individuals with Disabilities Education Act (IDEA) 2004, and a long tradition of research and practices, the United States is said to be successful in providing a free and appropriate public education to all students regardless of their disability status. Although the term *inclusion* is not mentioned in federal legislation, the intent of law has become a reality. The U.S. inclusion movement considers the education and instruction of all students with disabilities to be a fundamental right. This movement has made both the general and special education teachers responsible and accountable to instruct these students with their peer groups. The collaboration between the general and special educators ensures that students with disabilities will receive the appropriate support and services to adequately achieve academic, social, and life skills. Moreover, many students who do not have disabilities but need additional support to succeed are being educated in general education classrooms. Consequently, almost all school-going children in the United States are being educated in their neighborhood schools in the general education classroom settings.

The nature of a student's disability determines the services required in order to educate them. These services and interventions are not the same at each educational level. Different approaches and intervention strategies are implemented at the elementary and secondary levels. At the elementary level, students with mild-to-moderate disabilities are mostly placed in general education classroom settings for most of the school day. Some students are placed in special classes for part of the school day. Only a few are placed in separate special classes with an alternative curriculum for most of the school day. They are helped to achieve adequate academic and social skills. At the secondary level, these students are given special support toward becoming successful with developing friendships, peer relationships, and knowledge about sexuality. Students with a significant level of disability are the most challenging group to educate within the public school system. At the elementary level, most of them are included in general education classrooms for most or part of the school day. Many, though, are placed in separate schools or in special classes for most of the school day. A few of them are served in residential schools or hospital settings with modified curriculum and systematic instruction. In addition to these strategies, at the secondary level, these groups of students are given special instruction in content areas in order to promote their participation in future schooling or job possibilities.

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KEY TERMS AND DEFINITIONS

Americans with Disabilities Act of 1990 ADA: The Americans with Disabilities Act of 1990 provides nondiscriminatory protections to individuals with disabilities, in particular adults with disabilities. ADA applies to all segments of society including education, employment, public accommodation, telecommunications, and services operated by public and private entities, only excludes private schools and religious organizations.

Education for All Handicapped Children Act of 1975 (EAHCA): The Education for All Handicapped Children Act of 1975 made special education mandatory in the U.S. It was the first protection of American students with disabilities against discriminatory treatment by public education agencies.

Individuals with Disabilities Education Act of 1997 (IDEA): Stands for the Individuals with Disabilities Education Act of 1997 and its amendment in 2004 ensures students with disabilities have access to the regular classroom, and will be successful with the regular education curriculum. Under IDEA, children with disabilities, from age 3 to 21, are entitled to receive free and appropriate public educational services and support through their local school district.

Inclusion: Inclusion is a philosophy of education that integrates children with disabilities into educational settings in which meaningful learning occurs. Inclusion is not just a place or a classroom setting either; rather it means that all students, regardless of disability are included in the school community as valued members of the school.

Least Restrictive Environment (LRE): *Least Restrictive Environment* is a mandate that entitles students with disabilities to be educated with their non-disabled peers to the greatest extent possible. This means that students who have disabilities should have full access to the general education curricular, co-curricular, and any other activities that their non-disabled peers would have access.

Mild-to-Moderate Disabilities: This category of disabilities includes most of the students with learning disabilities, speech or language impairments, mental retardation, emotional disturbance, autism, developmental delay and some students within other categories.

No Child Left Behind Act of 2001 (NCLB): The No Child Left Behind Act of 2001 is a comprehensive piece of legislation designed to improve the educational performance of all students in the U. S. It mandates that the U.S. schools must be held accountable for educational outcomes for all students, including those with any type of disabilities.

Section 504: Authorizes federal support for the rehabilitation and training of individuals with physical and mental disabilities. Under Section 504, a student is considered to have disability if s/he functions as though having a disability. It also extends protections against discrimination beyond school settings to employment, social and medical services.

Significant Disabilities: This category of disabilities includes students with visual impairment, blindness, deaf-blindness, multiple disabilities, or any severe disability.

DISCUSSION QUESTIONS

1. **Identify the U.S. major legislative actions supporting inclusion for students with disabilities.** Public Health Service Act of 1798; Education for All Handicapped Children Act (EAHCA) of 1975; Individuals with Disabilities Act of 1990; Individuals with Disabilities Education Act (IDEA) of 1997; Individuals with Disabilities Education Act (IDEA) of 2004; No Child Left Behind Act (NCLB) of 2001; Section 504 of the Rehabilitation Act of 1973; and Americans with Disabilities Act (ADA) of 1990 are the most significant pieces of legislative actions supporting inclusion for the students with disabilities in the United States. For more detail about these regulations see the corresponding section of this chapter.
2. **Without the words being included in a federal law how did special education in the U.S. get its inclusive format?** The term *inclusion* is really not mentioned in any U.S. legislation. However, the nonbiased and effective practices of supports and services designed for the students with disabilities have made the special education *inclusive* in the United States. For more detail, see the introductory section of this chapter.
3. **What are the most prevalent categories of disabilities found in the U.S. classrooms?** There is a broad range categories of disabilities found in the U.S. However, the Individuals with Disabilities Education Act (IDEA) of 2004 has categorized them into 13 major categories that are most prevalent in the U.S. classrooms. These include: autism, deaf-blindness, developmental delays, emotional/behavior disorders, hearing impairment, intellectual disability or mental retardation, multiple disabilities, orthopedic impairment, other health impairments, specific learning disability, speech or language impairment, traumatic brain injury, and visual impairments. For more details, see Table 1.
4. **How are students with mild-to-moderate disabilities identified and treated in U.S. classrooms?** Students with mild-to-moderate disabilities are identified through some organized and scientific concepts and procedures embedded with the recent legislative actions, which provide supports and services to the students with disabilities. These include the Least Restrictive Environment (LRE) that govern a Free and Appropriate Public Education (FAPE) to all students with disabilities; Individualized Education Program (IEP) documentation that depicts support and services needed for the students with disabilities; and the procedure for the Section 504 of the Rehabilitation Act of 1973 and Americans with Disabilities Act (ADA) of 1990. According to the information and instructions provided in these documents, students with disabilities given appropriate support and services can better fulfill their goals. For more information about the procedures and practices, see the identification strategies and inclusion practices sections of this chapter.
5. **Discuss briefly, how less restriction has implied more inclusion in the U.S. education system**. As defined initiated in the Education for All Handicapped Children Act (EAHCA) of 1975 and elaborated in the Individuals with Disabilities Education Act (IDEA) of 2004, the Least Restrictive Environment (LRE) governs a Free and Appropriate Public Education (FAPE) to all students with disabilities or special needs so that they are educated with their typical peers to the greatest extent possible. You will see in Figure 1, how when less restriction is used in selecting students with disabilities, more students receive the opportunity to be placed in the general education classrooms for most of their school time.

6. **Download an example IEP document from the Internet and identify its main components.** To find a sample IEP document on the Internet, select the *Images* tab in the Google search page, and use the keyword *sample IEP documents* or *IEP forms*. You will find many samples. Download a sample IEP document that is compatible with the Figure 2. Then compare them by identifying their main components such as student's name, date of birth, date of meeting, annual goal, objectives, dates, and progress comments.

Chapter 2
Technology to Facilitate the General Education Curriculum

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ABSTRACT

Information and Communication Technology is becoming an essential learning tool for teachers and students in the classroom. The use of Information and Communication Technology scaffolds learning in a pedagogically meaningful way and gives students with learning disabilities more equal opportunities in school. This chapter discusses ways in which Information and Communication Technology benefits students with special educational needs, both academically and socially. Various computer applications create greater possibilities for inclusion by fostering collaborative learning and enhancing peer interaction. New technology also allows students more autonomy in the writing process and helps students develop historical thinking skills.

INTRODUCTION

This chapter highlights specific applications in which Information and Communication Technology has been used to support students with special education needs. The use of Information and Communication Technology has been shown to scaffold student learning in a pedagogically meaningful way and has given students with learning disabilities more equal opportunities in school (Lipponen & Lallimo, 2004; Mavrou, Lewis, & Douglas, 2010). Use of several computer applications has led to greater possibilities for inclusion by fostering collaborative learning and enhancing peer interaction (Gillies & Ashman, 2000; Mavrou, Lewis, & Douglas, 2010). For students with more severe learning problems, Information and Communication Technology provides exploratory environments for learning that may otherwise not be available (Florian &

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Hegarty, 2004). Recent examples of Information and Communication Technology that have been beneficial for students with special educational needs will be reviewed in this chapter.

NARRATIVE ANALYSIS

Faux (2005) investigated ways in which middle school students with special educational needs used an Information and Communication Technology multimedia environment to produce stories. This author used a multimedia authoring software (*TextEase2000*) to assist students in their writing. Instruction was divided into two phases. Each phase consisted of six lessons: (a.) overview of the software and developing a resource bank, (b.) making collages to be used in the story, (c.) learning to use a scanner, (d.) video-recording acting and importing video clips into the software, (e.) adding components to the resource bank and starting the story, and (f.) completing the story. The purpose of the first phase was to teach students how to use the software. Thus, activities were based on work with which the students were familiar (i.e. *Beowulf* and *The Pied Piper*). During the second phase students were asked to write their own stories based on the theme of "finding things." Students were asked to develop their own resource bank before writing their story. Disposable cameras were distributed and a story plan was provided to help students map out their ideas. Checklists were also provided to ensure that students considered all available multimedia components. The results of this study indicated that while two of the three students found it difficult to move away from a traditional way of writing, they were able to take advantage of certain aspects of the multimedia approach to create an interactive story or convey the genre. The third student relied entirely on the multimedia approach; this child used multimedia as a narrative device to develop an interactive story. Because the program offered written, aural, and pictorial representations, students were able to capitalize on their areas of strength. Faux's research suggested that the multimedia software allowed students to create high-quality presentations, and contributed to students working more autonomously. She also found the software to be effective in scaffolding instruction, particularly in relation to spelling. In the end, the use of Information and Communication Technology enabled students to experience using language for information-giving purposes--modeled and scaffolded by the teacher/researcher--which consequently augmented their thinking and learning.

Bouck and colleagues (Bouck, Okolo, Englert, & Heutsche, 2008) examined the relationship between a Web-based instructional environment and the cognitive apprenticeship of students with special educational needs into the discipline of history. The authors developed the Virtual History Museum, a Web-based history-learning environment that uses the metaphor of a museum, in which teachers and students take on the roles of curator, members, and guests (Okolo, 2006). As museum curators, teachers select artifacts and create their own exhibits in the Virtual History Museum. Artifacts include primary and secondary sources, written documents, images, sound clips, and video. Students are then given the opportunity to respond to each exhibit in activity settings based on the analysis and interpretation of the exhibit (Bouck, Courtad, Heutsche, Okolo, & Englert, 2009). Bouck and colleagues (2008) examined the impact of the Virtual History Museum with middle school students with high-incidence disabilities. Two history units were created within the Virtual History Museum. Students experienced the exhibits, teachers facilitated student discussion, and students were asked to complete activities based on their interpretations and synthesis of the exhibits. In the final session, students were also asked to write a position paper and give their opinions on the subject matter. Data were collected through interviews, written activity responses, and classroom observations. Researchers found that all participating students demonstrated their apprenticeship in the discipline of history as well as an emerging understanding of multiple perspectives of historical events, people, and issues. The majority of students provided positive feedback about the Virtual History Museum and indicated they preferred using the Virtual History Museum over textbooks when learning about history. Observations revealed increased class participation on the part of students with disabilities and teachers also reported that students were more engaged.

Like Okolo and colleagues, Hernández-Ramos and De La Paz (2010) chose historical thinking as an important aim in their investigation on technology-enhanced project-based learning for eighth grade students with and without learning disabilities. In this study on project-based learning, the authors selected mPower™ software (Multimedia Design Corporation, 2005) for students to collaboratively construct multimedia projects on westward expansion in the early to mid 1800s. Importantly, students worked within heterogeneous groups studying one of three regions. Each student read textbooks, as well as primary and secondary sources, to prepare brief reports on standards-based historical content within a broader unit. This content was then sent via the school's computer lab intranet to a student who served as a team leader, and who integrated it into a team project. While this report did not provide outcomes comparing the two populations of students (De La Paz & Hernández-Ramos, 2009), it did confirm several benefits for students who completed the multimedia projects.

First, content area tests confirmed that participants were able to learn from their peers' projects and use information from others to learn about what life in the early to mid 1800s was like in the other two regions. Moreover, even students who studied the same region gained an appreciation for the way historians used sources to develop understandings about history. Multimedia projects about the same region, within the same class of students emphasized slightly different information or students came to nuanced appreciations based on different ideas of what was important at the time the events occurred.

In addition, most students had positive views about their experience working collaboratively. An analysis of students' scenes revealed individual gains in historical thinking as well; 45% provided content that was supported by evidence such as a quote, example, citation, or demonstrated the student's awareness of some historical significance beyond a single event. An additional 44% included content in which students attempted to interpret information but gave no supporting evidence. Finally, some of the students with disabilities commented in focus interviews that they liked working on this project more than working on their routine classroom work because they could interact more easily with their teacher and peers through computers in the project-based learning environment.

Englert, Zhao, Dunsmore, Collings, and Wolbers (2007) developed and evaluated the efficacy of an Internet-based software (TELE-Web) to support writing by elementary students with learning disabilities. TELE-Web (Technology-Enhanced Learning Environments on the Web) was designed to offer several structural devices for students to frame their thoughts, words, and ideas. It scaffolds students' writing performance and provides a cognitive anchor from which students can generate papers that contain functional essay elements. In this particular study, students in two conditions (TELE-Web group and a comparison group) were asked to map their ideas using a planning graphic organizer for informative writing, then to transform their ideas into expository text during the writing phase. A drafting template with boxes for the introduction, conclusion, topic, supporting, and concluding sentences was also provided. Students in the experimental group accessed their scaffolding tools and mapping technologies through the TELE-Web software. TELE-Web scaffolds were also provided during the writing phase. Students in the comparison group completed the mapping and writing tasks using a traditional paper-and-pencil format. Englert and colleagues compared this online support with paper-and-pencil organizers and found that papers written with the online support were longer, better organized, contained more relevant content, and were higher in overall quality than students' handwritten papers.

Mavrou, Lewis, and Douglas (2010) examined interactions that took place between pairs of students on computer-based collaborative learning tasks. They were particularly interested in the use of the computer in scaffolding collaboration, peer acceptance between students with and without learning disabilities, and the overall effects of computer-based collaboration in inclusive classrooms. Twenty students without disabilities were paired with 20 students identified as having special educational needs. The computer was used to scaffold verbal and non-verbal interaction among peers and acted as an agent in terms of initiating and terminating conversation. Computer-based tasks, which involved picture-enhanced cloze-text and writing composition activities, were presented to student dyads. In the cloze-text activity, the story did not have an ending and students were asked to compose their own version. In another activity, which was intended to stimulate discussion between students within the dyad, a computer prompt showed an animated picture and asked students to choose from four matching facts. A writing activity asked students to fill in missing details for a story completion task. Results of the study showed that the computer effectively acted as a scaffolding agent, thereby facilitating students' efforts to help each other. Software prompts provided opportunities for all students to participate actively in the learning and social process. Students increased their number of verbal and nonverbal interactions when working in dyads (discussing possible responses, making suggestions, answering questions, etc.). In all but two cases, pairs of students continued talking and discussing the task at hand after the computer terminated its exchange.

The computer not only supported a collaborative atmosphere between students, it promoted mutual turn-taking and transformed the way the collaborative activity was organized. For example, in a cloze-text activity, one student took the role of entering responses with the mouse while the other took the role of the reader. In a writing task, one student read and reviewed the story that was written while the other student became the typist. These roles were often exchanged from one task to another so each student got a turn. This turn-taking strategy also provided students with disabilities with a feeling of acceptance and peer inclusion in the collaborative process.

CONCLUSION

In each of these examples, Information and Communication Technology has been successfully applied with students who have been identified as needing special education assistance in their educational programs. Information and Communication Technology is promising precisely because it allows teachers an opportunity to create new possibilities in the classroom, both academically and socially. Faux (2005) and Englert and others (2007) developed or discovered scaffolds that allowed students more autonomy in the writing process. Okolo and colleagues (Bouck et al., 2008; Bouck et al., 2009; Okolo, 2006) and Hernández-Ramos and De La Paz (2010) used varying forms of Information and Communication Technology to help students develop historical thinking skills. Finally, Mavrou and colleagues (2010) focused more on the interaction between students and computers and the role that computers may have in fostering a collaborative relationship between students. These are all viable learning situations that carry real benefits for students with and without special needs, and provide exciting new learning opportunities for the educators who work with them.

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KEY TERMS AND DEFINITIONS

Cloze-Text Activity: A reading assessment tool that is used to assess a student's reading comprehension. Teachers typically choose a grade appropriate reading passage and delete words systematically (for example, every fifth or seventh word), then ask students to predict words that belong in the blanks of the passage. The missing words are usually provided in a word bank.

Functional Essay Elements: Essential parts of an expository or persuasive essay, which include a *premise* or statement of belief, *reasons* to support the premise, a *conclusion*, and *elaborations* which elaborate on a premise, reason, or conclusion through examples, explanations, or experiences. Nonfunctional elements are not counted and include irrelevant material, which does not contribute to the overall topic.

Modeling: An instructional strategy by which the teacher thinks aloud, demonstrating a new concept or approach to learning. The benefits of modeling include presentation of self-regulatory behaviors such as sizing up a problem, managing task environment, and of course, completing an assignment, such as planning a composition.

Multimedia: The use of mixed media to convey information, often packaged with software on CD-ROM with links to the Internet. One example would be a means by which students develop an interactive story utilizing writing, sound, graphics, images, and animation.

Project-Based Learning: An approach to teaching that engages students in learning essential knowledge and life-enhancing skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed tasks.

Resource Bank: A collection of vocabulary words and multi-media components (e.g., pictures, animations, sounds and video) that students use to generate for a specific assignment or task. Other items in a resource bank may include design aspects such as background color/design, font color, font size, font style, freehand drawing and speech.

Scaffolding Instruction: An approach to instruction, in which a teacher models a desired learning strategy for students who are unable to accomplish a task independently. Scaffolding is a temporary support for students who learn to internalize instructional goals and take on responsibility for accomplishing a given task.

Web-Based Instructional Environment: An educational environment which uses the World Wide Web and Information Technology to provide students and teachers with a wide range of learning experiences and teaching environments, not possible in a traditional classroom setting. It is designed to promote the understanding of the subject matter by all students while offering supports and scaffolds to students including those with disabilities.

DISCUSSION QUESTIONS

1. **How effective is Information and Communication Technology in improving the overall quality of a struggling writer's composition?** Research on computer programs that provide meta-cognitive support or procedural facilitation for planning and revising processes have been mixed; producing more negative than positive results. The most positive results were found in a study by Zellermayer, Salomon, Globerson, and Givon (1991). Their Writing Partner asked students to answer questions about rhetorical purpose, topic, audience, main ideas, and key words. Metacognitive questions appeared in random order and prompted students to consider purpose, organization, and elaboration. Englert and colleagues (2007) reported that students using the TELE-Web software wrote papers that were longer, better organized, contained more relevant content, and were higher in overall quality than students who wrote their papers by hand.
2. **Can Information and Communication Technology replace traditional classroom instruction?** Technology in the classroom has surely been effective in helping students academically and socially. It promotes peer interaction and collaborative learning. It has also been effective in developing students' thinking skills. However, research has shown the most effective use of technology in the classroom is the result of good modeling and scaffolding of instruction by the teacher.
3. **Does the use of technology affect how students feel about learning?** Research has shown that technology benefits all students, but particularly those with special educational needs. Giving a student with a disability the opportunity to interact and collaborate with non-disabled students has proven to raise the self-esteem and confidence of the student with a disability. Students who used the Virtual History Museum were more engaged in their learning and reported having a better understanding of multiple perspectives of historical events, people, and issues. The majority of students reported they preferred using the Virtual History Museum over textbooks. Hernández-Ramos and De La Paz (2010) found that students with and without a learning disability had positive views about their experience working collaboratively. Furthermore, an analysis of the students' work revealed individual gains in their historical thinking.

Chapter 3
Integrated Technology for Culturally Competent Communication in Urban Schools

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ABSTRACT

A disproportionately high number of students who live in urban centers are found eligible for special education services. For some of these students, teachers and administrators may misinterpret communication and other behaviors. This chapter will provide ideas generated from the literature and lessons learned about interpreting communication and behavior in the urban context. Although the primary focus is face-to-face communication, the authors also discuss ways to integrate technology to support the communication process.

INTRODUCTION

Michelle said to her calm and gentle teacher: "You have an attitude problem!"

Jamal's smiling teacher said: "I'm so delighted you're here today. I made the Rotel dip you said you like for a celebration today." Jamal responded: "Really? Are you serious? I dreamt you were trying to kill me last night."

Park asked his teacher: "Is it okay to upload pictures of my girlfriend to our class blog?" The teacher looked at the pictures to see the student's girlfriend had very little underwear on.

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Because of Brittany's angry outbursts, her teacher had taken the teen to the office on multiple occasions, and Brittany complained to the administration about her teacher. On the last day of school, her teacher was trying to keep her distance during the picnic to avoid another student flare-up. To the teacher's surprise, Brittany charged across the student crowd and gave her teacher a huge hug: 'Thanks for everything. I'm not used to a teacher who cares so much about me."

These observed conversations suggest how confusing special education can be in the urban context. In the complexities of the city public school, the special education teacher may feel many doubts because of lack of preparation to interact effectively in the culturally diverse environment (Guerra & Nelson, 2007). As Kozol (2005) explained, teachers in the urban core lose confidence in themselves and what they know about children learning (p. 305). To complicate matters further, the disproportionately high percentage of students of different ethnic or racial backgrounds who are referred for special education services suggests that the lack of understanding of language and culture may cause discriminatory practices regarding students receiving special services (Artiles, Rueda, Salazar, & Higareda, 2005).

Regarding urban students diagnosed eligible for special education, the teacher may feel confused about what behaviors are related to a disorder and what behaviors are related to factors such as class, immigration, or cultural language expectations. It is widely recognized that student behaviors may be misinterpreted by teachers because of cultural differences between students and their teachers (Kerr & Nelson, 2006). Thus, two levels or foci exist for the special education teacher in the urban core: (a.) special needs of students and (b.) cultural influences that affect those students. Further, the digital divide may cause problems and offer opportunities for the special education teacher in an urban context (Ching, Basham, & Jang, 2005; Tettegah & Mayo, 2005). Thus, the purpose of this chapter is to identify communication and instructional behaviors for special education teachers, which may be particularly supportive to students in the urban context.

COMMUNITY BUILDING

There appears to be little research about communication skills specifically of urban students who are diagnosed with disabilities (Loncola & Craig-Unkefer, 2005). Until a clear research base is established, special education teachers can take cues from the research about students in urban schools that seems relevant (Obiakor & Beachum, 2005). In studying urban students, for example, Wasonga, Christman, and Kilmer suggested a lack of home participation in the school and low expectations may be particularly problematic for urban African American and urban Hispanic students. Additionally, poor school relationships may cause learning problems for urban Hispanic students (p. 67). Further, urban males tend to have poorer relationships with teachers (p. 70). To make learning more difficult, students also may experience disability-related relationship problems and isolation from others.

Supportive community building may be one way to support the learning of students diagnosed with special needs in the urban learning context. Children in urban schools are most comfortable and learn best in environments where they are secure, feel safe, and have ownership (Weiss & Gomperts, 2005). Frederick (2007) found that technology could be used in empowering ways for African Americans. Real life experiences can be described through technology, for example. Students may find a sense of community through blogs, social networking through sites such as Facebook, or website construction, which may give urban students an engaging way to apply the curriculum they are learning. Clark (2005) found that computer technologies may be important to use with underserved communities.

Urban students may appreciate a personal relationship with their special education teachers, which may have positive effects for the student and the teacher (Teven, 2007). A teacher may decide to have student friends on Facebook through an online class group, which may be a way to enhance a sense of personal relationships. In an elementary classroom, the sharing of personal information between students and their teachers is often accomplished through stories and electronic photos. Admittedly, this kind of sharing is often scarce in middle and high schools, although perhaps feasible through social networking.

At higher levels, students may still want or need a connection with other students and their teachers. In fact, for the adolescent, a sense of community may be the most important contributor to student learning (McIntyre, 2000). In response to that need, teachers can generate opportunities to reach out to students by taking the time to talk to them between classes, attending student sporting events and social functions, sponsoring student activities, creating a class website, and initiating conversations when in the community. For students at-risk of referral to special education services, positive communication that builds the student-teacher relationship can increase student success (Decker, Dona, & Christenson, 2007).

Varying cultural expectations and unwritten school and classroom rules may foster isolation (Gifford & Valde, 2006). Encouraging student communication and remediating deficient communication skills may help further move the student to become a part of the community within the classroom or school. Hug, Krajcik, and Marx (2005) suggested using technology to enhance science instruction, for example, and the interaction may enhance student content knowledge and social skills. Methods proven successful in teaching social skills that may reduce isolation and promote relationship building include modeling, direct instruction, and demonstration. In the course of daily instruction, teachers can provide visible examples of social interaction using these methods. In every school and classroom, there are unwritten and unspoken rules and standards. Students who are unaware of these are often viewed by peers as inept and by teachers as problematic. Because teachers in urban schools often are not a part of the urban community, there may be increased problems resulting from this lack of student knowledge. Without expecting students to know implicit rules, students cannot be expected to demonstrate appropriate behavior in all instances. Laffey, Espinosa, and Moore (2003) suggested that technology may be particularly useful in supporting student learning and behavior. It is important for teachers to deliberately provide instruction beyond that which is typically offered to present students clear guidelines for academic and behavioral expectations (Gagnon, 2001).

COMMUNICATION AND MEANING-MAKING

Communication is the social process of creating similar meanings between people. Special education teachers may want to be careful about attaching meanings in the urban culture, and teachers can benefit from sensitivity when attaching meaning to behaviors of students from culturally and linguistically diverse backgrounds. For special education teachers, there are multiple ways to develop effective teaching techniques (Meltzer, Roditi, Steinberg, Rafter-Biddle, & Taber, 2006), which include adaptation to the special learning needs of students and adaptation to the special cultural needs of students.

Through language and nonverbal (nonword) communication, individuals seek to be understood by others and to understand others through interaction. Students with disabilities who have problems with communication skills face an array of potential difficulties, including mental health problems, peer or teacher rejection, and low academic achievement (Miller, Lane, & Wehby, 2005). Of course, technology can enhance communication for special education students, whether using a computer keyboard to write or using required assistive technology.

Effective communication strategies are crucial to everyone, but for the special education teacher in an urban context, a sensitivity to culture and linguistics can improve the learning environment. Recognizing the effects of cultural differences on the teaching and learning process is crucial to student success (Chamberlain, 2005). Research has suggested, for example, that a clear relationship exists between a lack of communication skills and the presence of challenging behaviors (Nungesser & Watkins, 2005). Point in fact, the special education teacher may wonder whether a challenging behavior is prompted by cultural influences or an oppositional and defiant behavior disorder (Salend, & Sylvestre, 2006).

Although language is essential in communication, scholars have long believed that nonverbal or nonword symbols convey the majority of meaning attached to the words (Mehrabian, 1981). This nonverbal meaning comes through facial expression, tone of voice, gestures, and use of space, for example. Recognition of cultural influences and developmental influences can help special education teachers better understand their students. Special education teachers in an urban context can develop awareness that some nonverbal behavior is based on cultural differences between those of the teacher and those of his or her students (Gay, 2002). Awareness of students' varying cultural backgrounds may provide insight into student behavior that is excessively quiet, passive, loud, or assertive; student attitudes toward promptness; and student comfort with maintaining eye contact.

Howard (2002) suggested that effective urban teachers are nonverbally expressive of their emotional and passionate concern for their students' learning. To express their passion, special education teachers can use both verbal affirmation and nonverbal communication. To support the good things students do, special education teachers can assertively verbalize praise, smile, and use gestures such as a "thumbs up," "okay," and "high fives." Facial expressions can be used to note those things with which the teacher is either satisfied or dissatisfied. Internet research can be used to find out more about meaning-making for teachers and students.

Urban institutions continue to have in-groups and out-groups. Munoz (2004), described how while some people viewed the establishment of the public school system as a vehicle for equality, others saw the schools as a way to force immigrants to assimilate. Soon, Hispanic Americans will make up a quarter of the workforce, yet their typically lower academic achievement means they may have limited opportunities for work advancement. Including all students in learning is a critical need. Special education teachers can create opportunities for all learners to participate within the classroom learning community by helping students find common ground. The extensive Internet resources may provide backup for special education teachers. In addition, teachers can continue to revise their methodology to develop increased numbers of opportunities for students to participate inclusively.

Respect is highly valued in the urban community and the use of violence to gain respect has literally cost lives among urban students (Davis, 2006). Showing respect to all people, including students, both through actions and words is the expectation in an urban context. Teachers can value students by avoiding public criticism, avoiding raised voices, and avoiding showing frustration or impatience. Understanding why a problem happened and feeling empathy toward the student can help the teacher accept and forgive the student's behavior (Konstam, Holmes, & Levine, 2003).

To deal with a problem respectfully, the special education teacher may want to focus on fact without judgment, identify the problem to the student involved, and explain why a problem exists. Next, the teacher can identify what the expectations are and how to avoid the problem in the future. After the conversation, the special education teacher may decide to move ahead as if the problem never happened. Seemingly, teacher-directed student behavioral outbursts are often taken as personal affronts by educators (Landau & Gathercoal, 2000). In actuality, these sometimes sudden and ostensibly unprovoked eruptions by students in urban settings are often more related to a student's frustration, confusion, or self-perceived inability to complete a requested task or assignment (McCarney, 2003). Rather than reacting punitively, this situation creates an opportunity for the teacher to provide understanding and support, while strengthening student relationships. Once the student is able to regain composure, offering individual instruction to resolve the situation may reinforce the student-teacher relationship and help build trust for the future.

Special education teachers can chose to ignore whether the atypical nonverbal communication comes from disability or context, so the teacher can focus on how to use direct instruction to help students apply effective tone of voice, facial expression, spatial orientation, and gestures. Research has demonstrated that punishment, by contrast, is less effective than proactive, positive behavioral supports that provide clear guidelines and expectations for student behavior (Kerr & Nelson, 2006). If teachers are able to intervene at the onset of a problematic situation and use the issue as an opportunity to teach appropriate behavior, small conflicts may be prevented from escalating (Osher & Fleischman, 2005). Teaching expected appropriate nonverbal behavior, providing positive supports to sustain this behavior, and regularly reinforcing appropriate behavior not only can reduce classroom problems, but can allow increased time for instruction.

COMMUNICATION ADAPTATION

Respect for Success

Most educators associate two ethnic backgrounds with the culture of the urban core: African Americans and Hispanic Americans (Harriott & Martin, 2004). Munoz (2004) noted that although 87% of schoolteachers in the US are white, the number of students who are culturally and linguistically diverse is growing quickly. Munoz builds the case that low student achievement is fundamentally because teachers have low expectations and stereotypical prejudices that limit the urban student. Munoz (2004) identified low teacher expectations as a key cause of failure in US schools, suggesting that teachers must raise expectations. The use of validated, research-based teaching practices can be employed as a first step toward raising expectations (Stover, 2007). For example, teachers can use mastery learning as a way of maintaining high standards in the context of students with a wide array of motivations and abilities.

Teachers know that success breeds further success (Skindrud & Gersten, 2006). Nowhere is this truer than urban classrooms where students often face challenges to learning due to ecological issues often not shared by students in the suburbs or rural areas. Teachers can encourage success by experimenting with various strategies: (a.) calling on students when they know answers, (b.) regularly pre-teaching some portion of the lesson content so more students will be familiar with the answers, (c.) prearranging with individual students to ask them specific questions so they will be certain to have correct responses, and (d.) consistently reinforcing student effort.

There is evidence, unfortunately, that teachers need to be prepared for a lack of student respect toward schools, which includes anti-education attitudes in the urban context (Suskind, 1999). This conflict arises because academic success is not always valued in a student's culture to the same extent it is in the educational environment

(Sanchez, 2005). Parents and family members may be uncomfortable with the school context due to their own unsuccessful educational experiences, their cultural backgrounds, or their own daily challenges. Students may need emotional privacy and be encouraged by their parents to maintain that confidentiality at school. Teachers will want to be sensitive when talking about home situations to allay concerns about student privacy. Teachers also can be patient about students returning forms from home, not having computer access outside of school, having incomplete homework, and being absent due to family celebrations, events, or travel.

The use of validated, research-based teaching practices can be employed as a first step toward raising expectations for students (Stover, 2007). Due to the many and highly complex challenges faced by students in urban schools--unsafe neighborhoods, poverty, and negative peer influence--many students are exposed to poor decision-making more often than teachers might expect (Thorkildsen, 2007). This exposure can result in student decision-making skills that are either underdeveloped or poorly developed. Teachers can use academic content, such as history and literature, to discuss decision-making and encourage thoughtfulness and consideration about the process and how effective decision-making can work. Teachers can promote growth in this area by providing opportunities for discussion about decision-making using moral principles while remaining nonjudgmental of student ideas.

Respect toward students includes respect toward their group memberships. Students in urban classrooms who have pride in their membership in that classroom and school are more highly motivated to learn and succeed (Antrop-Gonzalez, 2006). Teachers can inspire pride in their students by demonstrating through actions that student opinions are valuable, by encouraging participation in some classroom decisions, and implementing student suggestions. Offering students choices about which of their papers and artwork will be prominently displayed, for example, and creating options in projects and assignments also are often successful in creating student pride.

Special education teachers are taught to respect diversity, but teachers may not be prepared for the nature of student diversity. Students in urban settings may not have access to knowledge and information at a level anticipated by educators (Nevin, 2005). By planning differently, teachers can provide background context for curricular content and review information that most students are expected to know. This open review avoids singling out any individual student who lacks needed background knowledge and allows instruction to begin with most learners at the same point.

Many students from culturally and linguistically diverse backgrounds in urban schools have different ways of thinking or processing than students considered typical in US schools. A student may have difficulty identifying learned information when cultural knowledge and expectations differ vastly from current teaching methods (Risko & Walker-Dalhouse, 2007). According to Nevin (2005), students in urban schools often vary dramatically in the pace and manner at which they learn. One way to accommodate these differences is to encourage group-learning activities. Carefully orchestrating the selection of student pairs and groupings may prove beneficial so that all students are able to work together successfully face-to-face or while using technology. Providing students the opportunity to be a teacher offers additional instruction and reinforcement and can include both individual and collaborative learning opportunities. This process can be teacher-driven rather than teacher-dominated. Although students have learning preferences, this preference does not preclude students learning using methods in classroom contexts. To remain culturally sensitive, the class can be taught by adapting to an array of student-preferred learning methods. For example, many urban cultures rely heavily on storytelling as a learning strategy, which may be successfully employed in classroom instruction (Wolvin, Berko, & Wolvin, 1999). Englert, Manalo, and

Zhao (2004) found that urban, special education students engaged well and actually wrote longer stories when using computer technology.

Finally, respect includes understanding power sources. Too often white teachers fail to recognize resentments caused by the complex power inequities between their own and urban cultures (Hatt-Echeverria & Jo, 2005). In addition, some urban students may have considerable influence in contexts outside of the school. These students also may be viewed as powerful within the school and classroom communities by other students because of their outside influence. Although it is important for teachers to treat all students with respect, it is crucial for teachers to recognize the perception with which the student is viewed and be equally as respectful toward an individual student who has significant power in the culture (Michie, 1999).

The Urban Context as a Solution

Despite a critical need for special education teachers in urban public schools, many teachers feel uncomfortable in a setting where their students have a different ethnicity, culture, educational values, or socio-economic class (Salinas, Kritsonis, & Herrington, 2006). For the new teacher or the teacher new to special education, teaching students who qualify for special services in an urban context may hold difficulties that seem insurmountable. Instead of the desired first job, the teacher may see the urban context as a problematic last choice. Instead, the new teacher can decide to see the urban context as an opportunity for learning. The vast majority of special education teachers are white, and many of those teachers have distorted perceptions of the urban culture (Berends, Chun, Schuyler, Stockly, & Briggs, 2002; Haberman, 1999, Rothenberg, 1997).

We believe the urban context is simply a different cultural context that needs clearer perceptions. Research has suggested that violence, ethnicity, crime, family involvement, community involvement, and other factors may play a role in school achievement, with the most profound effects coming from the effects of poverty (Brooks-Gunn, Duncan, Klevanov, & Sealand, 1993; Coulten & Pandey, 1992; Holt & Garcia, 2005; Tallerico & Burstyn, 2004; Taylor, 2005). For the special education teacher, some student behaviors are easy to accept when the teacher remembers the behaviors are prompted by developmental or learning disabilities. Other student behaviors are easy to accept when the teacher remembers they are prompted by contextual factors.

CONCLUSION

Home and school computer use can be an important part of school readiness (Ratner & Brumitt, 2006). Although urban students and special education may have less access to computers and the Internet, the use of computers may provide opportunities for communication between teachers and students (e.g., email, smart phones, school Webpages). Whether technology is used or not, teachers can learn to adapt their communication to their students.

We have found our teaching experiences in the urban context to be fascinating and rewarding. To effectively serve our students, we continue to reflect on our inadequacies as we seek to develop skills and sensitivities toward contextual factors. Every child deserves a good teacher and a good education, which includes learning effective communication skills through teacher modeling and student practice. From the student's standpoint, effective communication is crucial. In fact, a student's communication ability is the single best predictor of school success because of the correlation between communication skills and positive peer relationships and academic achievement (Sage, 2001).

We believe that teachers who are open to learning about the urban context can implement effective instructional strategies, which will build a sense of community building, improve understanding through communication, and demonstrate respect. According to Nagle and Crawford (2004), special education teachers in urban contexts face unique challenges, including the need to find appropriate communication to build relationships and help students learn. The close cultural bonds of communication behaviors and the connection between communication and learning suggest that special education teachers can increase their effectiveness by adapting to unique cultural and relational context when working with urban students (Rovai, Gallien, & Wighting, 2005).

LESSONS LEARNED

To create a supportive climate that encourages an atmosphere of open communication and community, special education teachers can reflect on those experiences that all students have in common, focus on topics of interest to students, and allow time for sharing events and issues of importance to individuals. Students can use technology for communication with distance pen-pals, who have similar needs or interests, for example. Not only are there learning benefits from computer practice in the computer-mediated process (Soonhwa, S., DaCosta, Kinsell, Poggio, & Meyen, 2010), but students may feel more accepted through a virtual friend or online group (Seymour & Lupton, 2004).

A positive climate may be accomplished through asking for and incorporating student input in some classroom decision-making as well as through the use of daily or weekly class meetings and shared journal writings (whether on paper or in Web blogs). Following this community development further, teachers can show caring toward students and encourage students to show that they care about each other (Andrews, 1995). To initiate an atmosphere where caring can begin to flourish, teachers may want to ask about student interests and discuss interpersonal topics and student goals. Of course, genuine listening shows caring.

After listening to students, teachers may be able to support students by applying course content and adapting instruction to meet specific student needs. Below are some types of success we observed in our work with students with special needs in an urban context.

1. A class blog can provide an engaging opportunity for students to write and interact with a sense of anonymity and distance, which they may not feel in face-to-face class discussions. The sense of anonymity can enable students to interact with less stress and more openness (e.g., online groups, chat).
2. An English language learner was able to make excellent progress through math software, even before learning rudimentary language skills. The student's boredom and frustration disappeared while working on the computer.
3. Students often appear highly absorbed using digital learning formats. Computers offer the opportunity to actively engage students simultaneously in ways that seem to be more active than some more traditional forms of learning.
4. Math software can adapt to the individual student's level so that students learn what they need to learn, thus being appropriate for students in the same class who are at different learning levels. Of course this advantage applies to other subject areas as well.
5. Without speaking, an English language learner diagnosed with an Autism spectrum disorder was able to communicate through simultaneous computer use with the teacher.

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KEY TERMS AND DEFINITIONS

Computer-Mediated Communication: Also called digital communication. Any interactive communication conducted solely through digital means (e.g., smartphone, computer, Smartboard) or where technology is used to enhance or supplement face-to-face communication. Examples include videoblogs, YouTube, Web blogs, online course environments, listservs, discussion boards, instructional software, and games.

Digital Divide: A contrast between most US Americans (high access to computers and the Internet) and those of lower socio-economic status (low access to computers and the Internet).

Urban Special Education: Special education services provided to students in the urban core, public city schools, or magnate schools.

DISCUSSION QUESTIONS

1. **What role do you think communication plays in the disproportionately high representation of minorities in special education?** Discuss the influences ethnicity and culture have on communication, and the different cultures that may exist between teachers and students in the urban context.
2. **How does technology improve face-to-face communication?** Discuss the ways texting, blogs, emails, and online groups support face-to-face friendships, family, work, or school relationships.
3. **What are some ways digital communication can be used by students with disabilities?** Discuss specific applications, such as the following: Facebook friends can give a student a sense of connectedness and positive relationships.

Chapter 4
Understanding Students with Special Needs Self-Disclosure in Internet Chat Rooms:
Applying the Communication Privacy Management Theory to Internet Communications

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ABSTRACT

This book chapter proposes a research agenda for determining, describing, and depicting special needs students' self-disclosure behaviors via the Internet in regards to the Communication Privacy Management Theory (formerly known as the Communication Boundary Management Theory). Internet, computer-mediated communication, chat rooms, self-disclosure, and the Privacy Management Theory are all identified and summarized. The theory is presented for its usefulness and its significance to studying self-disclosure in Internet chat rooms among individuals with disabilities. In addition, future research directions using each theory to study individuals with special needs' self-disclosure in Internet chat rooms are presented. Research presented in this chapter should be able to assist parents, teachers, and others who interact with individuals with disabilities, with an overview of the impact of self-disclosure on the Internet.

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INTRODUCTION

Research concerning self-disclosure is abundant (Valerian, Winstead, Mathews, & Braitman, 2008). However, Chelune (1979) argued that there is a deficiency of self-disclosure research based on theoretical models. Moreover, there is a lack of studies dealing with self-disclosure via the Internet. Specifically, there is a deficiency of studies concerning self-disclosure in Internet chat rooms (Wrench & Punyanunt-Carter, 2007). One cannot assume that self-disclosure behaviors, such as amount and content, in Internet chat rooms is similar to face to face interactions. Moreover, one cannot assume that self-disclosure demographics, such as sex and age, via the Internet is similar to face-to-face interactions. Equally important, the Internet provides a unique channel for interpersonal relationships, because it offers so many ways to disclose. Individuals diagnosed with disabilities such as autism, attention deficit disorders, emotional disorders often have difficulties with developing and maintaining interpersonal relationships. This unique communication medium provided by the Internet may be especially important for enhancing the communication activities of individuals with disabilities and allow for opportunities to build interpersonal relationships. Unlike other mediated channels such as telephone fax machines, the Internet is seen as more convenient and more expedient which may allow for relationships to develop more quickly (Cozik, 1997). Walther (1992) maintained that there are differences between the communication patterns on the telephone and via the Internet. Understanding self-disclosure via the Internet will provide awareness, such as safety and comprehension, for individuals with disabilities at all levels.

This chapter describes a theoretical framework for studying self-disclosure on the Internet. Furthermore, self-disclosure and The Communication Privacy Management Theory (Petronio, 2007; 2004; 1991) is presented for its potential application and importance in studying self-disclosure via the Internet. Moreover, potential research questions regarding the theory are proposed for studying self-disclosure among individuals with disabilities via the Internet. The goal of this chapter is to offer an exploratory, explanatory, and descriptive foundation for expanding research on self-disclosure via Internet chat rooms.

REVIEW OF LITERATURE

Pappacharissi and Rubin (2000) noted that individuals use the Internet for a variety of reasons. Similar to television viewers, Internet users decide how much time and what time they will use the communication medium. Unlike television viewers, Internet users can self-disclose information to another individual or to many individuals at once. The freedom to utilize the Internet in a way that is beneficial and pleasing to the user offers an alternative to conventional and traditional forms of communication, such as telephones and postal mail. Yet, Internet communication patterns need further investigation especially among individuals with disabilities, because there is little research on the topic. Hence, this chapter conceptualizes a research agenda regarding self-disclosure in Internet chat rooms for individuals with disabilities. To better understand the research agenda proposed in this chapter, it is important to highlight previous research studies that have looked at: (a.) the Internet, (b.) computer-mediated communication, (c.) chat rooms and Internet relay chat, (d.) self-disclosure, and (e.) the Communication Privacy Management Theory.

Internet

According to Flaherty, Pearce, & R. Rubin (1998), the Internet is “the fastest growing new communication technology” (p. 251). The Internet has been used quite frequently for various communication purposes and research on these purposes and functions is increasing rapidly (Punyanunt-

Carter, 2006; Punyanunt-Carter & Hemby, 2007). Although there is an increase in research into this mode of communication, there has not been a heavy emphasis on how the Internet functions as a communication medium for individuals with disabilities.

Due to the increasing popularity of the Internet, Newhagen and Rafaeli (1996) questioned the importance of studying the Internet. They argued that the nature of the Internet provides a very unique communication medium. The Internet allows communication to be interactive, visual, and elastic. Similar to its communication aspects, the Internet has become a common source of information. Johnson and Kaye (1998) discovered that individuals rated online information more credible than other types of information. In addition, females were more likely than males to regard information on the Internet as credible.

Lea and Spears (1995) found that relationships on the Internet occur at a slower pace because of the scarcity of cues for self-disclosure and Internet relationships take a longer time to acquire trust and communicate intimacy than face-to-face relationships. Perhaps the biggest concern about the Internet is not relationship development. Rather, the largest issue regarding the Internet is privacy (Hertzel, 2000). Salvaggio (1989) remarked that newer technologies have made it easier to accumulate and disperse personal information on the Internet. Even with the substantial impact that Internet communication has had upon society in general, very little research has been dedicated toward gaining an understanding of how this form of communication has influenced individuals with disabilities. Several questions remain to be answered regarding what individuals with disabilities communicate on the Internet and how they communicate with other Internet users.

Computer-Mediated Communication

Communication that occurs on the Internet is computer-mediated communication (CMC). Walther (1992) defined computer-mediated communication as "synchronous or asynchronous electronic mail and computer conferencing, by which senders encode in text messages that are relayed from senders' computers to receivers" (p. 52). Trevino and Webster (1992) asserted that computer-mediated communication differs from other types of communication mediums due to feedback capabilities and speed. In 1995, Walther discovered no differences between computer-mediated relationships and face-to-face relationships regarding intimacy. He mentioned that in order for computer-mediated communication to be an effective vehicle for interpersonal transactions, one must have the time and an appeal for computer-mediated communication. Most importantly, he concluded that CMC is very seldom impersonal.

Parks and Floyd (1996) observed that computer-mediated communication-initiated relationships often develop into face-to-face relationships. Moreover, the researchers noticed that computer-mediated communication users frequently do not differentiate their on-line and off-line personas. At the same time, men were less likely than women to initiate a relationship on the Internet. They reported that 60.7% of their subjects developed a relationship with someone they had met for the first time via an Internet newsgroup and 30% had developed a highly personal relationship with someone from an Internet newsgroup. From their results, they identified that the Internet is becoming a popular place where individuals can meet other people. This could be an important variable in need of further study as individuals with disabilities often have difficulties developing and maintaining interpersonal relationships.

Consequently, Postmes, Spears, and Lea (1998) noted that the Internet has limited channels compared to face to face interactions. However, they stated that computer-mediated communication can, "liberate individuals from social influence, group pressure, and status and power differentials that characterize much face-to-face interaction" (p. 689). Similar to face-to-face interactions, they found that Internet users are vulnerable to persuasion, criticism, and attraction.

In any event, Walther (1992) declared that many computer-mediated communication research studies occur in experimental conditions. He believed that such studies overlook possible intervening variables, such as CMC experience and the intensity of the relationship. In regards to computer-mediated communication experience, Walther implied that the time for communication may differ from face-to-face interactions. He noted that research studies that included time limits often restricted the transformation of relationships. Further, Walther maintained that relationships differ among individuals. One may consider a relationship as very intimate, while another may interpret the relationship as very friendly. Therefore, future research must take into account these two variables.

Nevertheless, Papacharissi and A. Rubin (2000) noted that very few studies have addressed why individuals utilize CMC and the Internet. Moreover, few, if any, studies have analyzed why individuals employ CMC and the Internet to self-disclose. Because CMC, the Internet, and chat rooms are relatively new, these research areas offer beneficial and profitable data especially concerning individuals with disabilities.

Chat Rooms and Internet Relay Chat

Chat rooms on the Internet have become a popular place for social interaction. According to Rintel and Pittam (1997), the type of CMC that occurs in Internet chat rooms is referred to as Internet Relay Chat (IRC). The authors defined Internet Relay Chat as, “one of a group of electronic interaction media that combine orthographic form with the ephemerality of real-time, virtually synchronous transmission in an unregulated, global, multi-user environment” (p. 508). In other words, chats let individuals communicate instantly.

According to Cornetto (1999), Internet Relay Chat (IRC) is the “most highly interactive forms of CMC” (p. 4). She asserted that IRC provides an appropriate circumstance for investigating communication behaviors. Because of its synchronous nature, Cornetto believed that IRC resembles face-to-face interaction. Rintel and Pittam (1997) recognized that there are similarities between face-to-face interactions and telephone interactions. They found that there are also similarities between IRC and face-to-face interactions. They observed that interaction management strategies are similar in both types of contexts: IRC and face-to-face.

Walther (1997) mentioned that Internet Relay Chat (IRC) users tend to have favorable impressions of other users, because there are fewer nonverbal cues than face-to face interactions. Walther proposed that interaction management strategies on IRC are more apparent than face-to-face interactions due to overattribution, or the tendency to attribute ascribe a person’s behavior based on a single characteristic. Walther implied that the disclosure of information among IRC users is more intentional than accidental. From this cause, self-disclosure is strategic and individuals control their personal information. This could be an important variable for individuals with disabilities who can exercise more control over the impressions that others receive about them especially when their disability is easily recognizable by others. On the other hand, some disabilities could give individuals less control over what would be appropriate disclosures.

All and all, the research on chat rooms is somewhat limited. Because chat rooms and the Internet are fairly new, it is hard to assess the effects of these communication mediums. Unlike other Internet channels, like electronic mail, newsgroups, and home pages, the communication in chat rooms is synchronous. Feedback is more immediate in chat rooms than electronic mail. Thus, the opportunity to disclose is greater and more strategic in chat rooms than in electronic mail. Hence, self-disclosure plays a significant role in Internet interactions. Bowker and Tuffin (2002) demonstrated the value of using the Internet to conduct interviews with individuals with disabilities who could control the amount and subject matter of their self-disclosure. Other studies have shown how Internet usage by people with disabilities can improve their self-reported feelings concerning the quality of their communication, independence, self-determination, and health concerns (Bradley & Poppen, 2003; Cook et al., 2005; Drainoni et al., 2004; Grimaldi & Goette, 1999). Studies such as these may reveal potential beneficial avenues for developing supportive modes of communication that could have a positive influence on the quality of life of individuals with disabilities.

Self Disclosure

One of the very first researchers studying self-disclosure was Sidney M. Jourard. Jourard (1971) defined self-disclosure as, "the act of making yourself manifest, showing yourself so others can perceive you" (p. 19). Jourard believed that self-disclosure was necessary in order to have good mental health. All and all, Jourard took a very humanistic or healthy approach to self-disclosure, because he deemed that it was an essential and integral part to our well-being.

Other researchers have viewed self-disclosure as a requirement for good health (Pennebaker, 1990; Greenberg & Stone, 1992). Greenberg and Stone (1992) reported that self-disclosure can alleviate stress. At the same time, Pennebaker (1990) found that self-disclosure can lessen mental and physical complications, from injury and/or illness.

Nevertheless, other researchers have expanded Jourard's perspective (Derlega, Metts, Petronio, & Margulis, 1993; Gilbert & Horenstein, 1975; Wheeless, 1967). Derlega et al. maintained that self-disclosure was vital for developing and maintaining relationships. Similarly, Parks and Floyd maintained that the closeness in a relationship is related to the amount of self-disclosure. Furthermore, self-disclosure can be used for informational purposes. For instance, Gilbert and Horenstein (1975) suggested that information between partners helps to augment relationships.

Wheeless (1976) suggested that, "the study of self disclosure can be characterized as a search for meaningful relationships" (p. 47). Wheeless also defined disclosiveness as, "a generalized characteristic or trait of the individual representing that person's predilection to disclose self to other people in general-his or her openness" (p. 47). He maintained that certain individuals were more inclined to be open than others. Thus, Wheeless viewed disclosure as a personal predisposition. Numerous support groups for individuals with disabilities have been identified on the Internet such as those for diabetes, multiple sclerosis, emotional disturbances, chronic illnesses. (Davison, Pennebaker, & Dickerson, 2000). In addition, Brownlow and O'Dell (2006) described Internet chat rooms as a safe and attractive medium where individuals diagnosed with autism were creating communities of support that might not develop in other settings.

Derlega, Metts, Petronio, and Margulis (1993) also viewed self-disclosure as an individual choice. They believe that self-disclosure is dependent on the discloser of the message rather than the target. Hence, Derlega et al. suggested that self-disclosure was trait-based rather than situational-based. As a result, individuals disclose for a variety of reasons. Derlega and Grzelak (1979) and Petronio (1991) have presented five potential reasons for self-disclosure: (a.) expression, (b.) self-clarification, (c.) social value, (d.) relationship development, and (e.) social control and influence. Petronio noted that, "for each type of disclosure, there is a corresponding expectation communicated that influences the choice of response" (p. 317).

All of the five potential reasons listed above can apply to Internet self-disclosers. Individuals on the Internet may feel that the Internet provides a place for them to exhibit themselves. In addition, Internet chat room users are able to communicate their opinions and beliefs. Also, the Internet allows individuals to find customized chat rooms or chat room communities, group of individuals, who have similar ideas and philosophies. The Internet is a rising source for people to find relationships. Moreover, the Internet allows for a place of commerce and control. Chat room users can target specific groups with their information or services. People can freely communicate their ideas and at the same time remain anonymous. This can be an important factor for individuals with disabilities who in many circumstances may not feel comfortable when others may readily identify their disability. This may promote disclosure for individuals with disabilities since they can disclose personal information when they feel comfortable.

Yet, self-disclosure can vary from context to context. In the educational context, Hurt, Scott, and McCroskey (1978) discovered that teachers who use self-disclosure increase their classroom effectiveness. Downs, Javidi, and Nussbaum (1988) noted that self-disclosure in the classroom retains students' interests. Likewise, Sorensen (1989) found that instructors that use positively worded self-disclosures were rated more favorably and heightened students' affective learning. It is evident that self-disclosure in instructional contexts is commendatory.

Self-disclosure also varies between males and females. Rubin, Hill, Peplau, and Dunkel-Schetter (1980) found that males did not differ in depth or breadth of self disclosures. Still, the authors observed on certain touchy topics, females disclosed more than males. Rubin et al. noted that in general females disclose emotions and males disclose facts. In 1986, Petronio and Martin found gender differences and disclosure. Specifically, they noticed that certain characteristics affected the perceptions to disclose. Women reported that they wanted to disclose to individuals, who were supportive and trust-worthy. Men reported that they did not need specific conditions in order to disclose information.

Dindia and Allen (1992) identified that women disclose a little more than men do. However, the authors posited that gender differences concerning disclosure behaviors are affected by the target's sex, the relationship effect of the target, and the self disclosure measures involved. They concluded that sex differences concerning self disclosure are relatively small. Similarly, Dindia, Fitzpatrick, and Kenny (1997) have found no self disclosure gender distinctions. Moreover, they reported that positive emotional bond does not influence the amount of self-disclosure. Most importantly, the authors noted that there are no disclosure differences among different relationship types: stranger to stranger, spouse to stranger, or spouse to spouse. Correspondingly, Pearson (1981) discovered that the amount of self disclosure occurs lesser in groups than in dyads. She also observed that males disclose more in dyads than females. Furthermore, females disclose more in groups compared to males.

Notwithstanding, Rosenfeld (2000) noted four considerations that are pertinent to disclosure. First, he mentioned that the type of relationship will affect an individual's need to disclose. The more significant the disclosee is to the discloser, then the greater the need more to disclose information. Second, he stated that disclosure has a risk-to-benefits ratio. In other words, individuals who disclose certain types of information, may risk losing certain things (such as, a career or pride) or may benefit obtaining certain things (such as, trust or security). Thus, the Internet may provide a safe place to expose information. Third, Rosenfeld mentioned that the appropriateness and relevance to the situation impacts what gets disclosed and what does not get disclosed. Fourth, he noted that disclosure depends on reciprocity. Individuals will disclose similar amounts of information to each other.

Along with considerations to disclose, there are also consequences of self-disclosure. Cooper (1994, pg. 338) stated that there are three consequences of disclosure: (a.) impression formation, (b.) social attraction, and (c.) trust. First, self-disclosure allows individuals to decrease ambiguity and create a favorable impression. Second, Cooper mentioned that liking is related to self-disclosure. Third, Cooper noted that self-disclosure is related to perceived closeness and trust.

Conducting a content analysis of four hours of audio-recording, Copper (1994, pg. 339) found that there are five types of disclosures: (a.) control, (b.) attitude, (c.) knowledge, (d.) personal, and (e.) dramatic. First, control disclosures are comments that indicate a longing to control another, others, or the conversation. Secondly, attitude disclosures denote an individual's attitudes, beliefs, or values. Third, knowledge disclosures comprise of information about the individual and are not opinions. Fourth, personal disclosures are statements about one's personal or private life. Lastly, dramatic disclosures are humorous, surprising, and/or shocking statements.

It is important to note that privacy and disclosure are closely related (Rosenfeld, 2000). Rosenfeld explained that, "privacy concerns keeping things hidden, and secrets are the specific messages chosen not to be shared, then disclosure is the process that grants access to private things" (p. 6). Petronio, Jones, and Morr (1998) deemed that privacy is a boundary control individuals use to regulate their disclosures.

Communication Privacy Management Theory

Perhaps, the theory that explains self-disclosure and privacy to a large degree is the Communication Privacy Management Theory (Communication Privacy Management Theory) (Petronio, 1991; 2002; 2004; 2007). This theory was formerly known as the Communication Boundary Management model/theory (Petronio, 1991). The Communication Privacy Management Theory explains what we disclose, to whom we disclose, what we choose to keep private, and what we choose to reveal to others. This is a useful theory to apply to self disclosure via the Internet, because it will enable researchers to understand what topics individuals chose to disclose only via the Internet. Moreover, the theory will assist researchers in understanding that type of individuals on the Internet are disclosed to more often than others.

Theory Characteristics

Petronio, Martin, and Littlefield (1984) first derived characteristics of Communication Privacy Management Theory. In 1991, Petronio created the Communication Privacy Management Theory (CPMT) and studied family disclosures. Later, Petronio, Reeder, Hecht, and Mon't Ros-Mendoza (1996) examined Communication Privacy Management Theory in abused families. Then, Petronio and Bradford (1993) analyzed Communication Privacy Management Theory in divorced families. Consequently, no study has looked at Communication Privacy Management Theory and family communication via the Internet.

Petronio (1991) noted that the theory controls disclosures on a continuum from "revealing" to "concealing." Furthermore, the theory elucidates that there are different levels of disclosure ranging from autonomy to intimacy. The Internet chat room user to another Internet chat room user(s) relationship is a unique one, because the relationships vary in the levels of intimacy. Petronio noted that, "when individuals wish to reveal private information, there is a need to regulate the way they communicate in order to control potential risks to self" (p. 313). Thus, Internet users may feel that they can only disclose certain information, because they may not want to invoke hostility, to be kicked out of a chat room, to deteriorate a relationship, or to risk personal security or safety.

The theory also addresses motivations to disclose. It would be interesting to distinguish what motives individuals have for disclosing information in Internet chat rooms rather than face-to-face. In the same fashion, it would be fascinating to see what motives individuals have for disclosing certain types of information on the Internet.

Boundary Structure Dimensions

Furthermore, Petronio's (1991) models consist of four boundary structure dimensions. The first boundary structure is *ownership*. Individuals have the authority to disclose certain types of information. Hence, individuals own information. Internet users have access to certain types of information and that information belongs to them. Secondly, Petronio noted that some information is co-owned. Many Internet users have access to enormous amounts of information. Because certain types of information are presented on the web, Internet users share that data with other users. Thus, Internet users have *control* on who receives information and how much to disclose. Third, information is dependent on its *permeability.* Petronio stated that some information is impermeable, or solid secrets, and some information is permeable, or publicly known secrets. Some chat room disclosures may start out as a private confession, but later result in having the confessions become public knowledge. Fourth, disclosures vary on different *levels.* In other words, disclosures can be placed on a continuum from total disclosure to absolute secrecy.

Rule-Based Management System

In addition to the boundary structure dimensions, Petronio (1991) included a rule-based management system. The rule-based management system is what drives the four boundary structures. The rule-based management system consists of four concepts: *boundary rule formation, boundary rule usage, boundary rule coordination,* and *boundary rule turbulence* (Petronio, 2000; p. 39). Each of the concepts will be discussed in more detail.

First, *boundary rule formation* refers to how we govern what and who we disclose to (Petronio, 1991). Internet users may choose to disclose on the Internet only to friends and family about their lives, whereas others may choose to disclose to everyone about their lives. Second, *boundary rule usage* states that we have criteria for announcing and hiding information. Likewise, Internet users have guidelines for what knowledge can be transmitted over the Internet. Third, *boundary rule coordination* assumes that individuals co-own information and must equalize disclosures. There is an enormous amount of information on the Internet that can be accessed by anyone. Thus, Internet users share this information with other Internet users. Lastly, *boundary rule turbulence* occurs when situational discrepancies occur. Often Internet hackers get access to information that was not granted to them and it causes turbulence for individuals who have been violated.

Consequently, boundary rules are created to control the type and amount of information given before this to others (Petronio, 2000). The formation of these boundary rules are based on four conditions (Petronio). The first condition is culture. Each culture has implicit and explicit rules for disclosing certain types of information. Likewise, some Internet cultures may display more self-disclosure behaviors than other Internet communities. Second, self-esteem affects what people elect to disclose to others. Phillips & Santoro (1989) implied that children with lower self-esteem are more inclined to use CMC to disclose than children with high self-esteem. Third, gender is a condition for constructing boundary rules. Dindia (2000) identified that males and females vary in their disclosure behaviors. Petronio asserted that males and females have different criteria for exposing and withholding private information. Fourth, motivation is the last condition for making rules. Petronio noted that loneliness may motivate certain individual to disclose in order to get a response, exhibit power, or solicit catharsis. In brief, these four conditions are the foundation for making boundary rules to reveal and conceal information.

In any event, Petronio (2000) noted that there may be turbulence. She noted that sometimes turbulence occurs when environmental stresses evoke changes in boundary rules. For instance, when a chat room user takes the identity of another chatter and pretends to be that person. The ownership of that identity is kept away from the original owner and it causes turbulence.

Still, disclosers and disclosees control or manage their communication boundaries (Petronio, 1991). Petronio noted that, "management is critical because it is the process through which the partners balance giving up autonomy by disclosing and increasing intimacy by sharing private information" (p. 312). Both disclosers and disclosees have certain management boundaries.

For the receiver of the information, the individual could manage the disclosure in three different ways (Petronio, 1991). First, the receiver must evaluate the expectations of the disclosure. The receiver may choose to accept responsibility or autonomy. Second, the receiver must search for attributions. Attributions mean that the receiver must ascribe motivations or reasons for the disclosure. Third, the receiver must determine a message response strategy. Responses may vary in directness and certainty.

Accordingly, the discloser of the information must also manage certain boundaries. According to Petronio (1991), there are three issues that the discloser must consider. First, the discloser must heed the expectations communicated. In other words, certain disclosures predispose certain types of reactions. Second, the discloser manages how explicit or implicit the disclosure is. Third, the discloser must select appropriate strategies for self-disclosure.

In order to disclose information in an effective and meaningful manner, disclosers must choose an appropriate strategy. Petronio (1991) noted that there are four variables that influence the discloser's strategy selection. First, the discloser must analyze the amount of emotional control they have in order to divulge information. Second, disclosers must consider the potential outcomes that may occur when the information is communicated. Third, the need for disclosure affects what type of strategy is selected. Fourth, disclosers may need an assurance of privacy concerning the information.

Petronio (1991) noted that self-disclosure may have positive or negative consequences. Thus, coordination between the discloser and the disclosee may result in four distinct degrees of coordination (Petronio, 1991). These degrees include: (a.) *satisfactory fit*; (b.) *overcompensatory fit*; (c.) *deficient fit*; (d.) *equivocal fit* (p.316). These will be discussed in more detail below.

According to Petronio, a satisfactory fit benefits the interaction relationship. This could occur when two chat room users disclose and understand each other in a satisfactory manner. Next, an overcompensatory fit refers to the receiver's response surpassing the discloser's expectations. For example, if an Internet chat room user discloses some disturbing financial information to another and the receiver gives money or comes to console the discloser in person. The receiver's actions exceed what one might expect from another individual. A deficient fit is the exact opposite of the overcompensatory fit. In other words, the discloser does not get any feedback at all. An equivocal fit results in the response fitting the discloser's message. Unlike the satisfactory fit, an equivocal fit may result in positive or negative consequences. This occurs when both parties address each other's self-disclosures in a similar fashion.

Petronio (2007) maintained that there are five principles of Communication Privacy Management Theory. First, individuals feel that they own private information. Second, individuals have control of the amount and whether to reveal their private information. Third, there are boundaries and rules that individuals use to decide how to reveal their private information. Fourth, there are rules that are in place when an individual decides to reveal private information. Fifth, individuals may encounter turbulence when privacy is not maintained. Turbulence may result in uncertainty, anger, frustration, and doubt. McBride and Wahl (2005) noted that Communication Privacy Management Theory is a useful theory and has been used in several different studies.

Petronio, Jones, and Morr (1998) distinguished three dilemmas that occur when an individual discloses personal information: (a,) *confidant privacy dilemmas*, (b.) *accidental privacy dilemmas*, and (c.) *illicit privacy dilemmas.* First, *confidant privacy dilemmas* happen when one discloses information trusting the disclosee will not reveal that information to anyone else. In a chat room setting, one chatter may send a private message to another chatter in faith that the receiver of the message will not tell anyone else. Then, the receiver could tell everyone in the chat room. The second dilemma, *accidental privacy dilemmas,* takes place when an individual unintentionally discovers personal information about another individual. This can occur in a chat room when a person discloses certain information and enables the receiver to discern the chatter's true identity. Third, *illicit privacy dilemmas* are when individuals deliberately attempt to ascertain private information. In a chat room, a person can secretly click on a person's profile in order to get more information about him or her.

Other current studies have used the Communication Privacy Management Theory as a guide (Greene, 2000; Petronio, Jones, & Morr, 1998). Greene (2000) looked at stigmas and boundaries. Greene concluded that Communication Privacy Management Theory is an advantageous theory in analyzing boundaries. She found that individuals were less likely to disclose that they have AIDS compared to cancer. Thus, individuals set boundaries for what they choose to disclose to others, particularly when it concerns health-related issues.

Tyma (2008) poised that many individuals are willing to self-disclose information in online social communities. He noted that value of belonging is more important than privacy issues for these individuals. He mentioned that Communication Privacy Management Theory is useful for understanding online communication behaviors. Metzger (2007) also supported Communication Privacy Management Theory for understanding online privacy management. Metzger stated that "similar kinds of balancing dynamics appear to operate in the Web environment as they do in face-to-face situations, thus extending Communication Privacy Management Theory into the domain of computer-mediated communication" (p. 2).

Overall, Communication Privacy Management Theory seems to be an applicable tool in a variety of contexts. Moreover, Communication Privacy Management Theory can be applied to the examination of self-disclosure via the Internet for a variety of reasons. First, the model emphasizes unsolicited private disclosures. For individuals who choose to reveal their real identities on the Internet, the disclosure is often unsolicited information. Second, the model notes that there are communication boundaries for disclosures. Internet users may have certain constraints on what they choose to disclose. These constraints may be safety issues or fears. Third, the theory looks at how rules are developed to maintain privacy. In a chat room setting, individuals may set certain guidelines for what they choose to disclose for safety, security, and/or confidentiality reasons. Fourth, individuals on the Internet must deal with coordination of information. After all, Gumpert and Drucker (1998) contended that the Internet is not as private as individuals perceive it to be.

PROBLEMS AND DIRECTIONS FOR FUTURE RESEARCH

Several research questions can be explored using Communication Privacy Management Theory for studying self-disclosures among individuals with disabilities in Internet chat rooms. Petronio's theory accounts for several variables that influence self-disclosure. The following are some problems and directions for future research.

1. Do the boundary structures realistically apply to the Internet? Do individuals with disabilities have ownership and control concerning

disclosure over the Internet? What types of levels exist in Internet chat rooms?

2. Do the rule-based management systems realistically apply to the Internet? Are there rule formations in Internet chat rooms? What types of boundary usage rules are present in Internet chat rooms?
3. Are the strategies for individuals with disabilities disclosing face-to-face similar to or different from disclosing via the Internet? Do Internet chat room disclosers consider the same variables? Is the impact of disclosures in Internet chat rooms the same as face-to-face communication?
4. Do receivers of self-disclosure act in the same manner face-to-face compared to the Internet? Do Internet chat room receivers encounter the same variables as face-to-face? Does time or experience with chat rooms affect the type or amount of disclosure? Does the type of relationship influence characteristics of self-disclosures in chat rooms?
5. Are there certain degrees of coordination that are more prominently used on the Internet? What types of coordination do Internet chat room users have? What types of turbulence is present in Internet chat rooms?
6. Does privacy influence disclosure via the Internet? What types of privacy issues are on the Internet? What types of turbulence is present in Internet chat rooms? What types of constraints are present?
7. What types of considerations and consequences are present in Internet chat room self-disclosures? What types of self-disclosures are exhibited in Internet chat rooms? Are they similar or different from Cooper's (1994) study?
8. Is there a difference between genders and ages? Are children more likely to reveal information, because they have been exposed to the Internet longer than adults? Do males and females disclose differently in Internet chat rooms? Specifically, are the manners and topics similar between males and females? Are there personality characteristics that make certain individuals disclose more on the Internet than others? Does birth order, ethnicity, disability, or sexual orientation correlate with how often one discloses on the Internet?
9. Are situational variables involved with self-disclosure via the Internet? Do people in colder climates, stressful work environments, or liberal contexts communicate more on the Internet? Are there cultural differences regarding disclosure patterns in Internet chat rooms?

CONCLUSION

There are several communication theories (e.g., Social Exchange Theory, Attraction Theory, or Uncertainty Reduction Theory) for studying self-disclosure via the Internet. Given all the available theories, the Communication Privacy Management Theory (Petronio) appears to have the best potentiality to analyze disclosure via the Internet. Petronio's (1991) theory was specifically created to study disclosure. Moreover, the theory accounts for many factors that surround self-disclosures, such as gender, motivations, culture and could reveal potentially valuable information toward improving the quality of interpersonal relationships for individuals with disabilities who frequently have difficulty with their relationships.

Most importantly, Cragan and Shields (1999) contended that Petronio's Communication Privacy Management Theory is very advantageous for studying communication in everyday life. They affirmed that the theory was very applicable and appropriate for realistic situations. Cragan and Shields also concluded that Communication Privacy Management Theory is a valid and beneficial theory.

Studies investigating the Internet and Petronio's (1991) Communication Privacy Management Theory have not been researched. The opportunities that this theory holds are unlimited especially for examining the disclosure of individuals with disabilities. There is a great need to study self-disclosure via the Internet, because it will help researchers better understand communication in this context and offer recommendations for improving relationship development and maintenance especially for individuals with disabilities.

The literature demonstrates that the knowledge of self disclosure in Internet chat rooms is yet to be explored. William and Rice (1983) stated "theories involving media uses and needs satisfactions should be expanded to accommodate the ability of certain new media to satisfy different and more traditional interpersonal needs" (p. 201). The purpose of this chapter was to show that the Communication Privacy Management Theory can serve as an approach to understanding self disclosure in Internet chat rooms among individuals with disabilities. With the different research questions offered in this chapter, it is evident that there are a lot of unanswered questions that need to be solved concerning self-disclosure in Internet chat rooms. To conclude, Strangelove (1994, p. 1) stated,

The Internet is not about technology, it is not about information, it is about communication-people talking with each other, people exchanging e-mail, people doing the low [American Standard Code for Information Interchange] ASCII dance. The Internet is mass participation in fully bi-directional, uncensored mass communication. Communication is the basis, the foundation. The Internet is a community of chronic communicators.

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KEY TERMS AND DEFINITIONS

Chat Rooms: Similar to Internet relay chat. These are virtual rooms where communication can occur.

Communication Privacy Management Theory: A theory that explains what we disclose and to whom do we disclose or what we chose to keep private and what we chose to reveal to others.

Computer-Mediated Communication (CMC): Synchronous or asynchronous electronic communications.

Internet Relay Chat (IRC): Virtual synchronous communication in an unregulated, general, multi-user environment.

Internet: A technology used for various communications, such as information and relationship development.

Online Social Communities: An online community or virtual space where individuals can display their thoughts, opinions, interests, and other communications.

Self-Disclosure: The behavior of revealing information about yourself to others.

DISCUSSION QUESTIONS

1. **Do you think there are other theories that better cover human behaviors on the Internet?** Suggestions may include: social penetration theory, expectancy violations theory, cognitive dissonance theory, and uncertainty reduction theory.
2. **Do you think that individuals with disabilities have ownership and control concerning disclosure over the Internet?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. The answers can be argued in either way.
3. **Do you think the strategies for individuals with disabilities disclosing face-to-face is similar to or different from disclosing via the Internet? If so, how?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. Reponses may include the fact that it might be easier to communicate via the Internet due to technology modifications and they are not perceived differently because the receiver of the message is not aware of their special needs.
4. **Do you think that privacy influences disclosure via the Internet? If so, how?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values.. It may depend on the person disclosing the information, who they are disclosing the information, and the type of information.
5. **Do you think there is a difference between genders and ages? If so, how?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. There may be a slight difference in age, because younger individuals are more computer savvy and literate than older individuals due to technological advances. Moreover, research has illustrated that women might communicate more because women typically use more words per day (face-to-face) than men.
6. **Do you think there are situational variables involved with self-disclosure via the Internet? If so, what might be some of these variables?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. It may depend on the person disclosing the information, who they are disclosing the information, and the type of information.
7. **Do you think there are there cultural differences regarding disclosure patterns in Internet chat rooms? How do these differences affect communication?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. There may be some cultures that are more comfortable disclosing private information online.
8. **How might educators working with students with special needs use the Internet in their classrooms?** Answers may vary depending on the students' personal opinions, beliefs, knowledge, and values. Answers may include responses such as communication behaviors, disclosure, rapport, skill building, information transfer, and perception checking.

Chapter 5
Using Spatial Constructivist Thinking Theory to Enhance Classroom Instruction for Students with Special Needs

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ABSTRACT

Spatial constructivist thinking theory is an alternative method of presenting digital materials to enhance the learning process of special needs students in a 21st Century classroom. Spatial constructivist thinking is the integration of pictures, animations, videos, color schemes, abstract plans, applets, graphics, and formatted texts in a presentation to represent text and verbal concepts. Concepts can be simple or complex, literary or symbolic representations of the concepts. This representation addresses Bloom's revised taxonomy to challenge students' thinking to create knowledge. Spatial constructivist thinking also posits that spatial representation is influenced by ones visual and verbal knowledge, and prior experiences. Spatial constructivist thinking is also influenced by the multiple intelligences theory. Presentations done by an instructor or knowledgeable peer using spatial constructivist thinking theory reflect the best spatial representation of the presenter's visual and verbal repertoire for concepts presented. For each spatial representation there is a corresponding verbal representation.

INTRODUCTION

As the educational system continues to experience a paradigm shift in using multimedia technology to deliver instruction at all levels of education, educators must refine how concepts are presented to address the learning styles of visual digital natives, especially students with special needs. In delivering instruction through media, an intelligence that plays a major role in

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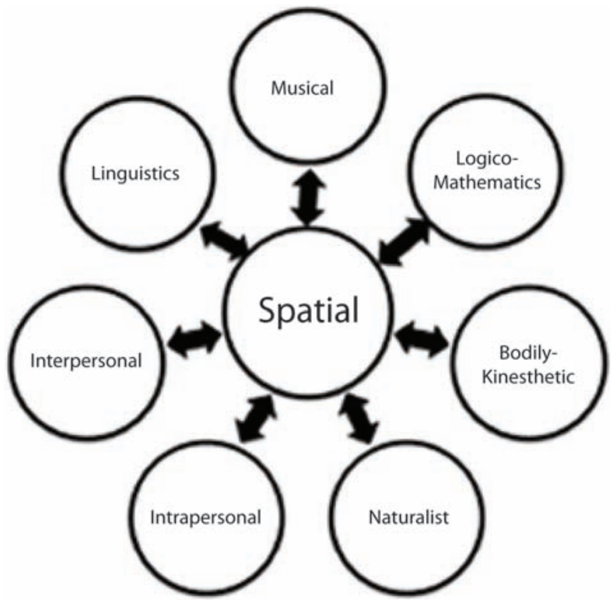
Figure 1. Spatial Constructivist Thinking aligned with Multiple Intelligences



how special needs students learn is the spatial intelligence (see Figure 1: Spatial Constructivist Thinking Aligned with Multiple Intelligences.) Spatial constructivist thinking theory posits that delivering instruction via multimedia technology is more effective when emphasis is placed on the spatial presentation of the information rather than on the traditional means of using text.

The integration of technology with students in the developmental disabilities spectrum has the potential to enhance learning. In a study of technology integration with thirty special education teachers working with individuals with severe cognitive and developmental disabilities, Bull (2005), identified fourteen reasons for technology integration with individuals with severe cognitive and developmental disabilities:

- Provided opportunity to keep pace with societal changes
- Aided with skill acquisition.
- Increased job opportunities.
- Enhanced the curriculum.
- Provided control over their environment.
- Increased eye and hand coordination.
- Promoted fine and gross motor skills.
- Improved attending skills.
- Provided consistent instruction throughout the curriculum.
- Provided alternate mode of instruction.
- Provided avenue to generalize skills.
- Served as a reinforcer.
- Improved self-esteem and self-confidence of students.
- Provided plain fun through music and videos.

The study also identified three areas in which technology made a difference; training, leisure activities, computer skills acquisition and vocational training.

SPATIAL CONSTRUCTIVIST THINKING THEORY

Spatial constructivist thinking theory is the integration of pictures, animations, videos, color schemes, abstract plans, applets, graphics, and formatted text in a multimedia presentation to represent verbal and auditory concepts for instruction. Spatial constructivist thinking theory concepts can be simple or complex, literal or a symbolic representation of the concept. One of the goals of using this theory is to challenge students to create, refine, modify, or transform spatial concepts to other modes of learning using knowledge from new and prior experiences. This new creation of knowledge addressed through Bloom's revised taxonomy is designed to foster students' higher level thinking skills to perform at the highest level of learning (Anderson & Krathwohl, 2001; Bull, 2009). Spatial constructivist thinking theory also posits that spatial representation is influenced by ones visual and auditory knowledge and prior experiences.

Spatial constructivist thinking theory presentations done by an instructor or knowledgeable peer reflect the best spatial representation of the presenter's visual and auditory repertoire for the concept presented. For each spatial representation there is a corresponding auditory and verbal representation. This chapter uses the concept of an apple as a symbolic or metaphoric spatial representation of content objectives, competencies and concepts teachers will teach to their students. For example, the picture of an apple linguistically corresponds to the word "apple." Knowledge is gained when students are able to connect each spatial representation with its corresponding auditory or verbal representation.

For effective learning to take place teachers should present spatial concepts with corresponding auditory or verbal representations. After concepts are presented students should be given the opportunity to refine, modify, change or replace those spatial representations with their own based on their prior experiences and knowledge in order to understand, learn and generalize the concept. Blooms' revised taxonomy presents a framework that supports spatial constructivist thinking theory. The highest level of Bloom's revised taxonomy is "creating." This process requires that students create knowledge as learners to demonstrate competencies. How do students create new media using different learning styles in alignment with Bloom's revised taxonomy as a scheme to promote learning in a digital environment? Spatial constructivist thinking theory states that when information is presented via spatial representations learners should be given adequate opportunities to interpret concepts and represent their understanding of the concepts by creating new knowledge that could be represented in other forms of media or intelligences.

Multiple Intelligences Theory

Multiple Intelligences theory scaffolds on the constructivist teaching approach to build on the spatial constructivist thinking theory instructional delivery model. For an instructional delivery to diverse population to be effective, it should address multiple intelligences and learning styles. According to Gardner (1980), intelligence should not be measured as a singular entry, but by multiple entries addressing intelligences possessed by all humans. Gardner (1983) identified eight basic multiple entries or multiple intelligences, which should be integrated in multimedia design:

- **Linguistic intelligence:** This entry deals with an individual's capacity to use words effectively, either orally or in writing. For instructional delivery to be effective instructional design should provide opportunities for oral presentations, discussions, debates, and writing in forums, blogs, social networks or online discussions.
- **Logical-mathematical intelligence:** This entry deals with an individual's capacity to use numbers effectively and to reason well. This intelligence focuses on mathematical and reasoning opportunities, but on the whole should promote and foster higher level thinking skills. Design should also

focus on object manipulations, animations, applets, and constructing or reconstructing concepts to facilitate learning.

- **Spatial intelligence:** This entry deals with an individual's capacity to perceive visual-spatial ideas relating to concepts presented. Instructional delivery should include pictures, images, graphics, animations, applets, maps, videos, slides, and constructing and reconstructing concepts to facilitate learning.
- **Bodily-kinesthetic intelligence:** This entry deals with an individual's capacity to express ideas and feelings through movements. With bodily-kinesthetic intelligence, the learner should have opportunities for movement, hands-on learning, interaction with objects, and constructing or reconstructing objects, graphics or applets.
- **Musical intelligence:** This entry deals with an individual's capacity to create, analyze, and discriminate different musical forms. With musical intelligence, the learner should have opportunities for musical presentations, musical stimulation, background music and musical creation, where appropriate.
- **Interpersonal intelligence:** This entry deals with an individual's capacity to understand, perceive and relate to other people. With interpersonal intelligence the learner should have opportunities for group discussions, group activities, social networking and presentations.
- **Intrapersonal intelligence:** This entry deals with an individual's capacity to reflect and understand one's experiences. With intrapersonal intelligence the learner should have opportunities for self-paced instruction, project-based learning, reflections and opportunities for the learner to reflect on prior experiences and knowledge.
- **Naturalist intelligence:** this entry deals with an individuals' capacity to understand the world. What this means for instructional design is that presentations should provide opportunities for global perspective, simulations, virtual worlds, creativity, project-based learning, and construction and reconstruction of concepts.

Constructivist Theory

Constructivist theory builds upon the theoretical structure created by spatial constructivist thinking theory to complete the theoretical framework for effective instructional delivery. The use of the constructivist approach in instructional design and delivery of multimedia content aligned with spatial constructivist thinking theory minimizes the educational challenges posed by computer-based instruction. The constructivist theory of instruction is based on principles of learning that were derived from branches of cognitive science. The constructivist teaching approach theory makes effective use of students' prior knowledge and cognitive structures based on those experiences (Asan, 2000; Vygotsky, 1978). According to Asan, these preconceived structures (prior knowledge) are valid, invalid or incomplete and students reformulate their existing structures only if new information or experiences are connected to knowledge already in memory. To integrate new ideas in learning, students must draw inferences, elaborations and relationships between old perceptions and new ideas (Asan, 2000; Dewey, 1910; Vygotsky, 1978). This concept is also supported by the spatial constructivist thinking, which is discussed later in this chapter. An example of what this means for spatial constructivist thinking is that images, animations, pictures, and graphics used should relate to students' prior experiences. The constructivist approach is based on ideas developed by educational philosophers, such as John Dewey (1910), and renowned educational psychologists, such as Lev Vygotsky (1978), Jerome Bruner (1973), and Jean Piaget, and educational technology visionaries, such as Seymour Papert (1980).

Use of a constructivist approach theory in multimedia design promotes:

- Problem solving, development of products and presentations.
- Global perspective with emphasis on generalizability related to problem solving and research skills.
- Group work rather than individual work.
- Alternative learning and assessment methods, such as exploration of open-ended questions and scenarios, research, product development, assessment of student portfolios, performance checklists, presentations and tests with open-ended questions.

Instructors or designers should apply the six major guidelines of the principles of constructivist theory to multimedia design for instruction associated with spatial constructivist thinking theory:

1. **Multimedia learning presentations should be context-based.** In designing multimedia presentations, instructors should ensure that learning outcomes involve making sense of real life environment, promoting learning experiences that are contextualized in authentic activities, making links with existing knowledge in the context of real life experiences, and ensuring that learning content and context are meaningful experiences that establish links with the learner's past experiences.
2. **Multimedia learning is through active involvement.** Multimedia instruction should be designed such that learning outcomes involve understanding and interpreting tasks through active participation, promoting construction and reconstruction of knowledge personally and internal to the learner, stimulating reconceptualization of knowledge based on personal (and therefore unique) background experience, creating personal meaning and understanding of concepts presented, and experiencing ideas.
3. **Multimedia learning promotes collaboration with others.** Multimedia learning should ensure that learning outcomes involve sharing existing knowledge with others and a willingness to resolve misunderstandings, engaging in interaction with others regarding shared knowledge and new knowledge, making available learners' ideas and notions to others for comments, suggestions and debates, enhancing understanding of reality as the outcome of shared construction, and promoting an avenue for negotiation with peers and teachers in reaching learning outcomes.
4. **Multimedia learning promotes personal autonomy and control over learning.** Multimedia learning ensures that learning outcomes involve promoting a significant proportion of personal decision making, requiring learners to derive and develop their own learning strategies and sometimes their own goals. Multimedia learning should help learners develop skills to construct their own plans for problem solving and providing avenues for mediation between the instructor and the learner based on the needs and skills of the learner.
5. **Multimedia learning promotes personal growth.** Multimedia learning ensure that learning outcomes involve stimulating thinking to reach shared understandings, providing avenues for learners to self-assess and reflect on progress, and promoting ideas and concept building, and refining concepts and ideas through argument if it leads to reflection.
6. **Multimedia learning outcome should be a perspective and an understanding.**

> Multimedia learning outcomes are not designed to ensure that learning specific content and learning outcomes should not be pre-specified. Learning outcomes in terms of meaningful, personal construction of knowledge are unique to the learner, providing opportunities for multiple perspectives. Learning outcomes within a learning task provide multiplicity of modes of delivery of information to allow differing approaches to knowledge acquisition and understanding to tap into the different learning styles of learners.

According to Anderson & Krathwohl (2001), the new terms in Bloom's revised taxonomy are defined as follows: Remembering represents retrieving, recognizing, and recalling relevant knowledge from long-term memory. Understanding represents constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. Applying represents carrying out or using a procedure through executing or implementing. Analyzing represents breaking material into constituent parts, then determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing. Evaluating represents making judgments based on criteria and standards through checking and critiquing. Creating represents putting elements together to form a coherent or functional whole then reorganizing elements into a new pattern or structure through generating, planning, or producing.

Spatial Constructivist Thinking Theory Aligned with Bloom's Revised Taxonomy

Spatial Constructivist Thinking theory is guided by the multiple intelligences theory of learning. Since linguistics and logico-mathematics are fundamentally the two main intelligences in traditional instruction, this chapter will provide examples on how spatial constructivist thinking could be used to promote writing, reasoning and mathematics at all levels of instruction for students with special needs. Gardner (1980) states that intelligence should not be measured as a singular entry, but by multiple entries relating all intelligences possessed by all humans. Spatial constructivist thinking, when aligned with the eight basic multiple entries, posits that spatial intelligence is the pivotal intelligence for delivering concepts in a technology driven environment (Figure 1). In a digital environment, from the spatial intelligence all other intelligences are processed for learning. Spatial intelligence in spatial constructivist thinking is the educational clearing house for receiving and processing knowledge in a multimedia technology learning environment.

Linguistic

Linguistic–Spatial constructivist thinking theory promotes use of linguistic intelligence by challenging both instructor and students to interpret spatial representations linguistically. Linguistic intelligence challenges students to think deeper about alternate images and auditory references to explain, modify or replace visuals presented. Once the student is able to create new concepts from those presented by the instructor, the student should be given the opportunity to create a linguistic presentation of the concept. (See Table 1.) Linguistic representations in multimedia products could be part of blogs, wikis, commentaries, electronic reviews and publications.

Logical-Mathematical

Logical-mathematical –Spatial constructivist thinking promotes use of mathematical and logical intelligence by challenging both instructor and students to interpret spatial representations mathematically and logically. Visual images are then

Table 1. Spatial Constructivist Thinking Theory, Linguistic Intelligence, and Bloom's Revised Taxonomy

Examples of types of linguistic projects that could be developed to address spatial to linguistics representation using Bloom's Revised Taxonomy.	
Remembering	Recognize an apple from a picture or real life.
Understanding	Write about the classification of an apple in the food pyramid.
Applying	Write about a recipe that uses the apple as the main ingredient
Analyzing	Analyze the nutritional components of an apple for healthy living
Evaluating	Evaluate the statement "an apple a day keeps the doctor away."
Creating	Write a paper or create a newsletter or wiki or blog on the apple

processed through the student's existing visual and auditory reservoir to solve problems. Once solved mathematically or logically, the problem could then be generalized linguistically, through other visual images for a better understanding or presented through other intelligences. Logico-mathematical representations in multimedia products can be videos, applets, audio and linguistic representations.

Bodily-Kinesthetic

Bodily-kinesthetic–This intelligence challenges the instructor and students to interpret spatial representations through bodily-kinesthetic intelligence. Spatial representations transformed to bodily-kinesthetic representations can also be presented in different intelligences for deep meaning and analysis. Bodily-kinesthetic activities in multimedia products can be videos, animations, simulations and applets.

Table 2. Spatial Constructivist Thinking Theory, Logico-Mathematical Intelligence, and Bloom's Revised Taxonomy

Examples of types of logico-mathematics projects that could be developed to address spatial to logico-mathematics representations using Bloom's Revised Taxonomy	
Remembering	How many apples are in the picture?
Understanding	Provide a mathematical explanation for the picture showing 3 apples in one basket plus 2 apples in another basket.
Applying	Solve the problem in the picture: 6 apples in basket #1 multiplied by 7 apples in basket#2
Analyzing	Show how the problem in the previous section was solved.
Evaluating	Conclusions can you reach from solving the problems presented?
Creating	Mathematical problems using pictures from your environment and solve them.

Interpersonal

Interpersonal–This intelligence allows instructors and students to present and interpret spatial presentations through verbal presentations, debates, and interactions with others. This interpretation can then be represented in different modes,

Table 3. Spatial Constructivist Thinking Theory, Bodily Kinesthetic Intelligence, and Bloom's Revised Taxonomy

Examples of types of bodily-kinesthetic projects that could be developed to address spatial to bodily-kinesthetic representation using Bloom's Revised Taxonomy	
Remembering	Use gestures or movement to represent the image of an apple.
Understanding	Identify a movie or clip that represents the concept of an apple.
Applying	Design a representation of an apple through movement
Analyzing	Analyze a video or movement that represents the concept of an apple.
Evaluating	Critique a demonstration or video or activities presenting the concept of an apple.
Creating	Create a play, skit or movement to represent the concept an apple.

Table 4. Spatial Constructivist Thinking Theory, Interpersonal Intelligence, and Bloom's Taxonomy Revised

Examples of types of interpersonal projects that could be developed to address spatial to interpersonal representation using Bloom's Revised Taxonomy	
Remembering	Tell me which fruit is the apple in the picture
Understanding	Talk about what an apple means to you.
Applying	Outline the steps you would use to make an apple pie.
Analyzing	Make a presentation on how to differentiate apples from other fruits.
Evaluating	Make a presentation on the health benefits of eating more than one apple a day
Creating	Create a presentation on the importance of the apple in the food pyramid.

such as linguistics (forums, journals, blogs and wikis), mathematical concepts, reasoning, interpersonal, and bodily-kinesthetic representations. Also, representations can be audio and video files.

Musical

Musical–This intelligence allows instructors and students to present and interpret spatial concepts through music, musical composition or songs. The new interpretation can be represented through different modes of presentations addressing multiple intelligences. Representations can be music audio or music video files.

Intrapersonal

Intrapersonal–This intelligence allows instructors and students to reflect on spatial presentations, share perspectives, and provide justifications for spatial images used. Intrapersonal presentations can be done through forums, blogs, wikis, and reflections. These new representations can be presented in different modes. Multimedia representations can be audio or video formats.

Table 5. Spatial Constructivist Thinking Theory, Musical Intelligence and Bloom's Revised Taxonomy

Examples of types of musical projects that could be developed to address spatial musical using Bloom's Revised Taxonomy	
Remembering	What song or lyrics remind you of an apple?
Understanding	Use a song or lyrics from a song to understand the concept of an apple.
Applying	Use the characteristics of an apple to write a lyric to a song.
Analyzing	Analyze a lyric or song that addresses the concept of an apple.
Evaluating	Evaluate the use of lyrics or music to understand the concept of an apple.
Creating	Create a lyric or song to represent the concept of an apple.

Naturalist

Naturalist–This intelligence allows instructors and students to transfer spatial representation to natural experiences and settings. Once the natural setting is identified students can make their representations through different modes to foster the transfer of knowledge. Representation can

Table 6. Spatial Constructivist Thinking Theory, Intrapersonal Intelligence and Bloom's Taxonomy Revised

Examples of types of intrapersonal projects that could be developed to address spatial to intrapersonal using Bloom's Revised Taxonomy	
Remembering	When was the last time you ate an apple?
Understanding	Write about why you eat apples
Applying	Discuss the relationship of eating apples to your health.
Analyzing	Make a case for eating apples to improve your health
Evaluating	Why should apples be included in a child's diet?
Creating	Create an activity to sequence the teaching of apple as a concept.

be through other spatial representations, videos, Web-cams, or simulations.

Certain characteristics must be considered in presenting, replacing, or changing spatial concepts to other intelligence modes based on the prior experiences of both students and teachers to elevate the intellectual climate:

- Spatial constructivist thinking concepts should be age appropriate and content based. All materials presented should relate to the objectives of the lesson or presentation.
- Delivery of spatial constructivist thinking information should promote participation through active involvement using other intelligences. For example, the presentation of a picture of an apple to represent the letter "A" should set the tone for students to identify other pictures that could be used to represent the letter "A." This lesson could also be expanded by reviewing different pictures of apple.
- Delivery should promote collaboration with others students to understand, refine, change, or replace concepts. In identifying pictures that represent an apple, students can be encouraged to form categories and themes to identify the best picture that represents an apple.
- Spatial presentation should lay the foundation for students to develop autonomy and control over learning to present their own spatial representation of the concept. From the example of an apple, students should be given the opportunity to generalize skills and generalize through other projects.
- Spatial presentation should promote personal growth of students. When used effectively spatial constructivist thinking expands the verbal and visual knowledge base of students.

Table 7. Spatial Constructivist Thinking Theory, Naturalist Intelligence and Bloom's Taxonomy Revised

Examples of types of naturalist projects that could be developed to address spatial to naturalist using Bloom's Revised Taxonomy	
Remembering	Name a place you have seen an apple tree or apple
Understanding	Why do apples grow in California and Florida?
Applying	What climatic conditions are necessary to grow an apple tree?
Analyzing	Visit a farm and write about caring for apple trees.
Evaluating	After visiting two grocery stores, discuss procedures used to preserve apples from insects and other bacteria.
Creating	Plant an apple tree and keep a journal.

- The outcome of a spatial presentation should stimulate a perspective and an understanding as it relates to the two major aspects of the learning process--relevance to the curriculum and understanding of the presenter's prior experiences and background. As instructors and students present spatial representation of concepts, they should justify use and relevance to the curriculum.
- When using teacher made spatial constructivist thinking materials use age appropriate words to represent visual images and auditory representations.
- When using commercial or ready-made spatial constructivist thinking materials, use age appropriate pictures to represent complex or simple words.

CONCLUSION: IMPLICATIONS OF SPATIAL CONSTRUCTIVIST THINKING ON INSTRUCTION

The use of spatial constructivist thinking theory in teaching diverse learners has the potential to engage students and enhance the learning process. The following are some of the advantages of using the spatial constructivist thinking theory in teaching diverse learners:

- Engage learners in creating knowledge aligned with prior knowledge.
- Promote individualized instruction.
- Allow learners to learn at their own pace and time.
- Design of multimedia should effectively utilize verbal and visual communication to present information.
- Minimize cognitive overload of memory through systematic design arrangements of verbal and visual communication in the presentation.
- Address multiple learning styles of learners.
- Provide opportunities to utilize prior experiences and knowledge of verbal and visual communication and content concepts to create knowledge.
- Provide opportunities for learners to construct knowledge based on multiple learning styles and utilizing verbal and visual communication.
- Minimize limits to boundaries of constructing knowledge.
- Provide opportunities for different interpretations, perspectives and understanding of verbal and visual communication and content knowledge.

Using spatial constructivist thinking theory in multimedia design will meet the needs of diverse learners in understanding concepts, involve students in the creating knowledge, and increase participation in the learning process. By engaging students in the learning process and knowledge creation spatial constructivist thinking facilitates generative transfer of knowledge.

EPILOGUE AND LESSONS LEARNED IN THE SITUATION

During spring 2010, spatial constructivist thinking theory was presented to several special educators, regular classroom educators, and preservice teachers as an alternative learning style and a new technology enhanced delivery mode for students and teachers. Spatial constructivist thinking theory was also integrated in a preservice teacher technology course and at one high school with students creating digital portfolios as a component of their high school graduation requirement. At all levels of integration spatial constructivist thinking was received positively by participants, students and teachers. Below are some of the unique strategies used with spatial constructivist thinking theory integration:

1. Teachers were encouraged to start lessons with a spatial representation.
2. Teachers and students used spatial constructivist thinking theory to bring to life essays, reports, reflections, and lab reports through their multimedia presentations. The exercise simply required students to replace sentences, statements, and phrases with appropriate pictures to tell their stories.
3. For their class presentations, teachers and students were encouraged to use more pictures and less text in creating multimedia presentations for instruction. A good multimedia presentation should tell the story with more pictures and less text. This process fosters creativity and higher level thinking skills.
4. Teachers were encouraged to use pictures as prompts for written tests, for oral presentations, to solve mathematical problems, and complete reflections.
5. Teachers and students were encouraged to start multimedia presentations with spatial representations that capture the attention of the audience or representations that depict the main aspects of the story.

6. Teachers and students were encouraged to create their own pictures or cliparts to adequately reflect concepts presented in instruction. Paint software was mainly used for this exercise.
7. Teachers and students were encouraged to use pictures figuratively to foster higher level thinking skills.

The integration of spatial constructivist thinking theory in classrooms at both the high school and university levels show great potential in motivating students, engaging students in the learning process, fostering creativity, and promoting learning. More in-depth research is needed to explore the impact of spatial constructivist thinking theory in different educational settings, especially with students with special needs.

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KEY TERMS AND DEFINITIONS

Bloom's Revised Taxonomy: It is a six level pyramid structure of complexities for classifying thinking (remembering, understanding, applying, analyzing, evaluating and creating).

Constructivist Teaching: A teaching approach that makes effective use of students' prior knowledge and cognitive structures based on those experiences to enhance learning.

Diverse Learners: Students with multiple learning styles, different levels of cognitive abilities, and social skills. It also includes students from different socio-economic and cultural backgrounds.

Instructional Design: A systematic process of planning, designing, implementing, and evaluation instructional materials and activities.

Multimedia: It is use of multiple forms of media (video, audio, text, animations, graphics, and pictures) to create products in digital environments.

Multiple Intelligences: It is a theory developed by Howard Gardner (1983) that identifies eight intelligences that capture the full range of abilities and talents that people possess (linguistics, logico-mathematical, spatial, musical, interpersonal, intrapersonal, naturalist, and bodily-Kinesthetic).

Spatial Constructivist Thinking Theory: It is the integration of pictures, animations, videos, color schemes, abstract plans, applets, graphics, and formatted text in a multimedia presentation to represent verbal and auditory concepts for instruction.

Students with Special Needs: It is the classification of students who are identified as academically gifted, and physically, emotionally or cognitively challenged.

DISCUSSION QUESTIONS

Use *Table 8. Some Key Words, Model Questions, And Instructional Strategies* to guide students to respond to activities in this section.

Table 8. Some Key Words, Model Questions, and Instructional Strategies

Bloom's Revised Taxonomy	Verbs for Objectives	Model Questions	Instructional Strategies
Remembering	Recognize, define, identify, label, list, locate, match, name, select, state, describe	Who? What? Where? How? Why? How much? When? Which one?	Memorize, highlight, mnemonics, rehearse.
Understanding	Match, represent, select, express, explain, demonstrate, give example,	Which is the same? This represents…, Select the best example, What does this mean? Show the difference, Give an example	Summarize, explain, state facts, spatial representations, show connections.
Applying	Apply, choose, role play, generalize, draw, sketch, solve, use	Apply, effects, results, What would happen, tell how, when, where, why	Practice, sequence, part and whole, simulations, models.
Analyzing	Analyze, identify, select, point out, compare, classify, categorize	What conclusions? What's fact? Opinion? What is the function of…? What ideas apply?	Discussions, challenging assumptions, decision-making situations, debates
Evaluate	Appraise, judge, criticize, defend, compare	Consistencies, which is more	Challenging assumptions, journals, debates, discussions, collaborating learning activities
Creating	Choose, combine, create, develop, make, plan, role play, tell, do design	How would you represent…? Retell a story, solve the following.	Model, challenge assumptions, debates, collaborate, design, decision-making situations, reflections, journals.

1. **Sequence a science experiment with captions in a PowerPoint presentation on a selected topic. Using information provided inTable 8, guide students to complete the following. Divide the class in eight groups aligned with the eight intelligences:**
   - Demonstrate acquisition and understanding of topic using the six levels of Bloom's revised taxonomy (remembering, understanding, applying, analyzing, evaluating and creating) with a preferred level of intelligence (musical, interpersonal, spatial, intrapersonal, naturalist, linguistics, logico-mathematics, and bodily kinesthetic) to show acquisition and mastery of knowledge.
   - Have each group present their understanding of the topic aligned with the levels of Bloom's revised taxonomy.
2. **Sequence a social studies event in a multimedia presentation and have students complete:**
   - Linguistic representation to create new knowledge.
   - Create a new spatial representation that reflects their understanding of the concept.
3. **Present pictures on your computer to represent verbs, words or concepts (language arts). Have students identify the verbs, words or concepts from the pictures using the following combination of an intelligence and a defined level of Bloom's revised taxonomy:**
   - Linguistics and remembering.
   - Interpersonal presentation and understanding.

    - Musically and applying.
    - Spatially and creating.
    - Intrapersonal (reflecting) and analyzing.

4. **Show a video clip or a picture and have students identify mathematics concepts using the following**:
    - Create spatial representations of mathematics concepts identified in the video clip.
    - Design mathematical problems from their spatial representations and solve the problems.
    - Make an oral presentation relating to 4.

Section 2
Assistive Technology

Chapter 6
Wheelchairs as Assistive Technology:
What a Special Educator Should Know

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ABSTRACT

Federal law supports the use of assistive technology in the education of students with disabilities. Arguably, wheelchairs are included as assistive technology. However, many barriers exist to selecting the appropriate technology and supporting its use within the educational setting. An informed team including the parent, educator, therapists, and wheelchair supplier can assist the student in reducing these barriers.

INTRODUCTION

According to Individuals with Disabilities Education Act (IDEA),

Assistive technology device means 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 the functional capabilities of a child with a disability. (IDEA, 2004)

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Mobility devices, including strollers, manual wheelchairs, scooters, and power wheelchairs, fit this definition of an assistive technology device.

In the educational setting, wheelchairs increase or improve the functional capabilities of the student in a variety of ways. Wheelchairs may provide the student with access to the school building and school transportation. Other students rely on a wheelchair to provide support of their body during educational activities. For yet other students, the wheelchair increases the student's independence in multiple school environments, such as in the gymnasium, on the playground, in the cafeteria, and between classrooms. A wheelchair can also provide an alternate method to carry the tools they need to access their education. These tools might include textbooks, writing tools or a computer, a communication device or other assistive technology. Independence can lead to greater social interaction with peers and being seen as more capable by teachers.

Different types of technology are needed relative to the student's needs and the purpose intended. Of course some students utilize their wheelchairs for multiple purposes. The special educator may be a key facilitator in assuring that the student's technology is a good match relative to their needs in the school setting since they may have the most consistent interaction with the student in the learning environment.

BACKGROUND

In the 1950's, students with disabilities were not seen in the typical school building. In this era, if a wheelchair was seen, it was used as a movable seat for a student with temporary health impairments such as a broken bone. Indeed, it was not until 1975, when Congress enacted Public Law (PL) 94-174, that children with disabilities were guaranteed a free public education. Previous to this, if children with disabilities had access to an education, it was in a completely separate school. Subsequent to passage of PL 94-142 and the continuing affirmation in IDEA and its subsequent revisions, it is not unusual to see students with a variety of disabling conditions resulting in mobility impairments in the school.

In the 35 years since a free, appropriate education for students with disabilities was first legislated, many changes have been needed. At first, many school buildings were not wheelchair accessible. It soon became clear that if students were to have access to a truly free, appropriate education, they would have to have physical access to their school and classrooms. However, it was not until 1990 and the passage of the American with Disabilities Act (ADA) that legislated that all public buildings must be accessible to people using wheelchairs that school buildings began to change. Existing schools as well as new buildings were mandated to provide accommodations for students with mobility impairments such as barrier free entry points, bathrooms with enough room to accommodate wheelchairs in the stalls and secure grab bars, and elevators to provide access to buildings with more than one floor.

Today, in spite of existing legislation, often securing access and accommodations to allow a student who uses a wheelchair to all classes *and* extra-curricular activities is won on a case by case basis. However, wheelchairs are now a common sight in public school buildings and the fight to gain this right is now being extended to higher education.

FUNCTIONAL REASONS AND COMMON DIAGNOSES FOR USE OF A WHEELCHAIR IN THE EDUCATIONAL SETTING

Muscular Incoordination

Students with a variety of diagnoses may display muscular incoordination. These diagnoses may include cerebral palsy, ataxia, and head trauma. The results may include effortful movement, inability to move voluntarily, reduced accuracy of movement, and/or slow response times. This may mean that the student may not be able to keep up with the movement of peers. The student may be unable to sit without support, stand, or walk. They may be unable to respond to quick environmental changes that put them at risk for falls. A student with any of these limitations may require the use of a wheelchair.

Muscle Weakness or Paralysis

Although muscle weakness may contribute to muscle incoordination, some specific diagnoses result in weakness and paralysis. Some common diagnoses seen in the educational setting include the various types of Muscular Dystrophy (including Duchenne, Fredrick's Ataxia, and spinal muscle atrophy) and brain or spinal cord injury due to accident. While brain and spinal cord injury is fairly static, the muscular dystrophies are progressive over time. Depending on the cause and location of the weakness or paralysis, different wheeled technology may be needed or the type of technology needed may change over time.

Fatigue

Fatigue may be the result of either of the above conditions, but other medical conditions can also result in fatigue. For example, poor oxygen exchange due to lung damage or heart conditions. Fatigue can reduce the student's alertness and energy available for use in learning. Preventing fatigue may play an important role in the use of mobility equipment especially as the students' body becomes larger and requires more effort from an already compromised system.

TYPES OF WHEELCHAIRS

Wheelchairs are divided into two basic categories, manual and power. Manual wheelchairs are defined as wheelchairs with a human power source whether propelled by the user or an attendant. Manual wheelchairs come in numerous styles. These include rigid frames, folding frames, tilt-in-space frames, transport chairs, lightweight wheelchairs, ultra-light sport wheelchairs, bariatric and heavy duty wheelchairs. Power wheelchairs are defined as wheelchairs propelled by battery power. This category includes scooters, rear wheel drive, mid wheel drive, and front wheel drive wheelchairs.

Major wheelchair manufacturers in the United States number approximately fifteen (Table 1). Some manufacturers specialize in one of the categories or styles listed above while several manufacturers offer several models in each of type and style of wheelchair. This quickly results in virtually hundreds of models of wheelchairs from which to choose and each model comes with a unique set of available components (e.g. arms, wheels, backs, seats, and legrests) with which to customize the chair. In addition to wheelchair manufacturers, there is a whole other group of manufacturers who specialize in wheelchair seat cushions, wheelchair back supports, headrests and other components for special applications.

Table 1. List of Manufacturers by Type of Wheelchair

Manual Wheelchairs	Power Wheelchairs	Power Scooters	Transport Chairs
21st Century Scientific	21st Century Scientific	ConvaQuip	Columbia Medical
Colours Wheelchair	ConvaQuip	Golden Technologies	Convaid
ConvaQuip	Gendron	Pride Mobility	Invacare
Freedom Designs	Golden Technologies	Shoprider	Sunrise Medical
Gendron	Invacare		Thomashilfin
Invacare	Permobil		
PDG	Pride Mobility		
Pride Mobility	Redman		
Sunrise Medical	Shoprider		
TiLite	Sunrise Medical		

WHEELCHAIR FUNCTIONS

Mobility Assistance

The general function of all wheelchairs regardless of style or model is to increase the ease of an individual's movement from place to place. The chosen type, style and model of the wheelchair can affect the user in a variety of ways. For example, if a transport wheelchair or stroller is selected, movement of the chair will be dependent on someone other than the user (the person sitting in the chair).

Manual chairs provide the user with more options regarding how the chair will be moved or propelled. When provided with the appropriate distance between the seat and the floor, the user may be able to move the chair with their feet as well as the more frequently seen use of their arms and hands. Manual wheelchairs because they may be user powered can be limited by the strength and endurance of the user. This may be adequate for the user who is able to push themselves and their chair for relatively shorter distances (like within a building or to a vehicle). A more active user who wants to compete in sports or move long distances will frequently choose an ultra light frame style to make efforts to move the chair as efficient as possible. A user who is unable to push for functional distances in a standard weight manual wheelchair might also choose an ultra light model. If needed, due to barriers or fatigue, a manual chair also frequently provides the option of being pushed by an attendant.

Power wheelchairs including scooters are generally dependent on battery power for movement. New batteries can generally last the typical user for an eight-hour day. A variety of driving speeds may be available, depending on the user's comfort and control. Recharging is recommended daily. The power drive can be disengaged to allow for an attendant to push it in an emergency. However, due to the size and weight of the chair, this is rarely done for any distance.

Scooters are frequently chosen by individuals who are able to walk very limited distances or are at least able to move from one seat to another independently. They require the user to be able to sit without specialized support and to be able to access and control the scooter through controls on the tiller positioned in front of the user. Therefore a scooter user generally has functional sitting balance and functional arm and hands use. Scooters also frequently require more room to turn than a power wheelchair, so they are often chosen for moving longer distances and in more open spaces.

Of the power options, power wheelchairs provide the most versatility. Power wheelchairs can provide the same positioning options as manual wheelchairs with the added advantage of having a variety of methods to control the chair's movement. The standard control module is a joystick usually positioned near the arm support on the user's preferred side. However, if control of the joystick is difficult in this position, it can be moved or replaced by a different type of controller entirely. Technology allows a user the option to control a power chair by small movements of a finger or tongue, through head movement, or through air pressure generated by sucking or blowing if needed.

Positioning Assistance

It is important to note that each user has differing needs related to positioning. Some need only the most basic of components. These would include a seat and back, wheels, and foot support. Other users require more specialized components. Each part should be chosen with the goal of providing adequate support for them to most effectively use their available movement abilities.

It is no longer assumed that all wheelchair users need to be positioned with the back at a 90 degree angle to the seat and seat positioned parallel to the floor for maximal function. Some wheelchair frame options allow the rear of the seat to be positioned lower that the front edge of

Figure 1. Wheelchair with Reclining Back (University of Iowa-Center for Disabilities and Development, used with permission)

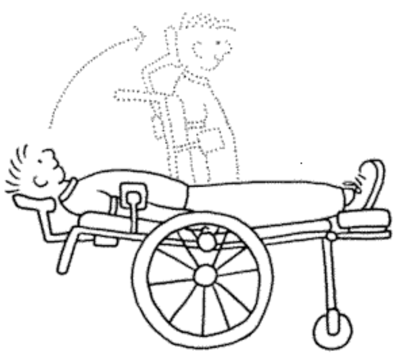
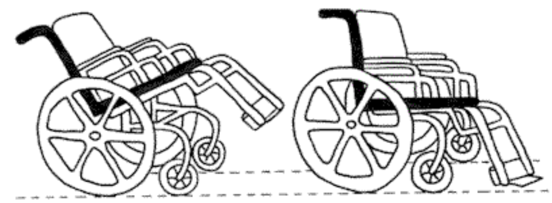


Figure 2. Wheelchair with Tilt-in-Space Seat (ibid. used with permission)



the seat. This option is frequently used to keep the user from sliding toward the front edge of the seat. Another frame option allows the back to recline (see figure 1) or lay back in relation to the seat. This can be helpful if back or neck weakness is present to promote a more supported head position. An additional frame option allows the seat and back support to rotate toward the rear. This is called tilt-in-space (see figure 2). This capability is especially helpful when the wheelchair user is unable to lift or move themselves in the seat enough to promote adequate blood flow under the thighs and buttocks.

In addition to the choices in the frame of the wheelchair, assistance with positioning also comes from the various options or component parts. These parts include but are not limited to different styles of components in the following nine areas:

- seat support
- cushion
- back support
- pelvic support (if needed)
- trunk support (if needed)
- chest support (if needed)
- armrest and pads
- legrests
- footplate
- headrest (if needed)

Since each chair model has a different array of optional components, determining the most beneficial options for the user is a daunting task. Each component should provide just enough support to allow the student to function optimally and limit interference in desired activities. Although some choices come down to user preference, most sources of funding require documentation of the medical condition that necessitates the use of each option chosen.

Promoting Independence

Especially in the educational setting it is important to focus on promoting independence. As with the student without a movement disability, school should promote students to learn to be as responsible and independent as possible. Students with movement disabilities may use different tools to achieve this goal, but the goal is the same. The research of Devitt, Chau, & Jutai, 2003, has shown that independence with use of a wheelchair can increase self ratings of the user's feelings of competence, adaptability, and self-esteem. This study demonstrates how important it is to select technology that can allow the student to be as independent as possible. According to Cook, & Polgar, 2007, the technology chosen must match the user's capabilities, their activities, and the environments in which it will be used in order to maximize the student's independence.

The student's physical and cognitive abilities must be taken into account if independence is to be maximized. For example, a student who is unable to walk or push himself in a manual wheelchair for the distances required of him throughout the day without noticeable fatigue may be a candidate for a scooter or power wheelchair in order to promote his independence. However, another student whose vision or judgment is impaired may be at risk for hurting themselves or others if they were given a power chair. They would require constant supervision or intervention by an attendant. This would be true even if the mobility needs and skills are the same as the first student. A power chair would not be a good match under these circumstances because it would not promote independence.

The activities in which the student needs to participate should also be carefully considered in order to determine which wheelchair options would contribute to the student's independence. For example, if the student needs his wheelchair outside of the school day, then transportation safety features will need to be considered. If the student moves from class to class, he may need to transport needed learning materials in order to be independent. Therefore, consideration of which wheelchair options will allow these activities to be carried out safely and reliably is needed.

Some wheelchair components may increase independence in some activities but may compromise the student's independence in others. In this case, the student and the educational team, which may include educators, parents, and therapists, need to discuss how best to protect the student's overall independence. If the student is not able to quickly and easily utilize a desk surface in each classroom, then consideration may need to be given to providing a work surface (wheelchair tray) that can be attached to the chair. This may be determined necessary even if the student needs help to remove the tray when it is no longer needed. Similarly, if the student uses a computer or communication device, consideration may need to be given of how these devices can be securely mounted for transport on the wheelchair and removed or moved out of the way in order for the student to exit the wheelchair when needed – even if some assistance by a caregiver is required.

ADDITIONAL FACTORS THAT MAY IMPACT WHEELCHAIR CHOICE

Each wheelchair choice may have intended and some unintended outcomes. Although the following factors may or may not affect the use of the wheelchair in the educational setting, it may be helpful to the educator to know why certain equipment choices were made and other options were not chosen.

Student's Age

Especially for young children, age can be a factor in the choice of a wheelchair. As with older users, the chair should promote the user to be seen as capable as possible. The size and height of the chair from the floor may be important factors. Because young children grow rapidly, a chair should be chosen that will accommodate this growth. In addition, children's skills change with growth and maturity. The ideal chair will have the versatility to add, change or delete different components as these changes occur.

Parental Preference

Heward (2002, p. 102) describes a grieving process that parents go through as their child falls behind the typical child in motor skills. Each parent goes through this process of grieving at their own rate. Some parents take longer and will resist moving their child to an alternate method of independent mobility such as a wheelchair. In this case they may choose a stroller over a wheelchair so that the child appears more typical. Another parent who reaches the acceptance phase of grieving earlier may push for the child to have opportunities to learn independent mobility, including power wheelchair control, as early as possible. Each parent should be supported where he or she is in the grieving process. At the same time, parents should be introduced to the options that exist for the child and the pros and cons of the available options. It is best that decisions be made thoughtfully as the child may have to remain in the chosen wheelchair for a period of years.

Funding Source

Due to the cost of even the simplest manual wheelchair, it is the rare case that a wheelchair is able to be purchased without support from outside the family's budget. The most common sources of outside funding are health insurance policies and public insurance such as Medicaid. In either case, the funding agency wants to know that the funding expended will be cost effective. In an effort to ensure this, they expect that the professionals and parents involved have taken into consideration the potential needs of the user for the foreseeable future and have chosen a wheelchair that can meet these anticipated needs. In addition, the funding source requires that each specialized option be shown to be necessary and connected to the user's medical needs. This is done by describing the functional affect of the disabling condition on the user. Components chosen without showing medical need are not funded and are the responsibility of the family or individual.

Home Accessibility

If the wheelchair will be used within the home, it must be able to enter and exit the home efficiently. This may require using a different entrance point for the wheelchair to avoid steps at the entrance of the home or obtaining a permanent or movable ramp. Once inside the home, the wheelchair must be able to go where it is needed. The width of the wheelchair and the amount of space needed for turns needs to match the available space within the home or plans to modify the house may be needed. Sometimes this is a special challenge for families that rent their home as they may not be able to obtain permission from the landlord to make home modifications. In this case, the type of chair selected may need to be different than would be selected otherwise.

Ease of Transport

Consideration needs to be given to all of the locations to which the chair must travel to be available for use. Some wheelchair choices are made because the wheelchair needs to be transported by a vehicle in a specific way. If the family's only means of transporting the wheelchair is in the trunk of their automobile and purchase of a different automobile is not expected, then the choice of the wheelchair may depend on the ability to fold or disassemble into a size that will fit in the trunk.

Transportability is a frequent problem encountered with power wheelchairs and scooters. These devices are larger and heavier and frequently cannot easily be transported in the trunk of the family car. In addition, to a potential need for a larger transport vehicle, determining how the device will be loaded into the vehicle, such as ramp or lift system, and making sure that it is secured to the vehicle during transport needs to be considered.

Another consideration is where the wheelchair user will ride during transport. If the user is able to safely sit in the auto without the special supports provided by the wheelchair, then the wheelchair may be transported in the trunk. However if the user needs to ride in the wheelchair during transport, a large vehicle such as a van is generally needed. In this situation, the same considerations needed with power wheelchairs of loading method and method of securing the chair during transport is needed.

ROLE OF THE SPECIAL EDUCATOR IN WHEELCHAIR MANAGEMENT

It is not anticipated that the special educator will bear primary responsibility for either the selection or maintenance of a student's wheelchair. The special educator does not need to be able to choose or repair the wheelchair components. With that understood there still is a role for the special educator to play.

Assist with Integration of Assistive Technology into the School Culture

A study conducted in Sweden by Hemmingsson, Lidstrom, Nygard (2009) revealed social barriers reported by users of assisted mobility devices and other assistive technology. The lack of, or perceived lack of acceptance and incorporation of available assistive technology by teachers, user's resistance to being perceived as different by peers, the burden of protecting assistive devices from other students were among the barriers mentioned. Special educators can help to diffuse many of these barriers through advocacy on behalf of the use of assistive technology with other teachers, students, and the user himself or herself.

Awareness of Functional Problems

The special educator has the unique opportunity to observe the student who uses a wheelchair within the educational setting. The teacher may be the only person who is aware of how the wheelchair functions in all the settings the student encounters at school. Since other people in the student's life do not have this information, it is important that special educators share their observations of how the wheelchair functions within the school settings, report areas where the wheelchair causes the student difficulty, and initiate requests for repairs when needed.

Accessing Resources

Each educational system may have a slightly different sequence for communication regarding care and use of the wheelchair. Whatever the sequence, the major resources available to the special educator are the same. Depending on the availability of the occupational and/or physical therapists who provide educational therapy to the student at school, concerns related to body support and requests for simple repairs may be appropriate to direct to one of these professionals. They can determine if the issue is able to be cared for at the school level or not. Therapists can also be a valuable resource when equipment replacement is considered. They can often provide a unique perspective that is not available to other people involved with the wheelchair and its use. An evaluation by an occupational and/or physical therapist is needed to provide documentation of the medical need for new or replacement components or wheelchairs.

Parents should be kept informed of any changes to their student's wheelchair since it may impact the use of the chair outside of the school setting. If repairs are needed they also need to be informed regardless of whether they need to arrange a visit to the wheelchair supplier or if repairs will be cared for at school. This will prevent duplication of efforts. Parents are the team members who have access to the most current information about insurance coverage and information about how the wheelchair functions outside of school. Their input is necessary whenever equipment replacement is being considered.

Wheelchair suppliers are the local equipment provider. They have access to replacement parts and can assist with more complicated repairs. They can determine if changes to the current chair are possible without needing a new wheelchair. If a new wheelchair is needed, these professionals assist with placing the order to the wheelchair manufacturer. They are the first to know if funding authorization for equipment has been approved.

Sometimes a student's wheelchair, positioning, or access issues are complicated to the degree that professionals and parents are uncertain about the direction to proceed in supplying a wheelchair to a student that will maximize the student's ability to be independent. In such a case, a professional with additional training and experience with wheelchairs may be helpful. These professionals are often physical and occupational therapists and wheelchair suppliers with a special certification designated by the initials ATP, Assistive Technology Professional. A list of ATP certified professionals in your area can be obtained at http://resna.org/find-a-certification. Searches may be made by state and area of assistive technology practice. Wheelchair specialists are listed under the Seating and Wheeled Mobility area of practice.

CONCLUSION

Wheelchairs as assistive technology are tools that can assist a student with a movement disability function better within the educational setting. This improved function will result in the student feeling more confident and capable. However, the equipment needs to be appropriately matched to the student, the activities, and the environments that the student encounters. Making this match is a complex process. No one person or professional, whether parent, educator, or therapist, can achieve this task alone. The best student outcomes will be achieved by the collaboration of team members including the informed special educator.

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KEY TERMS AND DEFINITIONS

Access: The ability, right, or permission to approach, enter, or use.

Component: A part of a mechanical system such as a wheelchair.

Functional Distances: The distance typically traveled in the course of the individual's daily routines.

Muscular Incoordination: A lack of coordination or organized muscle movement.

Positioning: A bodily posture, especially a posture promoted through the use of external supports.

Propelled: Caused to move.

Recline: In a wheelchair, a back support that allows the user to lean or lie back while the seat position remains unchanged.

Tilt-in-Space: In a wheelchair, the ability of the seat and back support to rotate while the position of the seat and back in relation to one another remains unchanged.

Transport: The act of carrying, moving or conveying from one place to another.

DISCUSSION QUESTIONS

1. **If you were to confine yourself to use of a wheelchair for an entire school day including extracurricular activities, how might your ability to access classes (including lab classes) and after school activities differ from the typical student? Would you need to expend more time or extra effort?** Think about how you would enter each building. Think about how you would get from class to class, floor to floor, building to building. Think about seating in each classroom. Think about table or counter height. Think about how students directly participate in different learning activities.
2. **What extra challenges do students who use wheelchairs face in making friends?** Wheelchair users may take longer to get from place to place; therefore they have less time to spend getting to know other students in the period before or after class. They may have to have special accommodation for seating that physically separates them or makes them different than other students. Typical students may not feel comfortable or know how to interact with someone who uses a wheelchair; therefore they might avoid the wheelchair user to reduce their discomfort.
3. **What might you do as a teacher to reduce extra challenges for the student who uses a wheelchair?** You might use part of an early class period for self introductions with a suggested short list of topics to be addressed chosen to highlight areas of commonality. Assign discussion groups with random groupings instead of the common buddy groupings, or seating proximity. Depending on the personality of the wheelchair user, you might interview the student in class to assist in breaking down perceived misconceptions.
4. **Do students in your school recognize the role a wheelchair plays in the life of a student with a movement disability? How do they demonstrate this understanding in how they treat this equipment?** One way you might demonstrate this concept is to ask students to list one item that is essential to them. Ask them how they would feel if someone ruined or abused this item. Discuss why a wheelchair (or other mobility device) is essential to the user. Ask them to respect this device as they would like others to respect their essential items.

Chapter 7
Trial and Error with Assistive, Accessible, Augmentative Technology

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ABSTRACT

This chapter describes the author's experiences in using assistive technology in undergraduate teaching. He argues for the importance of recognizing social factors that contribute to inequalities involving people with disabilities. The objective is to offer the simple, practical example of the author's use of communications technology.

INTRODUCTION

This essay describes my experiences since 1995, teaching at the university level, and using assistive technology. My hope and purpose in writing this essay is that my experiences will not be "exceptional," since technology works at its best when it is "seamless" and mundane.

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CASE

I have taught Political Science at Chapman University in Orange, California since 1981. Most of my teaching is in International Relations. Since 1995 I have developed Disability Studies courses, *People with Disabilities in Politics and Society*, and *Disability and the Law*. In every course, given the potential for assistive technology worldwide, my means of communication are, to paraphrase Marshall McLuhan, the media as well as an important part of the message.

Changing part of the world is inextricably connected to the educational mission of "explaining things." Power inequalities, and attempts to reduce them, are explicitly part of my discipline, and particularly of classes in which people with disabilities in politics and society are the focus. My hope is that communications technology is "stealth technology," so that rather than serving as a noticeable barrier, the technology augments the teaching and learning experience of teacher and students.

I have had the fortune of witnessing changes in communications technology in a brief period of time (less than two decades). This has included more natural sounding computerized voices, fewer problematic pronunciations, and fewer dilemmas of either having incorrect pronunciation from the computer, or incorrect grammar in the projected text.

I have used two software programs which function similarly. Initially, I used *Write Out Loud* from Don Johnston, Inc. Since August, 2009 I have used *Natural Reader*. With both programs, and equipment at Chapman University, a prepared written text is projected and a computer "speaks" what is written. (Other people might instantly generate new text, but I do not. I only have use of one finger [I therefore type extremely slowly], and my speech is impaired).

Computer-spoken and projected text is useful for students who learn in multiple ways. Many students read the text, which is then posted on a learning platform (Blackboard). My alternative mode of communication was particularly useful with hard of hearing or deaf students. Another discovery was that different seating arrangements are appropriate for different students. For example, one student was very far-sighted, and could sit in the back of the class room. Typed, saved, and projected text has the advantage of a concrete record, a way to resolve conflicts about what was said. Trial and error, and error and revision, have been central to my teaching and learning process.

Commercially available software has aided me, and new applications from Microsoft and Apple (notably the iPhone and iTouch) have great potential for increasing my access and other's. Open source software can and should allow the benefits of new communications technology to be universal. Joseph Shapiro noted in *No Pity*: "universal design-the idea of making things simple to use by people with and without disabilities alike-is newly in vogue among designers and architects." Universal design is now fortunately also in vogue with educators and instructional technologists. My experience bears this out.

CONCLUSION

Paul Watzlawick taught us that: "One cannot not communicate." With instructional technology that is human centered, I see a parallel: One cannot not be political. Political choices that recognize the interdependence of use of technology in education, with such factors as personal assistance, transportation, access to medical care, and employment, are vital to the inclusive, seamless, barrier-free, accessible, assistive world that can be.

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KEY TERMS AND DEFINITIONS

Universal Design: The concept of being barrier free, so that anyone can have access.

DISCUSSION QUESTIONS

1. **What factors contribute to reducing or increasing barriers to use of assistive technology? How are these barriers likely to appear in 10 years? In 20 years? How does access to assistive technology differ in different parts of the world?** Political, economic, and social factors contribute to barriers to use of assistive technology. Federal, state, and local governments have programs that provide assistance, but these all face budgetary constraints. Information is another significant constraint, since often potential beneficiaries of assistive technology will not have information about them. Factors such as levels of economic development make a big difference in access to assistive technology. Because of budgetary cutbacks, barriers are likely to intensify or remain the same over the next 10 years, but with an improving economy worldwide they are likely to be present although less severe in 20 years. With an aging population, the nature of access challenges is likely to change.

Chapter 8
Voice/Speech Recognition Software:
A Discussion of the Promise for Success and Practical Suggestions for Implementation

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ABSTRACT

In this chapter, the authors discuss the promise of speech or voice recognition software and provide practical suggestions for the teacher or any stakeholder working with a disabled child. The authors begin the chapter with a brief overview of the legislation mandating the accommodation of special needs students in the classroom and discuss the implications of assistive technology. The authors then move on to an examination of the promise of the software. The authors end the chapter with practical ideas for implementation should the caregiver believe that voice recognition software will assist the disabled child in the learning process.

INTRODUCTION

Assistive technologies hold much promise for students with disabilities. In fact, it is guaranteed in federal law in both Canada and the United States as well as in myriad countries around the world. Specially, Section 15.1 of the 1982 Canadian Charter of Rights and Freedoms and Section 602.1 of the 2004 American Individuals with Disabilities Act (IDEA) mandate that students with special needs have the right to assistive technology in

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their classrooms and cannot be denied that right. In fact, Canada appears to be the first nation to constitutionally guarantee the right to education for students with special needs in its federal law that

Every child is equal before and under the law and has the right to the equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on race, national or ethnic origin, religion, sex, age, or mental or physical disability (Government of Canada, 1982, emphasis added).

Generally, assistive technology is separated into assistive devices and assistive services. The former 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 a child with a disability" and the latter "means any service that directly assists a child with a disability in the selection, acquisition, or use of an assistive technology device" (US Department of Education, 2004). Additionally, both Universal Design and Universal Design for Learning (UDL) literature support the idea that all students, disabled or not, require assistance in the classroom so that products can be used by all in the classroom (Center for Universal Design, 1997; Center on Applied Special Technology, 2006; Rose & Meyer, 2002); however, the need for specialized devices and services for students with special needs, in particular, will always be strong (Bowes, 1999; Dell, Newton, & Perroff, 2008).

It is important to note that the device in and of itself is not enough to ensure successful integration of assistive technology since there also needs to be training for and maintenance of the device. To wit, the Individuals with Disabilities Act (IDEA) (1994) definition of service includes (a.) assessing the child in his or her learning environment, (b.) providing the device to the child through purchasing, leasing, or any other means necessary, such as donation, (c.) ensuring that the device is kept up and continues to serve the needs of the user, (d.) augmenting the device with services provided by other paraprofessionals such as speech and language pathologists and occupational therapists, (e.) providing training or technical assistance to the child and his or her caregivers, and (f.) training or technical assistance for persons working with the child in a variety of learning situations. In other words, the statutes allow for any device or service needed by a student with a disability to be provided in the classroom with appropriate training for the student, teacher aide, or teacher and so forth. These devices and services can range from supplying, modifying, repairing or upgrading a device to an augmentative speech device to training of professional and paraprofessionals to the use of predictive software to a pencil grip. One specific device that the authors would like to discuss is speech or voice recognition software.

Since the point of assistive technology is to impact the functioning of the child (Bowes, 1999; Dell, Newton, & Perroff, 2008), speech recognition software is a welcome addition to the repertoire of support systems for students with the disabilities (MacArthur, 1999a, 1999b; Speaking to Write, 1999). The most common software speech recognition software package is Nuance™'s Dragon NaturallySpeaking. Other packages include Quillsoft's SpeakQ and Microsoft Word's voice recognition feature. Each involves the student dictating words into the computer through an internal or external microphone or integrated headset. In this way, students who struggle with keyboards or handwriting can bypass the keyboard and learn to write by saying their words into the computer. The process of actually physically creating words is not an issue; however, the student's task does carry a much higher cognitive load since the student is required to not only say the words and punctuation but also read the words on the screen to check for accuracy, correct any errors that might have occurred in syntax or semantics, revise the words, and gather the train of thought to continue the process for each word or sentence.

Speech recognition software has evolved so that it can now be used for manipulating text on the computer such as dictating as well as for implementing commands to control the computer such as moving the mouse or words on the screen. When words are dictated one word at a time to control the keyboard and mouse, the student is using discrete speech programs that rely on precision and exact pronunciation. Most cell phone owners understand this type of program if they use voice commands to control dialing the phone; they know that there needs to be consistent pronunciation or they will end up phoning the wrong person or business. Although the authors acknowledge the argument that there has been discrete speech recognition software packages such as DragonDictate Power Edition, the authors find that adapted training programs for the student can allow easy access to and use of continuous speech programs. The authors argue for the Optimal Utterance Length (OUL) as a standard measure of how much language the student can produce. Specifically, the Optimal Utterance Length is the maximum number of syllables that a student can produce without decreasing in loudness or increasing rate to complete the utterance. This Optimal Utterance Length will vary according to a number of factors that may include posture, breath control, circumstances, cognitive load, and so forth. In practice, this will be the number of words, syllables (and including pauses) that the student can say at a given time. The other type of speech recognition software is continuous speech programs in which the user dictates phrases or sentences and can execute basic keyboard and mouse commands. The actual choice of type of training program is dictated by the needs of the individual student. If the student has a hard time articulating more than one word at a time, then an adapted training program that emphasizes smaller utterances and differentiates rate would prove to be more suitable. The student who can speak in strings of words and is concerned with increased speed and accuracy would benefit from the continuous speech programs such as Dragon NaturallySpeaking Preferred or Dragon NaturallySpeaking Professional.

MEETING THE PROMISE

One of the most promising writing technologies of the last 25 years has failed to deliver for many people with disabilities. Speech recognition software promised to unlock the potential of many who struggled with the physical act of writing. Those who had difficulty with pen to paper tasks, whether it was because of a physical limitation or print-based learning disabilities, often would fail to master the skills necessary to use speech recognition technology effectively. An adapted training regime can often help establish the suitability and potential baseline performance of speech recognition as a writing tool for individual users.

One has to enter the world of speech recognition with eyes and ears open. At its most basic level, speech recognition software is an alternative to keyboarding. It is simply a way to put words into a document. It does not bring writing skill, proficiency, or creativity to the writer. In many cases, the user is restricted within which the environment it can be used.

On the one hand, the positives of using speech recognition software are many, including increased written output and academic productivity. Spelling accuracy can increase as well as the sophistication of the finished product. On the other hand, speech differences, print disabilities, and dictating environment often prove to be insurmountable barriers to initial training. However, after several sessions of training, the user often overcomes these barriers but not without much practice and perseverance.

PRACTICAL SUGGESTIONS

In this section, the authors discuss some practical suggestions for implementation of speech recognition software using one specific software package, NaturallySpeaking but the suggestions would be applicable to similar software programs. NaturallySpeaking (version 9 and higher) offers some options that allow for adaptations in training without sacrificing the integrity of the user's voice file. The authors begin by arguing that there needs to be a definite starting point at which all involved in the decision-making process arrive at a decision as to whether the student will benefit from using speech recognition software. Additionally, the authors provide specific suggestions for adapted training.

The starting point involves determining whether speech recognition brings enough benefit to the user. The best way is to compare the corrected word per minutes using speech recognition with other methods. While the user may achieve a dictation rate in excess of 30 wpm with 80% accuracy, the rate may fall to less than three words per minute after time is taken for correction. One must compare this method to other methods of writing.

The first hurdle all users must jump over is the initial training session. This is where the student's speech and voice parameters are measured and the noise levels of the dictating environment are determined. If literacy or fluency is an issue, the teacher may substitute a known passage such as the months of the year or the days of the week repeated until the calibration is complete.

This dictation environment should be robust during calibration. A certain amount of background noise will allow the dictator to be coached during his or her training and dictation sessions with less risk of the coach's voice being picked up by the computer. This process is much easier with the use of a double-element, noise-cancelling microphone.

Most speech recognition software requires an initial training session that consists of dictating a passage presented on screen. If reading, speech rate, or fluency are challenges, the teacher may wish to turn the screen away from the student and in a quiet voice, present the student with the material to be trained. This adaptation allows for the teacher to model a good reading rate and breath control and reduce anxiety about fluency.

NaturallySpeaking can also improve its recognition accuracy by data-mining the student's e-mail and the contents of the My Documents folder, which helps the program build its list of words and phrases. If the teacher adds documents to this folder that contain curriculum material, it will help tune the application to the student's individual academic needs.

The main task of the software is to take the user's speech and organize the stream of syllables into meaningful and accurate text. A phrase such as "It is hard to recognize speech" may be misrecognized as "it is hard to wreck a nice beach." A slight pause at the end of each multisyllabic word can increase initial recognition levels dramatically. The training coach should model this type of dictation pattern for the student.

Using NaturallySpeaking's audio playback feature to analyze dictation errors and misrecognitions is an effective method to fine tune the process. If the teacher plays back the dictation on his or her own, he or she will get a better idea of some of the challenges to be overcome. Then the teacher can demonstrate to the student which errors or misrecognitions are occurring so that the student can be more conscious of corrections when dictating. Eventually, the process becomes much more natural so that it becomes second nature to the student when using the software.

Another effective method is to utilize an adapted dictation style that optimizes breath control for accuracy. In this way, the teacher can model for the student how to modulate the voice to maximize word recognition by the computer. Once again, as the student practices and perfects the adapted dictation style, he or she becomes much more adept at knowing when to change to accommodate many possible pitfalls in the dictation process.

Lastly, the teacher can demonstrate how dictation or practice exercises for specific purposes can markedly improve the process. For instance, if the focus is on literacy, the teacher can model how to articulate words better so that the speech recognition software picks up on the nuances of language or if speed and accuracy are more important, the teacher shows how speaking in short phrases will help the student get the words onto the screen while at the same time, allowing for thinking through the next part of the dictation.

In the authors' collective experiences, these simple and practical suggestions increase the likelihood of the speech recognition software training process progressing more seamlessly. If the teacher acts as a model (and practices many of the suggestions well in advance of working with the student) and then coaches the student to follow the same procedures, all stakeholders benefit and the power of the program can be realized.

CONCLUSION

Most students are competent with technology, in general, and computer use, in particular, as they are members of the Net Generation (Tapscott, 2009) or have been dubbed the Digital Natives (Prensky, 2010). These students' natural abilities using computers augmented by strong oral language skills, several training sessions, and the ability to stay motivated to master the software and persevere through trial and error sessions, all lead to a higher level of success (Dell, Newton, & Perroff, 2008; Speaking to Write, 1999).

Speech recognition software has met its promise in most cases. Some students should not use the programs, especially if they have problems with speech or thinking of words is a taxing activity with a high cognitive load. For many students, if they are competent at creating words and stringing those words together or if they persevere with the initial training, speech recognition software is a major assistive technology in the classroom and a major contributor to their academic success throughout their schooling years.

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IBM Via Voice. www.306.ibm.com/software/voice/viavoice

iListen: www.macspeech.com

ReadPlease. www.readplease.com

SpeakQ.www.wordq.com

KEY TERMS AND DEFINITIONS

Charter of Rights and Freedoms: Section 15.1: Canadian federal law that students with special needs have the right to assistive technology in their classrooms and cannot be denied that right.

Individuals with Disabilities Act (IDEA): US American federal law that students with special needs have the right to assistive technology in their classrooms and cannot be denied that right.

Optimal Utterance Length (OUL): The maximum number of syllables that a student can produce without decreasing in loudness or increasing rate to complete the utterance.

Speech Recognition Software: assistive technology software that enables students with disabilities to record and manipulate information through the use of their voices.

DISCUSSION QUESTIONS

1. **What examples can you think of in your classroom for assistive technology devices and/or services that are used?** Which ones are needed that you do not presently have? Answers would vary here, but one would expect to read about devices such as pencil grips, talking calculators, predictive software, and augmentative speech and services such as school psychologists' assessments, assistive technology training, and replacing laptops for students with special needs.
2. **In what circumstances do you see using discrete utterance or continuous utterance training programs?** Answers will vary but the authors would expect that readers would see the discrete utterance programs should be used for students who need to say a word at a time due to articulation or word retrieval problems whereas continuous utterance programs should be used for students who prefer to dictate in phrases and need to get the words down on the screen to maintain the writing flow.
3. **If you follow the practical suggestions listed in this chapter, what challenges do you anticipate?** Answers should be related to uncooperative or unmotivated students or the teacher not being able to train the software on his or her own.
4. **How would you determine the net benefit of speech/voice recognition over existing methods?** Answers should consider environments in which this method is used and alternative writing strategies that can be used where speech/voice recognition is not suitable.

Chapter 9
A Guide to Assistive Technology for Teachers in Special Education

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ABSTRACT

Everyone has the right to learn and to succeed in education. For people with certain disabilities, learning can be a challenging task, and proper use of certain assistive technologies can significantly ease the challenge, and help the learners to succeed. For teachers in special education, knowing existing assistive technology is an important step towards the proper use of those technologies and success in special education. This chapter provides a guide for teachers about assistive technology and its uses in special education. Assistive technology for people with learning difficulties, assistive technology for the visually impaired, and assistive technology for people with hearing difficulties will be discussed. Since online learning and the Internet are becoming trends in distance education, this chapter will focus on assistive technologies for Web-based distance learning, including assistive technologies for better human-computer interaction. Selecting more appropriate assistive technology for a given learner with a certain learning disability, among many choices, will be discussed.

INTRODUCTION

Education is important for everyone including those with certain disabilities. In practice, learners with certain disabilities face more challenges and difficulties than others. To succeed in education, those learners must overcome the challenges and difficulties they are facing.

In addition to their own great courage and help from families, friends, and the society at large, effective and efficient use of assistive technology and devices is very important for learners with special needs to overcome those challenges

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and difficulties, and to succeed in education. In some cases, appropriate assistive technology can make hard learning tasks become easier; while in other cases, assistive technology can even make the impossible become a reality.

There are many different types of disabilities, and some of them have no or little effect on learning. The assistive technology referred to in this chapter is for disabilities that have significant effects on learning. Those disabilities are mostly perception, cognition, and presentation or expression related, as learning essentially involves tasks of perception, cognition, and presentation.

Perception Related Disabilities

Perception related disabilities include vision disabilities and hearing disabilities. These two types of disabilities have obvious effects on learning. For example, people with vision impairment will have difficulties reading, or cannot read at all, while learners with hearing impairment will not be able to listen to lectures in classroom, or will have great difficulties listening.

Cognition Related Disabilities

Cognition related disabilities include disabilities that affect memory and comprehension. Such disabilities may be caused physically or psychologically. For example, damage to part of the brain may result in difficulties for someone to memorize things. Regardless the cause, the effect is the same: with such disabilities, it is hard for someone to remember, to comprehend things, and to plan (LoPresti, Bodine & Lewis, 2008).

Presentation Related Disabilities

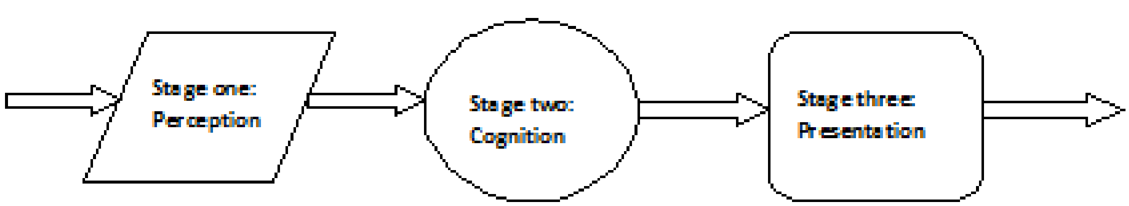
Presentation related disabilities include disabilities that affect one's ability to speak, to write and/or to use keyboard and mouse to interact with computers. In the process of learning, it is important for learners to express or present their ideas, thoughts, questions and answers to their teachers or peers for collaboration, help, exchange of knowledge, and assessment. In any given learning environment, learners with certain presentation related disabilities must be given some way to express. Traditionally, for learners who can't speak, hand language is often used, but that only gives those learners the ability to express to others who can understand the same hand language, not to the general public. Fortunately, the advancement of assistive technology has made it possible for those learners to speak to the general public, as we shall see later in the chapter.

If we depict learning as a three-stage process shown in Figure 1, then problems at any stage will hinder the entire learning process. That is why we have put learning-related disabilities into three categories as discussed above.

For teachers in special education it is important to know about different types of disabilities and available assistive technology for each type of disabilities.

In the rest of the chapter, we will provide some details about assistive technology, including systems and devices, currently available on the

Figure 1. Learning as a three-stage process



market or in the public domain as open-source systems, and then talk about how to select appropriate assistive technology for learners with special needs. Since online learning is becoming a trend in education, we will also talk about assistive technology for online instruction and discuss about issues related to designing online courses for people with disabilities.

ASSISTIVE TECHNOLOGY FOR PEOPLE WITH HEARING IMPAIRMENT

Hearing impairment is perception related disability. For learners without complete hearing loss, using assistive listening devices or ALDs can be a good option. In fact, today's technology has made the best hearing aid devices we have ever known. They are not only more effective with the best clarity, but also smaller and even invisible. They could effectively turn a person with hearing difficulties into a typical learner.

For learners with complete hearing loss, other channels of perception must be explored and used. If the learner is hearing impaired but not visual impaired, a speech-to-text (STT) can be used.

A speech-to-text system can be as simple as a computer program running on a computer with microphone or mic input or it can be a stand-alone device for the sole purpose of speech-to-text. In any case, the fundamental functionality of a speech-to-text system is to recognize speech (Ng, Zhang, Nguyen, & Long, 2008), convert the speech into text, and display the converted text on screen or print the text on paper.

Where may speech-to-text systems come to help? In the classroom a speech-to-text system can be used to help learners with hearing impairment to "listen" to lectures by converting the speech into text and displaying the text for the learners on computer.

Commercially Available Speech-to-Text (STT) Systems

There are many commercial Speech-To-Text systems available on the current market including the Dragon Naturally-Speaking systems offered by NUANCE (http://www.nuance.com). For individuals, the Dragon Naturally-Speaking systems have two versions: Dragon Home and Dragon Premium. As a speech recognition system, the Dragon Naturally Speaking system not only recognizes speech and converts speech into text, but also can be used to control a computer.

Spelling and Grammar Checkers

Although technology has advanced so much over the years, today's speech-to-text systems are still far from ideal. The best ones such as the Dragon Naturally-Speaking systems can only achieve 85% to 95% accuracy (Martin, 2007). So, spelling and grammatical errors are unavoidable in speech-converted text. To improve speech-converted text, spelling and/or grammar checkers should be used.

There are many spelling and even grammar checkers and correctors available. Microsoft Office Suite (Microsoft, Office 2010 trial version available from http://office.microsoft.com/en-us/) has its own spelling checker built-in. So, once converted into text, one can use Microsoft Word to open the text file and to check the spelling and grammar. In most cases today, such checking is automatic, which means one doesn't need to activate the spelling and grammar checker by pressing a key or keys, or clicking a menu item. The spelling checker built into Microsoft Word (Microsoft) or other programs in Microsoft Office Suite (Microsoft) will automatically check, and put marks on misspelled words or grammatically incorrect sentences. In some cases, the program can even automatically correct if it has been configured to do so.

In addition to the spelling checkers built into Microsoft Office Suite (Microsoft) one may have,

Figure 2. Hand-Held Magnifying Glass for Reading

some companies also offer software products that are said to do a better job in spelling checking and even proof reading, which can help to improve writings. WhiteSmoke Writer 2010 (WhiteSmoke) offered by English Software (http://www.englishsoftware.org/) is a good example of such systems available in the market. WhiteSmoke can be freely downloaded from the website, but if one wants to actually use it, a paid registration is required. The nice thing about WhiteSmoke is that it can be plugged into various software tools as an integrated part.

There are also freely available spelling and grammar checkers, and some of them are right online. They can be accessed through a Web browser. Grammarly offered by Applied Linguistic LLC (available from http://ed.grammarly.com/editor/view/?f=1 is a good example of such spelling and grammar checkers). In Grammarly all one needs to do to check and improve the writing of a text is to copy and paste the text into an online textbox, and the system will generate a report about the spelling, grammar, and suggested changes to the text based on the context. So, it is rather intelligent.

ASSISTIVE TECHNOLOGY FOR THE VISION IMPAIRED

Learners with vision impairment will have difficulties reading, or cannot read at all. In the former case, the solution is to magnify the content of reading materials using devices as simple as a magnifying glass, as shown in Figure 2.

To read on computers, in addition to the magnifiers that come with Microsoft Windows (Microsoft), Microsoft Office (Microsoft) and web browsers, there are also other magnifying programs available on the market or in the public domain. Virtual magnifying glass (http://magnifier.sourceforge.net/) is a free open-source screen magnifier that can run on many different computer environments including Microsoft Windows Vista, Microsoft Windows 2003, Microsoft Windows XP, Microsoft Windows 2000, Microsoft Windows NT, Microsoft Windows ME, Microsoft Windows 98, a UNIX system running X11 (any Linux Distribution such as RedHat, and FreeBSD), and Mac OS X 10.4 or higher.

There are also more advanced assistive technologies available today for learners with difficulties to read. The following are some examples.

Large Computer Monitor With or Without a Screen Magnifier

Specially made large-size computer monitors can display content in a bigger size. In some cases it is big enough to read even without a screen magnifier. Dell (DELL) sells 27-inch liquid crystal display (LCD) monitors for below $1,000 (Canadian) after discount, and some even larger monitors are being sold at BestBuy (BESTBUY, http://www.bestbuy.ca) for less than $400 (Canadian) at the time of this writing.

Video Magnifiers or Closed Circuit Television (CCTV)

On these systems, printed materials are placed under a camera which takes the images of the printed materials, then magnifies and displays the images on a screen.

Scanner with an Optical Character Recognition (OCR) Utility Program

The scanner is used to scan printed materials into electronic data, and the optical character recognition utility program converts the image data into text. The text can then be processed and further feed into a Text-To-Speech (TTS) system to generate speech, or just be magnified and displayed on a screen.

For learners who cannot see or read at all, a text-to-speech system, or a standalone reading aid, which integrates a scanner, optical character recognition utility program and a text-to-speech system into a single machine, can be used. If the learner is familiar with Braille language, a scanner with optical character recognition and Text-To-Braille converter can be used with a tactile monitor (Shinohara, Shimizu, & Mochizuki, 1998). There is also a Braille embosser. Connected to a computer in the same way as a printer, a Braille embosser creates Braille output by punching dots onto paper.

ASSISTIVE TECHNOLOGY FOR LEARNERS WITH COGNITION-RELATED DISABILITIES

Cognitive impairment can have some serious effects on learning. It limits one's ability to plan, remember, sequence thoughts and actions, manipulate numbers and symbols, and to develop conceptual knowledge (LoPresti, Bodine, & Lewis, 2008). According to an article by Braddock, Rizzolo, Thompson, and Bell (2004), the number of people with a cognitive disability in the USA has reached tens of millions. To help people with a cognitive disability, especially those at young ages, to succeed in education is a very challenging yet important task for teachers in special education. In this undertaking, assistive technology can be a great assistant.

When developing or selecting assistive technology for learners with cognitive disabilities, one must know the kind of disability or disabilities the learner has, and the impacts, in order to be helpful in alleviating the impacts on learning. If the learner has dyslexia or dysgraphia, then speech-to-text system, spelling and grammar checker may be used to assist in writing. If the learner has difficulties in planning and managing learning tasks, a computer program such as calendar in Microsoft Outlook (Microsoft) on a computer, a personal data assistant (PDA) or smartphone can be used to help planning. If the learner has problems with remembering dates, times or things on their agenda, calendar systems on computers, personal data assistants and smartphones have functionality built-in to alert and remind at a given time. To assist in conceptual knowledge development, special software such as mentioned in an article by Bates and Jones (Bates and Jones, 2003) can be used.

ASSISTIVE TECHNOLOGY FOR PEOPLE WITH PRESENTATION-RELATED DISABILITIES

For learners with difficulties speaking, writing and even interacting with computers, it is rather challenging or even impossible for them to present their ideas to teachers or their peers. For example, if a learner cannot speak, he or she won't be able to ask questions or answer teacher's query in a normal way. In such a case, a Text-to-Speech (TTS) system can be used to help.

As the name implies, a text-to-speech system converts text into speech through voice synthesis. When a learner with hearing impairment wants to ask a question in a classroom, he or she can simply type the question into a text-to-speech system, and the system will then generate the corresponding speech for the learner. The learner can present answers in the same way. Together with a speech-to-text system, it is possible for a learner with both hearing and speaking problems to communicate with others for knowledge exchange and presentation of questions and answers.

The most well-known open-source (for a definition of open-source, visit http://en.wikipedia.org/wiki/Open_source) text-to-speech system is Jovie, previously called KTTS, a Text-To-Speech system in KDE. KDE (The KDE® Community, www.kde.org) is an open-source desktop environment (http://www.linuxnewbieguide.org/content/chapter-7-what-kde), and Jovie/KTTS is currently released with KDE distribution as a module. At the time of this writing, the most current version of KDE is 4.5.1. Most updated information about KDE and Jovie is available at http://www.kde.org/download/, and http://techbase.kde.org/Development/Tutorials/Text-To-Speech. As a free graphic desktop environment, KDE offers not only a Linux version, but has been also ported to Windows (http://windows.kde.org/) and Mac OS X (http://mac.kde.org/) as well.

When you have many text-to-speech solutions to choose between, there is a need for evaluation of each choice. A white paper by ScanSoft (ScanSoft, 2010) provides some general criteria to base decision on when doing such assessment.

If a learner cannot write but can speak, he or she can use a digital voice recorder such as an Olympus WS-400S (Olympus, product information available from http://www.olympuscanada.com/cpg_section/product.asp?product=1456) to dictate speech, and then use Speech-To-Text system such as the Dragon Naturally Speaking system to convert the speech into text and then print or display. Better digital voice recorders such as the Sony ICD-MX20 even come with a STT system, which convert speech into a text file on its own.

ASSISTIVE TECHNOLOGY FOR DISTANCE EDUCATION

Distance education can be done by correspondence, via telephone, and the Internet. To correspond with an instructor at a distance, a learner has to find a way to present his or her ideas, thoughts, questions, answers or requests. In previous sections, we have discussed how speech-to-text systems can be used to transcribe speech into text and how to use spelling and grammar checkers to improve transcribed text. All these assistive technologies can also be used in distance education by learners who cannot write.

In order for hearing-impaired learners to use a telephone in distance learning, a text telephone, also known as a Telecommunication Device for the Deaf (TDD), or TeleTYpewriter (TTY) in the USA can be used. A telecommunication device for the deaf or TTY service first converts typed characters into tones, and then sends the converted tones over telephone lines. In order for a person with hearing impairment to hear what the other person at the other end of the telephone line is saying, a 'relay' service has to be used. In a "relay" service an operator reads the tones, and types back what the other end is saying. In order for a learner with hearing impairment to "hear" the other end, a telecommunication device for the deaf or TeleTYpewriter device usually has a small display or small printer to print out what the message, or even the transcript of the entire communication session for review. Using a telecommunication device for the deaf or TeleTYpewriter service together with a relay service, a learner with hearing impairment can then talk to his or her instructor or peers at a distance.

Because of the advances in computer, telecommunication technology, and the wide spread of the Internet in particular, telecommunication device for the deaf or TeleTYpewriter devices are becoming obsolete. Today's text messaging service provided over mobile phones can simply replace the service provided by the expensive telecommunication device for the deaf or TeleTYpewriter system.

Over the last decades advances in computing and information technology have completely changed the way in which distance education is done. Today computers and the Internet have replaced telephones and surface mail as major means for distance teaching and learning. For learners with a disability to learn from a distance, all they need do is have the right software tools installed on their computers, have the computer connected to the Internet, and then be able to interact with the computers. So, assistive technology for distance education in the Web age is really about assistive technology for human-computer interaction (HCI).

Software Tools for Distance Education

In the previous sections, we have talked about text-to-speech, speech-to-text software systems as well as spelling and grammar checkers that can be used to help learners with various disabilities related to learning. To do distance learning over the Internet, other tools available for learners to use include email, Web browsers, and office software such as Microsoft Word. Especially for communication with instructors and peers, MSN Messenger (http://explore.live.com/windows-live-messenger?os=winxp), Skype (http://www.skype.com/intl/en-us/home) or other similar products can be used. Much better than telephones, these tools are not only more efficient, they support all kinds of communication including text, audio and video. With MSN Messenger, for example, a learner with hearing or speaking impairment can communicate with other parties through text-messaging; if the learner cannot type, audio or even video communication can be used. Note that, in order to use audio communication on a computer, speakers and microphones need to be installed and enabled, and to use video communication a video camera or Webcam is needed, in addition to speakers and microphones.

In today's distance education through the Internet, another kind of software is learning management systems (LMS). Learning management systems are almost all Web browser-based. Some popular learning management systems include Moodle (http://moodle.com/), ATutor (http://www.atutor.ca/), and Blackboard (http://www.blackboard.com).

ASSISTIVE TECHNOLOGY FOR HUMAN-COMPUTER INTERACTION

Over the years, many assistive technologies have been developed through the great effort of researchers and the information technology industry. Some of those assistive technologies are software modules built into the computer systems, such as Windows, Microsoft Office and Web browsers. Some are special computer hardware components or devices designed to increase the accessibility for users with disabilities. With advancement of science and technology, new assistive technologies, devices and systems are still coming. The following are some examples of assistive technologies for learners with certain impairments.

Special Keyboards and Mice

For learners with mobility impairments, using a standard keyboard and mouse can be challenging. Some special keyboards have large keys and large prints for people to see and reach a key more easily. Some keyboards are designed and made for use with one hand, or even one finger; track-balls and joysticks are also available, in place of a mouse, for challenged learners;

Ergonomic Keyboards and Mice to Reduce Fatigue

Ergonomic devices are designed based on extensive studies of ergonomics and human computer interaction. They came with different shapes and layouts to suit users with special needs. The Footime Foot Mouse (http://www.disabledonline.com/products/direct-products/keyboardsmice/ergonomic-mice/footime-foot-mouse/), for example, even allows a user to use his or her foot to control computers.

Alternative Human-Computer Interaction Devices

In place of a keyboard or mouse, alternative means and devices have been explored to make it possible or easier for people with certain disabilities to interact with computers. Touchpads and joysticks are the most familiar examples of these alternatives. In recent years, research has been done to use eye-ball movement to control a mouse cursor on a computer screen (Porta & Ravelli, 2009), and to use Tooth-click to simulate mouse clicks (Simpson, Broughton, Gauthier, & Prochazka, 2007).

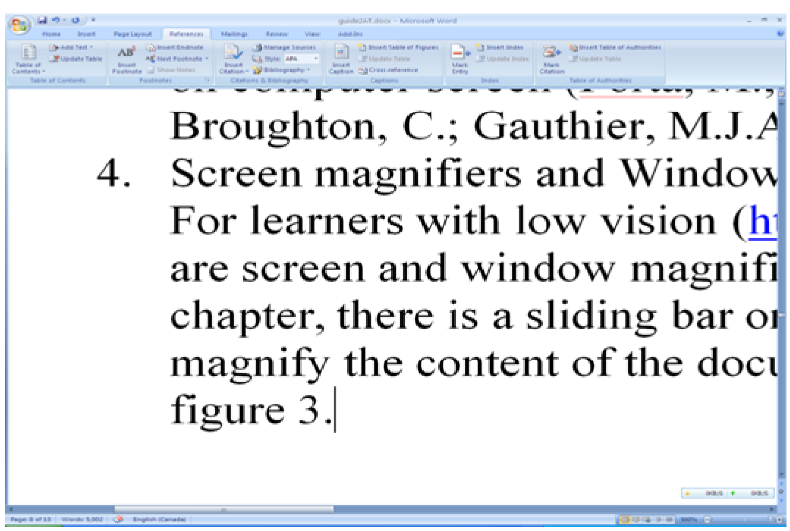
Screen Magnifiers and Windows Magnifiers

For learners with low vision, there are screen and window magnifiers to use. In Microsoft Word 2007, there is a sliding bar which can be activated and used to magnify the content of the document, up to five hundred percent (500%), as shown in Figure 3.

Similar functionality has been built in new versions of Microsoft Internet Explorer (http://www.microsoft.com/windows/internet-explorer/default.aspx) and Mozilla Firefox (http://www.mozilla.com/en-US/firefox/upgrade.html), Apple Safari (http://www.apple.com/safari/), Google Chrome (http://www.google.com/chrome), and some other Web browsers (http://www.free-web-browsers.com/).

In Windows operating systems such as Windows XP or newer versions, a suite of features are built-in to make the system more accessible for users with certain disabilities. For example, there are many options to make the display more

Figure 3. Magnified Content in Microsoft Word



readable such as changing the font size, color, screen resolution, and icon size. There are also options to make the sound more audible for the hearing impaired. The keyboards and mice can also be configured for better accessibility. For all the details of accessibility options provided in Windows XP by Microsoft, visit http://www.microsoft.com/enable/products/windowsxp/default.aspx. In Windows 7, assistive technologies are further enhanced. Details about those enhanced assistive technologies can be found at http://www.microsoft.com/enable/products/windows7/default.aspx.

SELECTION OF ASSISTIVE TECHNOLOGY FOR LEARNERS WITH SPECIAL NEEDS

When selecting assistive technology for learners with special needs, it is essential to know the type and severity of the disability and the assistive technology systems and devices currently available on the market or in the open-source domain. Previous sections have discussed the types of disabilities that have impacts on learning and the assistive technology that may be chosen for each type of disability. Once the type of disability is known, it is necessary to determine what particular assistive technology will be useful.

Over the years, researchers and practitioners have developed various standards for the design of assistive technology, especially their interfaces. Fitts' Law (Fitts, 1954) and Hick's Law (Hick, 1952) are two good examples of these standards, among many others.

Fitts' law states that the *time* taken for a user to move a pointer or cursor to the target on a user interface depends on two factors. These factors are the *size* of the target and the *distance* to the target. Accordingly, designers of certain assistive technologies should make clickable icons or buttons reasonably bigger and should arrange the clickable icons and buttons in a very thoughtful way. For example, clickable icons and buttons placed in corners or edges of the screen are much easier to reach, as the size of these clickable items can be considered infinite in one direction or two when the items are placed in corners.

Proposed by British psychologist William Edmund Hick, Hick's law states that the time taken for a user to make a decision is determined by the *number of choices* the user is given. The more choices one is given, the longer time it takes to make a decision. Essentially, Hick's law provides a general guideline for the design and use of hierarchical menu structures. This is consistent with the study (Landauer & Nachbar, 1985) showing that users do not consider each choice one by one. What they normally do is to subdivide the choices into categories, and choices in each category are further divided. The resulted structure will be a tree, which can help users to make a quicker decision.

As the research and development further advances in assistive technology and other related areas such as HCI, the needs for some international standards became prominent. In 1999, ISO13407 standards were published and gradually, more and more accessibility and ergonomic issues were addressed in the big group of ISO 9241 standards such as ISO 9241-171 (ISO 9241-171, 2008), which was released in 2008. In addition, there are 2 initiatives aimed at Web accessibility. These two initiatives are WEBAim (http://webaim.org/) and the Web Accessibility Initiative (http://www.w3.org/WAI/), which can be used to evaluate websites.

The principles defined in these laws and standards have often been used by the designers of computer systems and assistive technologies, but they can also be used in the selection of assistive technologies. When there are many assistive technologies with similar functionalities for the needs of a specific learner, these laws and standards can be used to evaluate the usability and accessibility of each assistive technology and to check to what extent it has met the requirements set in the laws and standards.

CONCLUSION

In this chapter first categorized the disabilities that can cause difficulties in learning. These disabilities were put into three categories based on a proposed three-stage learning model. For each category of disabilities related to learning assistive technologies were outlined that can be used to assist learners with that type of disabilities in learning. The assistive technologies outlined for each category are only part of the assistive technologies available, especially when considering the fact that science and technology are advancing very second.

Since today's assistive technologies are mostly computer-based, and because distance learning is becoming a big phenomenon, two sections were dedicated to assistive technologies for distance education and for better human computer interaction. To assist teachers and learners with the selection of assistive technologies, laws and standards were also discussed that can be used to evaluate and assess a given assistive technology for its usability and accessibility.

Luckily for people with various learning related disabilities today, great efforts from governments and all kinds of groups and individuals have never stopped to be put into the research, development, production, and promotion of all kinds of assistive technologies. These efforts have even been coordinated by government agencies, such as Industry Canada (AT-Links, http://www.at-links.gc.ca/ and http://www.disability.gov/education/assistive_technology), and sponsored by many big corporations such as Apple and Microsoft. There is no doubt that many new and more advanced assistive technologies will be developed and made available for more and more people with learning-related disabilities (Narasimhan, Gandhi, & Rossi, 2009; Fairweather, Hanson, Detweiler, & Schwerdtfeger, 2002; Israsena & Pan-ngum, 2007; Vanderheiden, 2008; Shinohara, 2006; Paniagua, Colomo, & García-Crespo, 2009).

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ADDITIONAL READING

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Grammarly offered by Applied Linguistic LLC: http://ed.grammarly.com/editor/view/?f=1

KTTS. A Text-To-Speech system, The KDE® Community: http://www.kde.org/download/ and http://techbase.kde.org/Development/Tutorials/Text-To-Speech

NUANCE http://www.nuance.com

Olympus, product information: http://www.olympuscanada.com/cpg_section/product.asp?product=1456

Open-source desktop environment: http://www.linuxnewbieguide.org/content/chapter-7-what-kde

Virtual magnifying glass (http://magnifier.sourceforge.net/

Web Accessibility Initiative: http://www.w3.org/WAI/

WEBAim. http://webaim.org/

WhiteSmoke offered by English Software: http://www.englishsoftware.org/

KEY TERMS AND DEFINITIONS

Assistive Technology: Technology that can be used to assist people with a certain disability in their living, study or work.

Cognition-Related Disability: A disability that has negative effects on one's ability to memorize, comprehend, plan or to perform other intellectual functions.

Perception-Related Disability: A disability that has negative effects on one's ability to perceive such as see and hear.

Presentation-Related Disability: A disability that has negative effects on one's ability to express such as write and speak.

Relay Service: A telephone service for callers with hearing impairment, in which an operator reads the tones, and types back what the other end is saying.

Three-Stage Learning Process: A proposed learning model that includes perception, cognition and presentation.

DISCUSSION QUESTIONS

1. **What disabilities may have effects on learning?** Disabilities that have negative effects on learning include those that can cause learners difficult or even impossible to read, hear, comprehend, concentrate, plan, speak or write.
2. **What are perception-related disabilities?** Perception-related disabilities are those that can cause learners difficult or even impossible to perceive such as see or hear. In medical term perception-related disabilities include vision impairments and hearing impairments.
3. **What are cognition-related disabilities?** Cognition-related disabilities are disabilities that make learner difficult to remember, to concentrate, to comprehend, to plan or follow a plan. One of the well-known cognition-related disabilities is dyslexia.
4. **What are presentation-related disabilities?** Presentation-related disabilities are disabilities that make learners unable or difficult to speak or write.
5. **What assistive technology and systems can be used to help learners with hearing impairment?** Hearing impairment is a perception-related disability. With hearing impairment, the learner will have difficulty to hear, or be unable to hear at all. For the former, hearing assistance devices can be used to help; in latter case, when a learner with a hearing impairment cannot hear at all, speech-to-text systems can be used to convert speech into text which can then be read by the learner.
6. **What assistive technology and systems can be used to help learners with visual impairment?** Visual impairment is another perception-related disability. With visual impairment, the learner will have difficulty to read in the case of low vision, or be unable to read at all. For the former, sometimes optical adds such as magnifying glasses can be used to help with reading; when using computers, zoom functions provided in my software systems such as Windows, Microsoft Office Suite and Web browsers can be used to enlarge the content; when a learner with visual impairment cannot see at all, text-to-speech systems can be used to convert text to speech for the learner to listen.
7. **What assistive technology and systems can be used to help learners who cannot speak?** For a learner who cannot speak, text-to-speech systems can be used to help. With a TTS system, the learner can type what he or she wants to say into the system, and then the system will convert the typed text into speech. In this process, spelling checkers can be used to correct the typos. With the help of TTS systems, a learner can do homework on computers, or ask questions in a lecture hall or classroom.
8. **What assistive technology and systems can be used to help learners who cannot write?** For a learner who cannot write or type, speech-to-text systems can be used to convert what the learner said into text. Due to the limitations of even today's speech recognition technology, there will be errors in converted text, so that spelling checkers will also be needed to improve the quality of converted text.
9. **What assistive technology and systems can be used to help learners with cognition-related disabilities?** Cognition-related disabilities can take different forms and have different effects on learning. For learners with dyslexia or dysgraphia speech-to-text systems, spelling and grammar checkers can be used; for learners with difficulty to remember, to sequence thoughts, to plan and manage learning tasks, computer programs such calendars and schedulers can be used. These programs are available on computers, PDAs and smartphones; for learners who have difficulty to

comprehend certain concepts, some special computer programs such simulators or games can be developed and used.

10. **How do you evaluate whether an assistive technology is suitable for a learner with a disability?** To evaluate whether an assistive technology is suitable for a learner with a disability, the first step is to know the type and nature of the disability, and then one will know whether an assistive technology is the right type. When there are several assistive technologies or systems available, the best one should be chosen based on some established standards. Over the years several standards have been developed for people in the assistive technology industry. Although these standards are made for the design and development of assistive technologies and systems, they can also be used to evaluate assistive technology.

Chapter 10
Assistive Technology:
A Tool for Inclusion

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ABSTRACT

Current federal legislation requires not only that students with disabilities be educated in the least restrictive setting but also that all students have equal access to a standards based curriculum. Providing this access can be a significant challenge for students who are unable to independently participate in traditional classroom activities. For these students, assistive technology supports may be the key to a successful general education placement. This chapter will discuss the process of designing and implementing assistive technology supports for a 2nd grade student with multiple physical, medical, and communication challenges.

INTRODUCTION

In 1975, the Education for All Handicapped Children Act opened the educational door to students with disabilities. As a result of that legislation, all children, regardless of ability, were guaranteed access to a free and appropriate public education (EAHCA, 1975). While this legislation opened the door to the school building, for many students, the door to general education classrooms remained tightly closed. Students with the most significant challenges were often placed in separate classrooms or buildings in an attempt to meet their unique educational needs.

Over the next thirty-five years, special education service delivery models continued to evolve. An initial focus on specialized instruction with "mainstreaming" gradually shifted to a focus on inclusive education (Zigmond, Kloo, & Volonino, 2009). Current legislative requirements address not only the right of a student to be educated in the least restrictive setting, but also the right of all

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students to have access to a standards based curriculum (Individuals with Disabilities Education Improvement Act, 2004; No Child Left Behind Act, 2001). Although IEP teams can determine that the general education curriculum is not appropriate for a specific student, it is expected that this will be the exception rather than the rule (Kohl, McLaughlin, & Nagle, 2006). While this legislation provides unprecedented educational opportunities for children with complex needs, it also poses a significant challenge to those charged with educating them.

BACKGROUND

In a typical general education classroom, instruction and assessment activities are interwoven throughout the school day. During instructional activities students may be asked to listen to a lecture, take notes, read a text, or search the internet for information. Formative and summative assessment activities may involve group projects, written responses, drawings, or participation in class discussions (Garrison & Ehringhaus, 1995). While some level of differentiation is usually present, it is rarely sufficient to meet the needs of students with complex motor and communication disabilities (Salend, 2009). For students who are unable to speak or hold a pencil, assistive technology is often the key to a successful general education placement.

Federal law defines assistive technology as “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 the functional capabilities of a child with a disability.” (IDEIA, 2004). Assistive technology serves two primary functions in the inclusive classroom. First, it can provide an alternative means of accessing general education curriculum materials. A student who is unable to read may be quite able to understand grade level concepts in social studies or science. Unfortunately, if those concepts are presented only through traditional text materials, the student may be denied an opportunity to learn material which he or she could have mastered. Since a well-designed curriculum builds upon previously learned concepts, students with complex needs can easily lose access to the building blocks necessary for future academic development.

The power of access to appropriate technology is illustrated in an example described by Erickson (as cited in Beukelman & Mirenda, 1992). In this situation, eight students ranging from 5-12 years of age were placed in a specialized classroom for the purpose of providing “intensive technology assistance.” At the start of this program all students demonstrated multiple severe disabilities, were non-readers, and had not been exposed to any type of assistive technology supports. The initial goal of the program was to provide assistive technology supports which would allow the students to be placed in less restrictive, but still segregated classrooms. Within two years, seven of the eight students were not only proficient with their technology supports but also reading within 1-2 years of grade level. Two had been placed in general education classrooms as competitive students and the others were in the process of moving to more inclusive placements. Without assistive technology supports, it is likely that these students would have continued to be perceived as having severe cognitive deficits and unable to benefit from access to traditional curricular materials.

Assistive technology supports can also allow teachers to more accurately assess a student’s mastery of the curriculum (Purcell & Grant, 2005). In the current climate of accountability, teachers are required to measure student progress using standards based assessments. In many cases, assessment questions and tasks are pre-determined and must be presented in a specified manner. Any deviation from this presentation must be documented and, in some cases, may cause the child to be scored at a beginning level of mastery regardless of performance. This presents a dilemma for students whose motor or communication disabilities prevent them from responding in the prescribed manner.

In response to this dilemma, many states have attempted to develop guidelines regarding allowable changes to mandated assessment procedures. Any change to an assessment is considered to be either a modification or an accommodation. As defined in Nebraska state assessment guidelines, a modification consists of "adjustments or changes in the test or the testing process that change the test expectation, the grade level, or the construct or content being measured." An accommodation "does not change the test expectation, the grade level, or the construct or content being measured." (Nebraska Department of Education, 2010). To further clarify this process, many state departments of education now provide specific lists of allowable accommodations for each major state-wide assessment instrument. In the vast majority of cases, the use of assistive technology supports to access or respond to test materials is considered an accommodation rather than a modification to the test itself. However, due to the legal requirements surrounding student assessment, the reader is strongly encouraged to review state and local policies prior to providing assistive technology supports during formal assessment activities.

There are hundreds of items which can be used as assistive technology supports. These items may be as simple as a highlighter pen or as complex as a camera which tracks eye movement to control a computer. Sweeney (2009) described a continuum consisting of three levels of assistive technology supports. At the bottom of the continuum are low tech tools which involve no electricity. These tools are often readily available or easily made and relatively inexpensive. Mid-tech tools generally involve battery power. While more complex than low-tech tools, mid-tech tools typically require only a short amount of training prior to implementation. In many cases, these are familiar items which are used in a unique way. For example, a CD or MP3 player may be used to access recorded textbooks. High-tech tools involve both electricity and electronics and require specialized training for successful implementation. Although high-tech tools can be powerful supports, they are typically less portable and less reliable than tools lower on the continuum. Due to the complexity of the equipment, high-tech tools are also more prone to failure and often require a low/mid-tech support as a backup.

Most students with complex needs require supports from all levels of the assistive technology continuum. These supports are typically identified through a formal assessment process which looks at the student's abilities, the task requirements, and the environmental demands prior to identifying potentially appropriate tools (Zabala, 1995). Often a student may require multiple tools to complete a given type of task dependent upon the supports available in a specific environment.

CASE: TERRY

Terry is a fun-loving seven year old girl who attends a general education second grade classroom. She has multiple medical and physical challenges which make it difficult for her to walk, change positions, and complete most fine motor tasks. Terry is able to walk for short distances but must be closely supervised since she is unable to catch or protect herself should she fall. Although Terry is able to hold a pencil when it is placed in her hand, her inability to move her wrists and elbows makes it impossible for her to complete written work. Terry is able to speak but has limited breath support and often speaks very quietly. Due to her serious health issues, Terry must always be accompanied by a nurse in the school setting. Over time, Terry has come to rely on the nurse or a para-professional to complete many of her assignments.

Terry shares her classroom with 21 other 7 and 8-year-olds. The teacher, Ms. Miller, encourages the students to participate in cooperative, hands-on learning activities. The students sit at desks arranged in groups of four to five but often move to other areas of the room to engage in small group activities. Reading, writing, and math centers line the walls of Terry's classroom. Although there is no computer available in the classroom, wireless network access is available throughout the elementary school.

During a typical day in Ms. Miller's classroom, the students engage in a wide variety of learning activities. Large group instruction alternates with periods of independent reading, small group activities, and written assignments. Students are often moving among the various centers in the classroom or working together on projects while Ms. Miller works with a small group of students. Throughout the day, Terry and several other students leave the classroom for short periods to work in small groups with the resource teacher, speech pathologist, or reading specialist.

Prior to the start of the school year, Terry's IEP team met to discuss the types of support she would require for a successful second grade year. Terry's parents and nurse reviewed her current medical status and discussed the types of medical equipment that must be readily available during the school day. The team then reviewed the assessment results from Terry's most recent multi-disciplinary team evaluation. Psychological testing indicated that Terry had average cognitive ability. Achievement testing, however, showed that Terry was slightly behind her peers in reading and math skills. The team agreed that Terry's delays in math and reading were likely related to her frequent absence from school. They also felt that Terry would benefit from more opportunities to work independently on assignments which provided practice on basic math and reading skills.

After a period of discussion, the team agreed on four guiding principles for the provision of assistive technology supports. First, these supports should allow Terry to participate as independently as possible in all aspects of her second grade classroom. Second, all supports should be designed so that they could be integrated into Ms. Miller's existing classroom structure with as little disruption as possible. Third, Ms. Miller must be able to easily implement the supports while continuing to engage in daily instructional activities. Finally, whenever possible, the supports should be portable so that they could be used in the home setting when Terry was unable to attend school.

General Classroom Access

Although Terry has a power wheelchair which she can drive independently, she prefers to be with the other students—on the floor, at her desk, at Ms. Miller's teaching table. Terry is able to sit safely in a beanbag on the floor though she needs assistance getting up and down. She is not, however, able to sit safely on a classroom chair. Terry is also unable to raise her hand to get Ms. Miller's attention which is an expectation of all students in the classroom.

During the preschool planning meeting, Ms. Miller had expressed concerns about the additional storage space required for Terry's medical equipment.(Table 1) Ms. Hamilton, the school principal, stated that the building would have several empty classrooms during the coming year. Plans were made to reserve an adjacent classroom for storage and medical needs. Terry's IEP team agreed that, on days when she was physically able, Terry would be allowed to leave her wheelchair in the adjacent classroom while in Ms. Miller's class. She could then move about her classroom under the direct supervision of the nurse. Terry would continue to use her wheelchair to travel to other locations throughout the school.

Terry also required additional storage at her desk; therefore, her desk group was composed of six desks. The sixth desk provided an additional work surface to allow room for a laptop computer. An adapted chair, with sturdy sides and a footrest, was modified so that it could fit under Terry's student desk. A revolving "police light" beacon was placed in the corner of Terry's desk

Table 1. Assistive Technology Supports and Vendors

Item	Vendor	Website
Adapted Chair	Rifton	www.rifton.com
ArtRage	Ambient Design Limited	www.artrage.com
CD Player and Audio Textbooks	Reading for the Blind & Dyslexic	www.rfbd.org
Chattervox portable voice amplification system	Asyst Communications Co.	www.chattervox.com
Co:Writer word prediction software	Don Johnston Inc.	www.donjohnston.com
Digital Textbooks	Bookshare	www.bookshare.org
Dragon Naturally Speaking™ voice recognition software	Nuance Software	http://www.nuance.com/dragon
Joystick to Mouse Software™	R.J. Cooper	www.rjcooper.com
LiveScribe Pulse™ Smart Pen	Live Scribe	www.livescribe.com
Math Pad™	Intellitools	http://store.cambiumlearning.com
Police Light	Enabling Devices	http://enablingdevices.com
Read OutLoud™	Don Johnston Inc.	www.donjohnston.com
SAM Joystick™	R. J. Cooper	www.rjcooper.com/sam-joystick
SmartBoard™	Smart Technologies	http://smarttech.com
Specs Switch™	Ablenet	http://ablenetinc.com

and attached to a small pressure switch placed on a sheet of non-slip plastic on the footrest of her chair. This allowed Terry to request the teacher's attention by activating the beacon with her foot rather than by raising her hand. When Terry moved to another area of the classroom, the nurse or a peer would carry the beacon and switch to that location. This allowed Terry to interact directly with Ms. Miller rather than relying on the nurse to answer questions or gain Ms. Miller's attention.

Reading

Reading activities are an important part of Ms. Miller's classroom. A large block of time is spent each day on reading instruction and students are also given many opportunities throughout the week to engage in reading for pleasure. Some books, such as textbooks, are used on a daily basis throughout the year. Others, such as library books and books from the reading center, are self-selected only minutes before they are to be read. Although Terry is able to read, she is unable to physically hold a book or turn the pages. Allowing Terry to independently participate in the many reading activities in her classroom required a variety of assistive technology supports.

To accommodate her physical challenges, Terry was provided with a book stand which held books open at an appropriate angle. Page fluffers (Purcell & Grant, 2005) were constructed from craft foam, paper clips, and index cards. A peer could quickly insert these into any book to separate the individual pages. This allowed Terry to use a mouthstick with a magnet attached to independently turn the pages of her books. While these accommodations allowed Terry to access her current textbooks, the team felt it was important that she begin learning to use the technology she would need as she transitioned from learning to read to reading to learn.

To begin this process, Terry was enrolled in the Reading for the Blind and Dyslexic (RFB&D) Learning through Listening program. This program provides accessible text materials to individuals who cannot access standard print due to physical, visual, or learning disabilities (*RFBD.org*). Through the RFB&D program Terry could access audio recordings of textbooks and chapter books which could be played on a CD or MP3 player. Although Terry enjoyed listening to the books, she was physically unable to operate either of the playback devices. To provide additional independence, she was also enrolled in bookshare.org. Bookshare.org is an organization that provides digital versions of textbooks, periodicals, and novels to individuals with print disabilities. While books from this program are available in audio format, the text can also be downloaded to a computer and accessed via programs such as Read OutLoud™. This allowed Terry to independently access a wide variety of text materials using her laptop computer.

Written Work

Ms. Miller's students complete many assignments during the course of a school day. On any given day, students might be asked to complete workbook pages, illustrate a concept, complete a graph or chart, or write about a past experience. Many of these assignments are formative, allowing Ms. Miller to assess each student's progress toward a specific learning objective. Others, primarily tests and quizzes, are summative and allow Ms. Miller to measure what each student has learned in relation to a specific content standard.

During first grade, Terry completed most assignments by dictating her answers to a scribe. While this allowed the teacher to assess Terry's knowledge of some concepts, it did not provide Terry with the same opportunities to practice skills as her peers. As the team discussed potential technology supports, it became clear that, at least initially, it would take longer for Terry to complete assignments independently. To address this concern, the team agreed that Ms. Miller and Ms. Smith, the resource teacher, would decide on a task by task basis whether Terry should complete the task independently or be allowed to dictate her responses. This decision would be based upon Terry's physical status at the time as well as the primary objective of the assignment. The overall goal would be to increase the number of assignments Terry was able to complete independently.

To meet portability needs, Terry's assistive technology system was designed around a laptop computer. Though Terry could not use her hands to operate the computer in a typical fashion, she was able to control a modified joystick using the toes on her right foot. While manipulating the joystick, she could also concurrently activate a small pressure switch using her left foot. The use of Joystick to Mouse™ software allowed the modified joystick to control the computer cursor in the same fashion as a typical mouse. Using a pressure switch connected to the input jack on the joystick Terry was able to click and drag icons to perform various computer functions. Text entry was accomplished using the on-screen keyboard which is included as part of Microsoft Windows XP. Using this combination, Terry was able to independently access all of the programs on her computer.

While this system allowed Terry to participate in learning games and web-based activities, it did not yet allow her to complete the same assignments as her peers. Due to Terry's age, many assignments were in the form of workbook pages or worksheets which required that she circle or underline an answer. The team decided to use Adobe Acrobat Pro 9 to digitize these assignments so that Terry could complete them using her laptop computer. Implementing this strategy required a coordinated effort on the part of Ms Miller, Ms. Smith, and the assistive technology department. Although Ms. Miller was not required to submit lesson plans until Friday afternoon, she agreed to provide a list of upcoming assignments to Ms. Smith by Thursday morning. Those worksheets and workbook pages were then scanned into Acrobat by assistive technology staff members. Depending upon the type of response required various modifications were performed on the document (Sweeney, 2010).

When the worksheets had been modified, they were emailed to Ms. Smith who transferred the files via USB drive to Terry's laptop computer. To facilitate access to the various documents, the files were placed in daily folders on the windows desktop. Terry quickly learned to use the various tools available in Acrobat Pro to underline, circle, or type her responses onto the worksheet. At the end of the day, Ms. Smith printed the assignments using a color printer so that Terry's papers would look identical to those of her peers.

As the year progressed, Ms. Miller required her students to write several sentences each day about an assigned topic. Terry had difficulty completing this task as her typing rate remained much slower than the writing speed of her peers. When this activity was first introduced, Ms. Miller allowed Terry to dictate her responses. Once Terry was familiar with the activity, Ms. Miller began to require Terry to type her responses with the assistance of word prediction software. As Terry began to type a word, a list of possible word choices would appear in a small box on the computer screen. The words that appeared were based upon the combination of letters typed, an analysis of the grammatical structure of previous words, and pre-programmed information about words which are likely to occur together in the English language. When Terry saw the word she wanted to type appear she selected it by activating the corresponding number key on her on-screen keyboard. The use of this software reduced the number of key activations necessary to complete an assignment by 65-80 percent.

Math

While Terry had little difficulty memorizing basic addition and subtraction facts, she struggled with problems which involved regrouping or required her to show her work. This was especially noticeable as the class began solving problems involving two and three digit numbers. Although a calculator would have been a simple solution, Terry's IEP team felt that it was important for her to develop basic computational skills. Excited about the success Terry had experienced with Adobe Acrobat, Ms. Smith began digitizing pages of the math workbook. Using a combination of form fields and editing tools, Terry was now able to solve problems in the same way as her peers. While watching Terry do a math sheet, Ms. Smith noticed that some steps (e.g. regrouping) required Terry to access multiple tools in a specific sequence. In searching for a way to simplify this process, Ms. Smith discovered MathPad™, a piece of software designed for elementary school students who have difficulty completing problems using a paper and pencil. When math worksheets were scanned into this software, Terry had access to a customized on-screen keyboard which included numerals, symbols, and common mathematical functions such as regrouping. The software also displayed problems on a graph paper like screen which assisted Terry in correctly aligning numerals as she solved multi-step problems.

Art and Illustration

Ms. Miller believes strongly in the creative process. She encourages her students to use art to communicate what they have learned about a topic as well as to express their thoughts and feelings. The classroom art center is a popular place that allows the students to experiment with a variety of tools including crayons, markers, colored pencils, chalk, and paint. While Terry loves to spend time in the art center, she often appears frustrated that she is only able to make limited marks while her friends are creating pictures.

Since many of Ms. Miller's assignments included a drawing component, Terry needed a way to use her computer to illustrate and color her work. Ms. Smith suggested that coloring sheets could be scanned into MS Paint. While Terry could not mix colors or use different media (e.g. markers, colored pencils, etc.) in Paint, she was able to complete assignments that looked similar to those of her peers.

Providing a way for Terry to illustrate her work proved to be more challenging. Initially, Ms. Smith taught Terry to use the Microsoft Clip Art Gallery to locate and import images into her assignments. Terry quickly mastered the computer skills necessary to do this, however she was often unable to spell the name of the picture she wished to draw. Terry also complained that many of the pictures "didn't look right." When asked to explain herself, Terry stated, "The pictures are too grown-up." After much research, Ms. Smith located a digital art program that was both simple enough for a young student and robust enough for a digital artist. ArtRage™ provided Terry with a digital art center. She could now use her joystick to access electronic pencils, markers, crayons, chalk, and paint. These digital tools functioned similarly to actual art tools allowing her to create, mix, and blend colors as she was drawing. As Terry became familiar with the program, Ms. Miller found that she had a budding artist in her class.

A PEEK INTO THE FUTURE

Thanks to the strong foundation laid by early IEP teams, Terry is a busy, active member of her senior class. Although she still has significant medical needs and remains in a wheelchair, Terry no longer requires a nurse to be with her at all times. If she should need the nurse, Terry's friends will speed dial the health office on the cell phone that Terry keeps clipped to the side of her chair. As Terry heads to her Algebra II class, she worries about the upcoming unit test. She is sure that Mr. Sullivan will spend the period working review problems on the SmartBoard™. That means a large digital file in her email box by the beginning of study hall. After Algebra, Terry heads to Civics class. The class is working on a research project, so Ms. Sampson has asked the students to meet her in the school library. Knowing that there is no SmartBoard™ in the library, Terry asks Sue to take notes for her. Terry directs Sue to the LiveScribe Pulse™ pen and notebook in her book bag. Following class Sue plugs the pen into Terry's laptop and uploads both a visual copy of the notes and a corresponding audio recording of the class. Terry especially appreciates the audio recording today since Sue seemed to be a bit distracted by the new boy in their class. Finally, Terry heads for study hall to work on the English paper that is due on Friday. She finds a quiet area of the room and begins softly speaking in the direction of her laptop. Unless she is creating digital art, Terry has not used a joystick to control her computer since she was introduced to voice recognition software in the 5th grade. She now controls all functions of her computer using voice commands and can dictate text faster than most of her friends can type.

At last, the bell rings. Terry's friend Pat helps pack up her books and together they head to debate practice. On the way, Terry reminds Pat about the community art show this weekend. She is excited that two of her digital paintings were accepted into the show and hopes to finally sell her first painting. As they arrive at the debate room, Pat grabs Terry's portable microphone and places it on her head. Although Terry still has difficulty speaking loudly, the portable microphone and amplifier she wears allow her to engage in loud and spirited exchanges with her debating opponents.

Today's topic is disability awareness and Terry cannot wait for the discussion to begin. In researching this topic, Terry discovered a website created by another high school student with a disability (www.imtyler.org). As part of his requirements to become an Eagle Scout, Tyler wrote and produced a short movie titled "I'm Tyler…Don't be surprised." In this video, Tyler, who also had multiple disabilities which impacted his motor and communication abilities, discussed what he termed "ability awareness." Terry agrees with Tyler's view that recognizing what a person CAN do isSO much more important than what they can't do and plans to base her speech around that concept.

As the gavel is passed to Terry, she begins her presentation. "I don't want to speak to you about disability awareness. That concept is too limiting. I want to speak about possibilities. When I was a small child everyone in my life practiced disability awareness. I mean, after all, it was pretty obvious. I *was* a tiny bit different from the rest of you. Fortunately for me, my 2nd grade teachers didn't understand disability awareness. When I couldn't do something, they didn't see it as an obstacle; they saw it as a challenge. And you know teachers, if they see a challenge they have to meet it... have to find a solution. Well, they did. Let me tell you about what they did understand... Ability Awareness..."

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KEY TERMS AND DEFINITIONS

Accommodation: A change to an activity that alters how content is taught or learning is measured without changing the difficulty of the content.

Assistive technology: 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 the functional capabilities of a child with a disability.

Formative Assessment: An activity designed to measure progress toward a specific learning objective.

High-Tech: Assistive technology tools that involve both electricity and electronics and require specialized staff/student training for successful implementation.

Low-Tech: Assistive technology tools that involve no electricity, are often readily available or easily made, and are relatively inexpensive.

Mid-Tech: Assistive technology tools involve battery power, are more complex than low-tech tools, and typically require only a small amount of staff/student training.

Modification: A change to an activity that alters what is being taught or measured.

Summative Assessment: An activity designed to measure a student's mastery of a concept at one specific point in time.

Voice Recognition Software: A software program which allows the user to control computer functions and enter text by speaking to the computer.

Word Prediction Software: A software program that predicts the word being typed and/or the following word based upon letters typed, word frequency, and context.

DISCUSSION QUESTIONS

1. **Discuss the difference between an accommodation and a modification. Give at least 3 examples of each.** An accommodation changes **how** content is being taught or learning is being measured. A modification changes **what** is being taught or measured. Examples of accommodations include reading material (other than reading assessments) aloud, allowing a student to type rather than write by hand, and allowing a student to point to answers rather than circle/underline them. Examples of modifications include reducing the number of items on a multiple choice test, allowing the use of a calculator on a test assessing computational skills, and replacing essay questions with multiple choice items.
2. **Describe the difference between low-tech, mid-tech, and high-tech assistive technology supports. Give at least one example of each that was NOT included in the example presented in this chapter. Low-tech tools** involve no electricity, are often readily available or easily made, and are relatively inexpensive. **Mid-tech tools** involve battery power, are more complex than low-tech tools, and typically require only a small amount of staff/student training. **High-tech tools** involve both electricity and electronics and require specialized staff/student training for successful implementation.
3. **Why do you feel Terry was so successful in Ms. Miller's classroom?** Possible answers might include the advance planning done by Terry's IEP team, the team approach to problem-solving as issues arose, clear delegation of responsibilities so that no one staff member was overwhelmed, using a variety of technology tools dependent on the requirements of a specific task, or an emphasis on identifying supports that could be easily integrated into Ms. Miller's existing classroom structure.
4. **View the video "I'm Tyler... Are you surprised?" (**www.imtyler.org**)** Discuss what Tyler's high school experience might have been had his teachers not practiced "ability awareness." How could the principles of ability awareness be applied to one or more students in your classroom?

Section 3
Perspectives

Chapter 11
The Student with Complex Education Needs:
Assistive and Augmentative Information and Communication Technology in a Ten-Week Music Program

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ABSTRACT

Categories of potential research questions concerning trends and issues affecting the education of students with complex educational needs are numerous. For example, it seems that whether one studies musicians and their music, the processes of music, the performer, the composer, or the teacher-researcher, music is often observed as implicated in and determinants of the ways individuals are able to be intelligent.

The chapter reports the findings of a research project during which a ten-week music program was developed and implemented in a public special education setting in metropolitan Melbourne, Australia (Farrell, 2007). The program featured the application of information and computer technology and assistive peripherals for a defined classroom grouping of students with complex educational needs that embedded notions of differentiated instruction.

Like special education settings and classroom groupings of students with complex educational needs are observed within and across education systems of many sovereign states. However, from an Australian perspective, findings and conclusions suggest future directions in the application of assistive and augmentative information and communication technology for students with complex educational needs.

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INTRODUCTION

Human rights law, regulation, and policy is informed by social and cultural theory that has challenged very powerful economically efficient and politically expedient values with social and cultural values centered on equal opportunity and diversity (e.g., notions of integration, normalization and least restrictive environment; educating all students together) (e.g., Lyotard, 1984). Derrida (1978) deconstructed language by taking pairs of terms by which one may ascribe binary opposites. He thought of one of the pairs of terms as dominant--the Being. He took the side of the minor term--the Other--and asked the reader to imagine the minor infiltrating the dominant. Notions of disability and impairment are understood in the context of understandings of whatever is defined as normal or typical. He considered classification of these notions arbitrary and suggested that hierarchies of terms can therefore be dismantled. Derrida coined the term "difference" (from the French: *différance*) that keeps the ear alert to the call of the Other, not of the Being.

Christensen and Rizvi (1996), Gill (1999), Seelman (2000), Skrtic (1995), and Swander and Lubeck (1995) described paradigms that have shifted the location of the "problems" of disability and impairment from the individual to environmental responses to disability and impairment that evolved from the legacy of these scholars, activists with disabilities and impairments and their non-disabled allies. The paradigms frame disability and impairment from the perspective of a social and cultural minority group that is defined as a dimension of human difference and not as a defect. The goal for people with disabilities and impairments is not to eradicate their disability or impairment but to celebrate their distinctiveness, pursue an equal place in society and acknowledge that their differentness is not defective but valued. This social and cultural theory has called for those who advocate social and cultural values to emerge with voices that have produced very positive effects (e.g., profound influence on social and cultural attitudes toward people with disabilities and impairments).

Core values embedded in human rights law, regulation, and policy in the context of disability include:

- The *dignity* of each individual, who is deemed to be of inestimable value because of his or her inherent self-worth, and not because he or she is economically or otherwise "useful;"
- The concept of *autonomy* or self-determination, which is based on the presumption of a capacity for self-directed action and behavior, and requires that the person be placed at the centre of all decisions affecting him or her;
- The inherent *equality* of all regardless of difference;
- The ethic of *solidarity*, which requires society to sustain the freedom of the person with appropriate social supports.

BACKGROUND

Reported prevalence of disability and impairment vary widely. In many developed countries, the rates are quite high. Based on census data, the reported prevalence of disability and impairment in The United States and Canada are approximately 19.4% and 18.5% respectively. The reported prevalence in Australia is approximately 20%. Conversely, developing countries often report very low prevalence. Kenya and Bangladesh report prevalence under 1%. These rates vary for a number of reasons: Differing definitions of disability, different measurement methodologies, and variance in the quality of that measurement.

The United Nations promotes the rights and well-being of persons with disabilities and impairments. The Organization's commitment to the full and effective participation of all persons with disabilities and impairments is deeply rooted in the quest for social justice and equity in all aspects of societal development. The United Nations General Assembly established an Advisory Committee for the *International Year of Disabled Persons* in 1977. The *International Year of Disabled Persons* was proclaimed in 1981. Annual observance of an *International Day of Persons with Disabilities* (3 December) was established to promote a better understanding of issues relating to disability and impairment with a focus on the rights of persons with disabilities and impairments and gains to be derived from the integration of these persons into every aspect of economic, political, social and cultural life in their communities. *The World Program of Action Concerning Disabled Persons* was adopted by the United Nations General Assembly in December 1982. In order to provide a time frame during which Governments and organizations could implement the activities recommended in *The World Program of Action Concerning Disabled Persons*, the General Assembly proclaimed 1983-1992 the *United Nations Decade of Disabled Persons*.

These commitments provide an international policy framework further strengthened by the *Convention on the Rights of Persons with Disabilities* adopted by the General Assembly in December 2006. The Convention provides an impetus and unique platform for advancement of the international disability rights agenda. Members to a *Committee on the Rights of Persons with Disabilities* were elected at the third annual Conference of States Parties to the *Convention on the Rights of Persons with Disabilities* held in September, 2010. Many commitments have been made by the international community to include persons with disability and impairments in all aspects of development. However, the gap between policy and practice continues.

There have always been children with disabilities and impairments, but there has not always been special education. Crockett and Kaufman (1998) provided an insight into the various lenses throughout history through which children with disabilities and impairments have been viewed. For example, during the closing years of the eighteenth century, approaches to effective teaching were devised for teaching the blind and the deaf–those living with visual and hearing impairment. Jean Marc Gaspard Itard (1775-1838), a prominent French physician and authority on diseases of the ear and on education of those with a hearing impairment, is the person to whom most trace the beginning of special education as we know it today. Itard's mentor, Philippe Pinel (1745-1826), also a prominent physician and an early advocate of humane treatment of the insane, advised him that his efforts would be unsuccessful. Examination of nineteenth century views of children's behavioral disorders suggested that prior to the American and French revolutions, the most that was given to such children was asylum from the cruel world into which they did not seem to fit, nor survive with dignity, if at all (e.g., Ball, 1971, Kauffman, 1976, Lane, 1976). Equal opportunity and diversity has meant increased support for many more students with complex needs within and across education systems in many sovereign states of the world.

Baker (1998) and Scheerens and Demeuse (2005) are among those who debate some of the models, theories, and philosophies; evidence-based theory of organizational and educational leadership; emerging issues and trends that impact the mission of a school and its community; and national and state legal, regulatory, and ethical issues that inform exemplary leadership and management practice of programs and services within and across education systems in many sovereign states. The real aims of education have perhaps been lost in the current politically expedient rhetoric relating to high stakes test scores in many sovereign states, including Australia (e.g., national tests in Reading, Writing, Language Conventions (Spelling, Grammar, and Punctuation) and Numeracy commenced in Australian schools in 2008). Perhaps, there should be a return to the notions of great developmental thinkers of the past (e.g., Piaget, Montessori, Dewey, & Steiner) to regenerate discourse on how children develop through the stages of life (e.g., early childhood development focused on play; primary (elementary) school curriculum geared toward learning how the world works; middle schools creating programs that develop social, emotional, and meta-cognitive growth; and high schools preparing students to live independently in the real world by way of differentiated academically and vocationally orientated pathways).

Notions of inclusive education (i.e., integration, normalization and least restrictive environment) were espoused by Wolfensberger (1972) and Wolfensberger and Zauha (1973) in the early 1970s. For example, by the end of the 1990s, practice within and across education systems of many sovereign states included a variety of law, regulation and policy initiatives that embed notions of integration, normalization, and least restrictive environment into the education of people with disabilities and impairments.

In the United States, law, regulation and policy initiatives include *Education of All Handicapped Children Act* (Public Law 94-142) (Education of All Handicapped Children Act 1975), *Towards Equity*: *Education of the Deaf* (Commission on Education of the Deaf, 1988), *Procedures Governing Programs and Services for Children with Special Needs* (North Carolina Department of Public Instruction, 1993) and *Individuals with Disabilities Education Act* (IDEA) (Individuals with Disabilities Education Act, 1997).

Visser and Upton (1995) provided insights into the impact of law, regulation, and policy initiatives within and across the English education system (e.g., Warnock, 1978).

A Round Table on inclusion and the right to education was held at the third annual Conference of States Parties to the *Convention on the Rights of Persons with Disabilities* in September, 2010.

SETTING THE STAGE

Australian education has historically had a substantial concern with the education of students with disabilities and impairments. Law, regulation and policy initiatives are essentially based on the principle of equal opportunity and diversity at all levels. Australian Federal Government, and Australian State and Territory Government have embedded the rights of all Australians against unfair treatment on the basis of race; sex; race; marital status; pregnancy; family and career responsibilities; and disability and impairment (e.g., Human Rights and Equal Opportunity Commission 1975, 1984, 1986a, 1986b, 1992).

Long (1988, 1994) provided insights into the impact of law, regulation, and policy initiatives within and across education systems of all Australian State and Territory Governments (e.g., Collins, 1984, Cullen, & Brown, 1992; Cullen & Brown, 1993 in the State of Victoria). Ashman (1988, p. v) commented that "many problems being confronted by Australian educators today are much the same as they were twenty years ago." Nonetheless, the challenges and opportunities of inclusive education practice continue to assume a position of prominence in contemporary education.

Education systems in many sovereign states appear to have accepted responsibility for the education of all students irrespective of disability or impairment. Yell (2005) provided an overview of many of these laws, regulations and policy initiatives that appear to have led to more inclusive practice in recent decades. Common key challenges have included disparate definitions of inclusive education practice; notions of Differentiated Instruction in curriculum, assessment and reporting; assistive and augmentative information and communication technology; and the intense cry for preservice programs, and professional development of teachers. However, notions of integration, normalization, and least restrictive environment appear to have neither disappeared, nor become sufficiently integrated into practice they become little discussed facts of life that are no longer of concern to educators.

Burrello, Lashley, and Beatty (2001), Lipsky and Gartner (1997), and Villa and Thousand (2000) are among those who debate some of the models, theories, and philosophies that provide the foundation for exemplary leadership and management practice of programs and services for individuals with complex needs and their families within and across education systems (e.g., promote a free appropriate public education in the least restrictive environment) in many sovereign states. These models, theories, and philosophies continue to provide both mammoth challenges and exciting opportunities for systemic transformation. For example, the complex educational needs of those with disabilities and impairments have become the shared responsibility of both education and many other allied health professionals in recent years. The unique patterns of the delivery of these programs and services require work within and across multidisciplinary teams. Education profession members of these multidisciplinary teams are often recognized as having highly specialized attributes, knowledge and pedagogical expertise (e.g., in developmental disabilities and autism; in hearing and/or vision impairment; in early childhood special education; as an inclusion specialist; in physical and health disabilities). They keep abreast of and often contribute to the generalist and specialist professional learning of the multidisciplinary team. Iano (1986); Kleinhammer-Tramill (2003); Monteith, (August, 1994) and Skrtic (1991) have suggested that high expectations for self, staff, and individuals with exceptional learning needs be promoted; candidates, newly certified teachers and other colleagues working with those with complex needs be mentored; and a personal inclusive vision and mission for meeting the needs of those with complex needs be and their families be communicated. Without doubt, the historical and social significance of the human rights law, regulation, and policy in many sovereign states must be interpreted and applied to the implementation of exemplary leadership and management of educational programs and services for individuals with complex educational needs and their families (e.g., Davidson & Algozzine, 2002; Fuchs & Fuchs, 1994; Furney, Hasazi, Clark-Keefe, & Hartnett, 2003; Furney, Hasari, & Clark-Keefe, 2005; Gallagher, 2006; Hillman, April 1988; Huefner, 2000; Lieber, Hanson, Beckman, & Odom, 2000; Palley, 2006; Robertson, 1996; Sage & Burrello, 1986; Turnbull, Huert,a & Stowe, 2006; Turnbull, 2005; Weatherley, 1979).

Exemplary leadership and management practice of programs and services for individuals with complex needs and their families that promote positive school engagement such individuals includes debate relating to the curriculum, assessment, and reporting agenda in many sovereign states. In turn, this debate must support notions of differentiated curriculum, assessment, and reporting (e.g., Moran, 2007; Strickland, 2009a, 2009b; Tomlinson, 1999; Tomlinson, 2001; Tomlinson, 2003; Tomlinson & Allan, 2000; Tomlinson & Eidson, 2003a, 2003b; Tomlinson & McTighe, 2006; Tomlinson & Strickland, 2005; Tomlinson, Brimijoin, & Narvaez, 2008).

Certainly, no less than in Australia. The Australian Curriculum, Assessment, and Reporting Authority (ACARA) is responsible for a national curriculum (K-12), a national assessment program, national data collection and reporting. A key stakeholder in this process is the Australian Curriculum Coalition (the Coalition), a forum of Presidents, Executive Officers and Executive Directors of a number of affiliated national education organizations whose membership include teachers, principals, school leaders, academics and education researchers. Individual and collective affiliates have cooperated in supporting the development of a high quality, 21st century national curriculum, assessment, and reporting agenda over many years in the belief that Australian schools, their teachers and students deserve the highest quality national curriculum, assessment, and reporting of achievement against standards that is embedded in international and national research that informs curriculum theory. Drafts of the first four learning areas do not appear to provide clarity about assessment and reporting of achievement against standards.

The Coalition recently published an opinion paper addressed to all Australian Education Ministers and the media.

[The Coalition] believe that ACARA [Australian Curriculum, Assessment, and Reporting Authority]should identify and strengthen the understandings of equity and diversity that inform the development [of the national curriculum, assessment, and reporting agenda]... the principle that all students have an entitlement to challenging curriculum content is an important one... [therefore] is essential, however, that curriculum development is informed by an understanding of how this principle can work in practice and in different contexts... the [national curriculum, assessment, and reporting agenda] should aim to support "high quality, high equity" for all young Australians... work should be undertaken to identify how the Australian Curriculum is to take account of the needs of student populations including students with complex educational needs, students (especially indigenous students) in remote settings, students for whom English is not their first language and gifted and talented students. (personal email)

Furthermore, scholars have advocated the integration of appropriate strategies (e.g., assistive and augmentative information and communication technology) into differentiated curriculum, assessment and reporting (Anderson & Anderson, 2005; Anderson & Dexter, 2005; Brown, 1992; Bryant & Bryant 2003; Bryant & Seay, 1998; Bryant, Bryant, & Raskind, 1998; Campbell, Milbourne, Dugan, & Wilcox, 2006; Cavalier, Ferretti, & Okolo, 1994; Claudet, 2002; Derer, Polsgrove, & Reith, 1994; Gregory, 2002; Lewis, 1993; Michaels & McDermott, 2003; Puckett, 2004; Raskind & Higgins, 1998; Rose, Meyer, & Hitchcock, 2005; Smith & Jones 1999; Stremel, 2005; Thompson, Siegel, & Kouzoukas, 2000; Watts, Thompson, & Wojcik, 2003; Woodward & Rieth, 1997; Zabala & Carl, 2005). Sounds familiar? Space for dialogue and scholarly engagement must continue to be created.

THEORETICAL CONSTRUCT

Research evidence and theory in several core academic disciplines seemed to intersect with the application of assistive and augmentative information and communication technology in programs in special education. This research evidence and theory has the potential to provide the education professional with a better understanding of instructional practices that not only are essential for students with complex needs, but also benefit their peers, helping teachers face the challenges and opportunities of teaching an inclusion class and make teaching more fruitful and rewarding.

Neuropsychology

A broad and deep understanding of the structure and functioning of the human brain that includes the development and organization of the nervous system, brainstem function, motor control systems and sensory systems, by definition, must be embedded into any exemplary development and implementation of differentiated curriculum, assessment and reporting; and integration of suitable strategies (e.g., use of information and computer technology and assistive peripherals). A great many major influential researchers and theorists have turned their attention to the nature of human intellectual competencies and the essential characteristics that seem to underlie them, including contextual characteristics. Characteristics of the intelligence are exercised across the many roles that humans play in a multiplicity of distinctive ways.

Students with abnormalities in these processes present with a combination of challenging disabilities and impairments. These disabilities and impairments may lead to severe limitations of movement, problem-solving, socialization, and communication. Some may require total care and be medically at risk. Epilepsy is common and not necessarily completely controlled by medication. Concomitant hearing and/or vision impairment may be manifest. Physical abilities may vary considerably from well formed fine motor skills such as reaching, grasping, and manipulation to a complete lack of voluntary independent physical movement. Some may seem unable to comprehend or adapt to unfamiliar environments and events manifesting in difficulty in transitions from familiar to unfamiliar situations. Similarly, these students may not appear to demonstrate recognition of familiar people, including family, teachers and therapists. They may vary considerably in their ability to understand and communicate information. Some may be able to make use of simple language or alternative communication systems, whilst others may be quite unable to communicate needs or responses effectively (e.g., Carlson, 2001; Kandel, Schwartz, & Jessel, 2000; Kandel, Kolb, & Wishaw, 2003; Nolte & Angevine, 1995; Springer & Deutsch, 1994).

Developmental Psychology: The Multiple Intelligences

Since the 1960s or even earlier, notions of intelligence as a single entity have been challenged (e.g., Wechsler (1992) that primarily provides an assessment of linguistic and mathematical modes of thinking). Other abilities appear to have been overlooked and/or not valued. Notions of a diverse intelligence (i.e., relatively distinctive, autonomous modes of thinking) have been expressed. For example, Phenix (1964) identified six distinctive, autonomous modes of thinking. Eisner (1985) argued several distinctive, autonomous modes of thinking. Collins (1998, pp. 94-96) referred to the notion of multiple intelligences as "seven kinds of smart." No doubt the most widely known argument for the notion of a diverse intelligence is that of Howard Gardner (1993a, 2000). Further information regarding the work at Project Zero in the Harvard Graduate School of Education can retrieved from www.pz.harvard.edu/Pls/HG.htm. Furthermore, notions of multiple intelligences appear to integrate well with other notions such as Bloom (1956); Krathwohl, Bloom, and Masia (1964); and De Bono (1974, 1991, 1992, 2000).

With a background in special education and associate of Gardner at Project Zero in the Harvard Graduate School of Education, Armstrong was one of the first educators to write about the notions of multiple intelligences in the special education context (Armstrong, 1980, 1987a, 1987b, 1988, 1993, 1997, 1999a, 1999b). For Armstrong, multiple intelligence theory "provided a language for talking about the inner gifts of children, especially those students who had accumulated labels such as LD (learning disability) and ADD (attention deficit disorder) during their school careers" (Armstrong, 2000, p. vii).

Notions of multiple intelligences suggest complex relationships between brain mechanisms and behavior. The human brain is an extremely complex organ. There is apparently no question that hemispheric specializations exist in humans, but the cerebral hemispheres are not at war with each other (Gates & Bradshaw, 1997a, 1997b; Leng, Shaw, & Wright 1990; Radocy, 1978, 1979; Schlaug, Jancke, Huang, & Steinmetz, 1995). Mostly, diverse parts of the brain are used as the occasion arises, acting together. However, the consequence of brain injury may destroy or indeed spare thinking in a particular domain. Individuals may demonstrate a highly uneven profile of thinking. An individual may demonstrate a more highly developed level of performance in one domain against a background of mediocre or poor performance in another (Miller, 1989). There may be poor performance in a particular domain (e.g., an individual with an autistic spectrum disorder may demonstrate poor intrapersonal and interpersonal competencies, while an individual with a specific learning disorder may demonstrate poor spatial-perceptual competencies).

Each child's abilities are viewed in terms of a profile of strengths and needs. Thinking entails multiple sets of skills that enable an individual to resolve genuine problems or difficulties that are encountered. Thinking creates an affective product and entails the potential for finding and creating new problems thereby laying the groundwork for the acquisition of new knowledge. The key to teaching is to recognize and honor these distinctive, autonomous modes of thinking and their interrelationships. Nurturing intelligence requires that the parts be made whole by immersing meaning into interrelationships. For example, Vaille and Perry (2002) suggested that students who may not have mathematical ability or be able to read at an advanced level still have intelligences that need nurturing. The theory of multiple intelligences in the special education context appears to imply a changing role for the special education teacher that includes identifying students' strongest intelligences, focusing on the needs of specific students, developing and implementing a curriculum that includes a full spectrum of intelligences, increased self esteem and increased understanding and appreciation of such students (Armstrong, 2000, p. vii).

Developmental Psychology: Psychomotor Control

Early developmental behaviors may still need attention even in the middle and even latter years of schooling in students with severe, profound and multiple disabilities and impairments. For example, Lathom-Radocy (2002, p. 28) suggested that music activities and experiences provide many possibilities for movement ranging from the simple to the complex (e.g., offer the motivation and energy to start and stop movement). Movement accompanied with music with others becomes an enjoyable activity and experience rather than tedious exercise.

Because it is time-ordered, music activities and experiences may be an ideal stimulus to help coordinate and master basic psychomotor movement such as nodding the head, tapping a foot, head extension and body alignment as difficult as it may be (e.g., Raucher, Shaw, & Ky, 1993; Raucher, Shaw, Levine, & Ky, 1994). Initial attempts are more important than successes. For example, the music teacher, therapist or director may use maracas, tambourines or other instruments while singing simple songs to provide an interesting stimulus for the student to lift his or head to an upright position, focus on the source of a sound or sound effect and/or turn his or her head to follow a moving sound or sound effect. As the student becomes more comfortable, the music teacher, therapist or director encourages more coordinated movements with the music. Imitation of standing, sitting, swaying, walking, running, jumping, hopping, skipping, marching, galloping and movement of the arms and head can be encouraged, albeit at a less sophisticated level than their normal peers. Students may demonstrate brief moments of synchrony to the beat of live or recorded music. Thaut (1985) suggested that gross motor activities such as folk dancing will strengthen large muscles and help to develop coordination and balance. In turn, these skills are associated with improvements in body image, balance, locomotion, agility, flexibility, strength, laterality (side-to-side movement) and directionality (up-down, right-left, back-forth). These skills are particularly critical in orientation and mobility in those with a visual impairment.

Fine motor control involving smaller muscles and greater precision, including eye control, reach, grasp-release, manipulation, exploration, experimentation, wrist-hand-finger motion, eye-finger coordination, object in one hand-manipulate with the other, may also be promoted with music activities and experiences. Students may draw attention to, and/or point, request or reject a musical instrument. For example, the music teacher, therapist or director may use maracas, tambourines or other instruments while singing songs to provide an interesting stimulus for the student to reach for, manipulate, explore, hit and shake an instrument. They may learn to hold, blow, strum, or pluck an instrument. They may even push, drop or throw an instrument.

Developmental Psychology: Social Behaviors

One of the most important goals for students with disabilities and impairments may be to modify inappropriate personal behaviors, particularly manifest in students with intellectual disability (e.g., Down Syndrome, Fragile X Syndrome) and pervasive developmental delay (e.g., Autism Spectrum Disorder, Asperger's Syndrome, Rett Syndrome, and ADHD). Davis, Wiesler, and Hanzel (1983), Jellison, Brooks, and Huck (1984), Madsen, Greer, and Madsen (1975) and Martin (1979) suggested that behavior modification based on the principles of B.F Skinner (1953 and 1971) (i.e., positive reinforcement, differential reinforcement, time out and contingent reinforcement) are used widely and have been successful in reducing maladaptive behaviors and improving social skills. Inappropriate behaviors (e.g., out-of-seat behavior, short attention span, low frustration tolerance and hyperactivity) may be reduced or even completely eliminated with positive reinforcement (Bruscia, 1991). Immediately after the student demonstrates an appropriate response, he or she may receive a desired reward: A smile, a hug, a pat on the back.

The pleasure of participating in a musical activity or experience may often be a powerful reinforcer in itself in that immediate attention and cooperation is often captured. Wimpory (1995) suggested that structured musical activities and experiences may provide a stimulating environment in which appropriate social skills and processes can be learned (i.e., provide a foundation for developing active and informed members of society capable of managing the interactions between themselves and their social, cultural, organizational, physical and natural environments). As young students grow and develop, form and negotiate relationships with family, friends, and in groups in a musical context. Musical activities and experiences will challenge students to consider effective relationships and ways of managing transitions and changing demands, responsibilities and roles; to understand and deal with often competing and contradictory expectations that young people experience; and to emphasize that a person's capacity to deal with these changes is variable and dependent on a sense of trust and security, opportunities and skills to communicate effectively and a sense of self as a capable and worthwhile person.

Music is an excellent medium for group experiences that affords nonverbal interaction allowing non-threatening participation at different levels regardless of severity of disability or impairment as students develop musical ideas (Gaston, 1968, p. 51). Structured musical activities and experiences promote early intrapersonal and interpersonal skills (e.g., becoming comfortable with familiar people, musical objects, and the musical environment; watch and show interest in the musical activity of others). However, students may be very happily engaged in the same activity or experience next to or parallel to each other, yet cooperation and interaction rare. Structured musical activities and experiences in a group, by definition, promote more advanced social skills and processes (e.g., cooperation, sharing, taking turns, and learning appropriate ways to greet people).

A structured group musical activity or experience may require a student to anticipate a musical cue. They may demonstrate great excitement as they anticipate a turn. The music teacher, therapist or director can help improve attention span by providing structure and motivation with the use of aural cues. The music teacher, therapist or director can increase attention span by gradually increasing waiting time. Musical activities and experiences may promote learning to follow a sequence of simple one, two, or three step commands. An interesting musical activity or experience will help establish and maintain eye contact between student and music teacher, therapist or director. The duration of eye contact can be systematically lengthened.

Developmental Psychology: The Cognitive Domain

Students with disabilities and impairments may find it difficult to apply skills and processes in the cognitive domain. Skills and processes in the cognitive domain apparently develop in the same sequence as their non-retarded peers, albeit at a slower rate with less retention of information. Difficulties will include a short attention span, difficulty with short term memory, inability to abstract concepts and difficulty in generalizing a skill learned in one setting such as a classroom and applying it to a different setting such as in the home (Dunn & Fait, 1989; Isern, 1959). Early schemata with which to respond and attend to the musical environment (e.g., object permanence; predicting cause-effect relationships) may not be apparent.

Students may simply receive, orientate to and discriminate obvious differences in the constituent music elements, or simply fixate on and track the source of a sound or sound effect. They may begin to predict a cause-effect effect relationship. Students may communicate with music elements in more intentional ways. For example, students may respond with bodily movements (rocking, nodding, seesawing, swaying and bouncing, seesawing, nodding the head, raising and lowering the heels, moving the knees backwards and forwards). They may demonstrate clear attempts to carry out dance movements with other people. There may be some early signs of co-ordination between music and movement. Students may demonstrate synonchrony of movement to the rhythm of the music for short periods of time. They may begin to develop the ability to discriminate obvious differences in the constituent music elements (e.g., short/long, high/low, loud/soft, and fast/slow). Students may imitate and improvise rhythmic and melodic patterns. They may make use of short term memory as they recall and perform rhythmic and melodic patterns as they participate in small group improvisation. Students may begin to demonstrate the ability to pitch match when singing with their natural voice.

Developmental Psychology: Communication and Language

Musical activities and experiences also require thinking in the linguistic domain. Music can serve as a way of capturing feelings, knowledge about feelings, or knowledge about the forms of feelings, communicating them from the performer to the attentive listener. Music can provide a satisfactory and socially acceptable means of communicating (Wolverston, 1991).

Children with intellectual disability and pervasive developmental delay nearly always exhibit difficulties in the linguistic domain. Such children follow the normal sequence of communication-language development, but generally lag based on the severity of the disability. Delay in language-communication acquisition will often interfere with self-esteem and social relationships with others. There are clearly vast differences (e.g., the kinds of words that children utter first, the extent to which children imitate, and not least, the rate and level of skill with which children master central aspects of language).

Students may demonstrate a range of unique personal responses. Students may be quite unable to comprehend or adapt to unfamiliar environments and events. Scholars have suggested that attempts at social interaction are frequently extinguished because of the absence or irregularity of social signaling (Barber, Goldbart, & Munley, 1995; Coupe, Barton, Barber, Collins, Levy, &

Murphy, 1985, Goda, 1960; Hewett & Nind, 1998; Jones, 1980; Nind & Hewett,1994, 2001; Park, 1997a, 1997b; Rowland,1990). Interactions may be extremely brief. Social signaling may occur on average only once every 12-13 minutes. Students are less likely to receive initiations which expected a response. Students' behavior may rarely be responded to. Such students may not be given the opportunity to initiate interactions. A sneeze may be more likely to be responded to than other behaviors! These students may not demonstrate recognition of familiar people including family, teachers and therapists. After looking at objects, a referential look to a caregiver is apparently less frequent. They may vary considerably in their ability to understand and communicate. Establishing a topic of conversation, even the ability to communicate needs or responses effectively, may be difficult.

Students may have difficulty with a very short attention span (e.g., remaining seated in a comfortable position in chair ready to participate in an activity, establishing and maintaining eye contact in response to name being called or in response to the command "look," responding to their own name by discontinuing activity; and looking at the person who has called their name). They may have difficulty focusing on a simple task due to inability to filter irrelevant stimuli.

Communication of personal responses of these students may become more intentional. Responses will include facial expressions, natural gestures (nodding, shaking, waving, pointing), vocalizations and verbalizations (protowords, phrases, and sentences within known vocabulary). A student may draw attention to a musical instrument; they may point to an instrument; they may request an instrument; they may reject an instrument. Behavior may be very persistent. They begin to follow simple one, two, or three step directions (e.g., stand up; stand up, and pick up the tambourine; or stand up, pick up the tambourine and give it to Bob). Some may make use of augmented forms of communication such as gesture, objects, photographs, compic pictographs, communication boards, voice output speech devices, micro-switch technology, and computers (Schweigert, 1989).

Children who exhibit a background of mediocre or poor performance in other intellectual domains may exhibit language thinking that has been relatively spared. For example, individuals with an autism spectrum disorder may display a surprising ability to master core syntactic and phonological aspects of language. Such children may prove able to read at an astonishingly early age. Whilst reading normally begins at the ages of five or six, these children are able to decode texts as early as two or three. However, these children may have relatively little of significance to utter and are often restricted to echolalic modes of language. They may enter a room, seize any reading material and begin to read it aloud in a ritualistic fashion. The reading is so compulsive that it is hard to stop. It proceeds with the child's total disregard of semantic information, indifference to whether the materials are drawn from a primer, a technical journal, or a collection of nonsense.

Children with a hearing impairment, but born of hearing parents will develop simple natural gestures that exhibit basic syntactic and semantic properties exhibited in early communication of a hearing child. However, Gfeller (1990) and Gfeller and Darrow (1987) suggested that those so often socially isolated due to hearing and/or visual impairment may also display inappropriate behaviors that interfere with learning and interacting appropriately (e.g., out-of-turn behavior, out-of-seat behavior, short attention span, low frustration level or hyperactivity often resulting in poor self-esteem and social relationships with others). They may miss out on many interactions with others. With limited communication-language skills, they may find it difficult to understand instructions, ask questions and express concerns or frustration. They may demonstrate immature behaviors or revert to socially unacceptable ways of expressing themselves such as tantrums. They may have little or no interest in an activity. Musical instruments that have frequency ranges matching a students' residual hearing may need to be selected.

Children may exhibit specific language difficulties. Some children may show insensitivity to syntactic factors. Given sentences to imitate, such individuals may affect simplifications (e.g., "they won't play with me," may be simplified to "they no/not play with me"). Difficulty may arise from poor auditory discrimination evident in decoding a string of phonemes. Such individuals may not only have problems in comprehension, but may also articulate improperly. Such individuals may prove quite normal in solving all manner of other problems providing that the oral-aural channels of communication can be bypassed. The ability to process linguistic messages rapidly apparently depends upon an intact left temporal lobe. So injury to, or abnormal development of this neural lobe is generally suffice to produce language impairment.

Apparently lesions that cause specific learning difficulties with phonological discrimination, pragmatic uses of speech, and semantic and syntactic aspects of language can be specified. Moreover, each of these aspects of language can be destroyed in relative isolation. Hence one may confront, for example, individuals whose syntax is impaired, but whose pragmatic and semantic systems are relatively preserved, or individuals whose ordinary communicative language is largely impaired in the face of selective preservation of their syntactic powers. It has also been clearly established that written language (reading and writing) is dependent on oral language (speaking and listening). So, for example, if oral-auditory language areas are destroyed, it normally may be possible to continue reading. It is possible to learn to read by at least two alternative routes, so children with a specific learning difficulty ought to be able to exploit other routes. Oral-auditory elements remain integral to the development of the linguistic intelligence, albeit that humans, both skilled and those with disabilities and impairments, exploit language heritage for communicative and expressive purposes in an amazing variety of ways. Complex instructions and explanations may be difficult to comprehend. Use of words such as dark, blue, yellow or other visually based language concepts may be inappropriate for visually-impaired students.

Developmental Psychology: The Musical Intelligence

Of all the modes of thinking with which individuals may be endowed, apparently none apparently emerges earlier than the musical (Bamberger, 1991). Musical activities and experiences offer a wide range of ways to be intelligent. Musical thinking indeed requires involvement of right hemisphere, left hemisphere or both depending on the nature of the musical task and the experience of the musical performer or listener. A diverse set of descriptors relevant to the musical intelligence has existed for a very long time. Gardner (2000) used a long list of synonyms that serve as descriptors of the general characteristics attached to the musical intelligence. He suggested that an understanding of music may be central to understanding all human thinking. Few music educators would not feel ennobled by such a bold and breathtaking claim, valuing music as we do. Few would be quite so ambitious about music's nature and value. Intuitively, many would appreciate that music is more central to humankind than generally thought, struggling to explain why, stopping short of identifying music as the one sure clue to unraveling the mysteries of the human mind. Certainly Gardner's work brought more widespread attention to this concept than any other single theory. His major contribution has been description of the musical intelligence in a way that is indeed a manifestation of thinking.

Reimer (2003, p. 201) argued that the "human intelligence... is better understood as constituted not of frames conceived as stable mental structures, but rather of *roles*." Reimer argued that Gardner's position is entirely correct, but does not go far enough. Gardner's notion of the musical intelligence may not be sufficiently descriptive of the diverse ways thinking is manifested in the musical intelligence and how the musical intelligence is manifested in other modes of thinking. It is not sufficient to posit a generalized musical intelligence. Beneath the surface are different musical roles--e.g., performance, improvisation and composition, music theory, listening, and musicology--that give a broad sense of the multiplicity of ways that the musical mind discriminates and interrelates. Each of these roles call on particular yet related ways that characterize the musical intelligence.

Development of musical thinking in students with disabilities and impairments appears to have important and integral links to the development of thinking processes in the psychomotor, social, cognitive, and communication and language domains. What are the qualities and characteristics of musical thinking in students with disabilities and impairments? What is the nature of the development of musical thinking, including the nature of responding to music in students with disabilities and impairments? What can young students with disabilities and impairments do musically? How does what students with disabilities and impairments do musically change over time?

Performance, improvisation, and composition afford the opportunity for students with disabilities and impairments to demonstrate spontaneity, creativity and freedom of expression, playfulness and a sense of identity. Performance, improvisation, and composition are useful in helping the music teacher, therapist or director to establish a medium of communication with such students. Students are given the opportunity to express feelings that may be difficult to express verbally. Performance, improvisation, and composition provide a safe means of experimenting with new behaviors, roles or interactional patterns whilst also developing the ability to make choices and decisions within established limits. Students are given the opportunity to organize their decision-making, learn selectivity and commitment, develop economy of means, identify and develop themes, document inner thoughts and feelings and have tangible evidence of personal achievements.

Baker and Wigram (2005), Bruscia (1987, 1998), Nordoff and Robbins (1977), Nordoff (1990), Plach (1996), and Wigram (2004) provided comprehensive guides to assist in developing and implementing a range of performance, improvisation, and composition skills, techniques and processes in students with disabilities and impairments as an expressive stimulus for promoting and exploring new behaviors in individuals in a group setting. Guidelines include basic principles of performance, improvisation, and composition in music programs for such students; a detailed synopsis of more than twenty-five models that have been applied over more than thirty five years:

1. Observation skills; assessment of entry skills in individuals and/or group.
2. Developing learning outcome descriptors.
3. Developing and implementing activities.
4. Assessment and reporting of learning outcomes descriptors.
5. Professional ethics.
6. The role of the director, leader, teacher or therapist in the education and/or multidisciplinary team.

Creativity in music teaching recognizes the needs of students and the importance of an optimal learning environment. Such approaches also accommodate differences in working styles and musical background. The music teacher, therapist or director's role involves a concern for strengthening engagement between students and music. The music teacher, therapist or director assists students to not passively tolerate limited musical idioms, but to actively and willingly engage in music from a range of styles and contexts. Creative musical work is not controlled by the music teacher, therapist or director. Rather, the music teacher, therapist or director sets off trains of thinking to help the student develop critical powers and perceptions. The music teacher, therapist or direc-

Figure 1. Banana Keyboard. © 2010 Helen J. Farrell. Used with permission.

Figure 2. Small (6cm Diameter) Jelly Bean Switch Mounted onto Board. © 2010 Helen J. Farrell. Used with permission.

tor's role is one of facilitator and guide. Scholars have suggested stages in facilitating and guiding performance, improvisation, and composition with students with disabilities and impairments (Baker & Wigram, 2005, pp. 262-263; Blume, 2004; Brunk, 1998; Edgerton, 1990; Gillette, 1995; Krout, 2003; Primadei, 2004; Rooksby, 2000). Focus is more on *process*. The primary concern is to provide opportunities to explore and structure sounds into a musical whole.

Scholars have suggested that students with disabilities and impairments are less frequently engaged in performance ensembles (Atterbury, 1990; Gfeller, Darrow, & Hedden, 1990; Gilbert & Asmus, 1981; Hughes, Robbins, Smith, & Kinkade, 1987; Jackson, 1975, Krout, 1983; Rosene, 1976, 1982; Smith, 1987). Limitations need not exist with appropriate strategies. For example, Clark and Chadwick (1980) and Elliot (1982) suggested ways in which musical instruments may be adapted for students with disabilities and impairments. Large print music and/or a braille music format may be appropriate for visually-impaired students. Furthermore, information and computer technology--digital imaging, desktop publishing, multimedia, and music authoring software--may have great potential to impact on artistic skills (Aland, 1994; Brown, 1994; Conant, 1988; Dreyfus & Dreyfus, 1986; Hickey, 1997; MacGregor, 1994; Stevens, 1994). Scholars have suggested that assistive peripherals to support the use of standard music authoring software may have great potential to impact on musical skills in students with disabilities and impairments (Drake & Grant, 1987; Ellis, 1990; Junker & Fallon, 1996). Activated through a switch box, assistive peripherals may include banana keyboard (Figure 1), micro jellybean switch(Figure 2 and Figure 3), and SoundBeam (Figure 4).

Developmental Psychology: In Summary

There appears to be a paucity of research and theory literature specifically regarding the development of intelligences in students with disabilities and impairments. One may observe quite uneven outcomes. Development appears to vary greatly depending on the particular category of disability and the task. The largest proportion of research has focused on students with an intellectual disability. Such students fall below their chronological peers in many tasks. A student's intellectual age may be a better predictor of development than

Figure 3. Vertically Mounted Large (13cm Diameter) Jelly Bean Switch. © 2010 Helen J. Farrell. Used with permission.

Figure 4. Soft Pad Swithc. © 2010 Helen J. Farrell. Used with permission. See Beukelman & Mirenda, 2005.

chronological age. In contrast, there is little about the development of intelligences in students with other types of disabilities and impairments. Development of intelligences may not only vary greatly within each category of disability, but also across category of disability depending on the severity of the condition as well as the particular task. However, the intelligences apparently develop in a similar sequence as their non-disabled peers throughout their years of schooling, albeit at an uneven and/or lower rate.

CASE DESCRIPTION

The majority of students with disabilities and impairments in the State of Victoria (Australia) are educated in mainstream schools. At the time of the program development and implementation, there were approximately 6,600 students with disabilities and impairments in Victoria educated in nearly 100 public education system special school settings such as Day Special Schools, Special Developmental Schools, and schools and facilities for the deaf and blind (based on school system data).

The setting for this program was a public education system specialist school setting that caters for students aged between five and 18 years of age who have significant physical disability and/or health impairment. Many students demonstrated severe, profound, and multiple disabilities and impairments. The school was divided into three mini-schools. Some students were integrated into local mainstream primary school and secondary college settings for between one half and four days a week. At the time, the school setting had an enrolment of approximately 100 equivalent full time students. The school setting was a large airy building set on a property of several acres with attractive, well-maintained grounds leased to the state government education department from a not-for-profit non-government organization well known in Melbourne, Victoria and around Australia that provided extensive paramedical and other services and facilities for persons with physical and multiple disabilities and impairments. Students travelled daily to the school setting from their respective homes, and return via coaches modified for wheelchair access. Transport for students at the school setting was contracted by the state government education authority to two local coach companies.

An early intervention centre and kindergarten setting was also located on the property, but geographically quite separate from the main building. The setting serviced a mix of preschool children also with a combination of challenging intellectual, physical, and multiple disabilities and impairments from a wide geographical area and local regular preschool children. Many of the preschool children with intellectual, physical and multiple disabilities and impairments at the early intervention centre and kindergarten subsequently enrolled at and attended the specialist school setting.

Programs were developed and implemented in the context of current standards-based curriculum frameworks in Victoria. They included sensory focused and early learning stages of motor, social, cognitive, communication-language and musical development. There was a fully equipped Music Room. The school setting hosted an annual combined regions specialist schools music festival.

Programs were developed and implemented to promote individual behaviors, learning styles and educational needs of the students. To accommodate the wide range of abilities and the unique communication techniques of some students, a wide range of alternative and augmented communication systems were incorporated into programs. The school employed a number of teacher assistants to support the development and implementation of both education and therapy programs. The not-for-profit non-government organization also employed a number of therapy assistants to support the development and implementation of both education and therapy programs. Teaching staff, paramedical staff, teacher assistants, therapy assistants often developed and implemented both education and therapy programs together as small, often very close-knit interdisciplinary teams based in the mini-schools. Education and therapy programs were also very much supported by an army of community volunteers, some of whom had supported programs in many ways for many years.

Participants

The participants in this program were a defined classroom grouping of students; staff of the school community; and teacher-researcher. The defined classroom grouping for this study was five students with disabilities and impairments in their middle and later compulsory years of schooling enrolled in the specialist school setting selected purposefully (Patton, 2002, p. 45). This defined classroom grouping appeared to have distinct potential interest. The five individual students seemed to demonstrate very significant (maximum) variation in qualities and characteristics in thinking both within and across categories of disability and impairment (Patton, 2002, p. 234). The unique and diverse characteristics in thinking observed in this classroom grouping seemed to vary from that typically expected of students in very early childhood to that typically expected of students in the early years of schooling.

The five individual student participants in the classroom grouping were:

- A male student with a significant degenerative physical/health disability, who seemed to communicate with, even made informed decisions about creating, making and presenting music; music criticism and aesthetics; and the past and present contexts of music in quite conventional ways.
- A female student with multiple disabilities (i.e., concomitant physical disability, speech and language impairment, perceptual-motor impairment, and visual impairment) who seemed to communicate about creating, making and presenting music; music criticism and aesthetics; and the past and present contexts of music in intentional ways.

- A female student with a chromosomal disorder, resulting in degeneration of functional attention, cognitive, motor, and language-communication skills; significant degeneration of general health; hearing and vision who also seemed to communicate about creating, making and presenting music; music criticism and aesthetics; and the past and present contexts of music in intentional ways.
- Two male students with traumatic brain injury resulting in multiple disabilities (i.e., intellectual disability, speech and language impairment, visual impairment). One of the students seemed to communicate about creating, making and presenting music; music criticism and aesthetics; and the past and present contexts of music in intentional ways. The other seemed to possess unique ways of demonstrating personal responses to creating, making and presenting music; music criticism and aesthetics; and the past and present contexts of music (i.e., responses were assigned). Traumatic brain injury is an injury to the brain caused by an external physical force, or by internal event such as stroke, or aneurism, resulting in total or partial disability in the areas of cognitive, motor, and language-communication skills. The term does not include brain injury that is congenital or degenerative, or brain injury that is induced by birth trauma.

Staff of the school community, whether they be teacher, therapist, teacher assistant, therapy assistant or community volunteer, assisted in the process of the development and implementation of the classroom music program.

METHOD

Much is written about the role of the teacher-researcher in the development, implementation, and evaluation of educational initiatives (Britsch, 1995; Hargreaves, 1992a, 1992b; Wagner, 1990). Elliot and Adelman (1973b) suggested that teachers' research in the classroom be encouraged. Teacher-researchers perform leading roles in advocacy of differentiated curriculum, assessment, and reporting practice (Fawns, 1984). Interest in the key issues for this study certainly developed, at least in part, through ordinary involvement in the daily life as a music educator in specialist education settings in a teaching career that had spanned some twenty years before formally deciding to conduct research as teacher-researcher. The researcher could assume access to the setting as the classroom music teacher and had sufficient access to phenomena of interest.

There are no perfect research designs. Limited resources, limited time, and limits of the human ability to grasp the reality of the extraordinary complexities of an issue or set of issues necessitate trade-offs. Space for dialogue and scholarly engagement must be created. Furthermore, research about people with disabilities and impairments has always presented its own special set of challenges. Not only is there a need for more research in the special education context, but there is a need for critical analysis of existing research and improvement of the quality of such research. There is a great need for empirically based data in the special education context that assists in decision making for those who set policy, for those who implement and administer programs, for those who teach students and for those who advocate for people with disabilities and impairments in the public, corporate and not-for-profit sectors.

Traditional quantitative approaches in the general psychological research and theory literature have had the most profound influence on music research and theory (Boyle, 1992; Boyle & Radocy, 1987; Colwell, 1970). However, it seems to have been clear for some time that traditional quantitative approaches to the planned and systematic process of assessment and reporting about students' musical thinking are useful only to a point. This notion is not new. Existing quantitative approaches simply do not report and assess what students have learned. Time and funding are generally not available to develop appropriate test protocols for students with disabilities and impairments. Assessment and reporting about students' musical thinking is regarded as far more than test scores. The study of the nature of the musical intelligence and the constituent components of musical thinking require application of learning theories to learning and teaching music. Recent years have seen extensive reviews of knowledge, continued interest in multiple intelligence theory and a growing desire to know more about the generative processes in music (Davies, 1978; Hargreaves, 1986; Howell, Cross & West, 1985; Reimer, 2003; Sloboda, 1985).

The socially situated researcher enters into the depth and complexity of traditional and applied qualitative research perspectives. A qualitative approach seemed to best fit the focus of this study (i.e., experiences and meanings in the context of the social-interpersonal environment). A qualitative approach allowed the research process to adapt, change and mould to the key issues. This study was socially constructed. Qualitative research has a great deal of interest in the uniqueness of the individual case. Relationships and what is studied are stressed. Situational constraints of the everyday social world are confronted. For example, the phenomenon in this study could not always be easily distinguished from the context. It was not always easy to determine when an activity started or ended (Goode & Hatt, 1952). The study had to construct at least some sense of the context (e.g., the learning environment, the classroom climate, and classroom interaction). Why did I respond to the class in that way? Just what did motivate Jimmy? How did Jane feel when asked to... ? How did an announcement on the public address system affect... ? When interruptions occur... ? I had to be flexible enough to utilize unpredicted events and occurrences that so often arose in the teaching context. Decisions about design, measurement, analysis and reporting in a qualitative approach all flow from the focus of research. Such decisions become evident when examining alternative purposes along a continuum of categories in qualitative research. Anything worth knowing in an inquiry and evaluation of policy and program frameworks should be understood in a naturalistic context.

Qualitative inquiry and evaluation has become a discipline in its own right with a long and distinguished history in the social science fields (Greenwood & Levin 2005). Those who conduct research concerning people with disabilities and impairments must be aware of the challenges of their work. For example, Gaylord-Ross (1990-1992), Mertens and McLaughlin (2004) and Switzky and Heal (1990) explored the adaptation of research methods in the special education context. Standley and Prickett (1994) and Wheeler (1995) discussed the many challenges of research in the music therapy context. These texts were intended as supplementary texts alongside the more comprehensive research methods texts. They did not purport to replace the major research methodology texts. No approaches to the construction of a research design are unique to research with people with disabilities and impairments in either of the abovementioned contexts.

Successive waves of theory and research have crosscut historical moments or periods. Qualitative inquiry and evaluation has meant different things in each of these historical moments or periods. The qualitative researcher is located in a particular historical moment or period, simultaneously guided and constrained by the historical moment or period in any specific inquiry and evaluation. Paradigms in qualitative approaches to inquiry and evaluation embrace controversies and contradictions. Qualitative inquiry and evaluation is a set of interpretive activities. A paradigm is a worldview, a way of thinking about and making sense of the complexities of the real world.

A *multiple*, *descriptive case study format* (n=5) was designed--i.e., assessment and reporting of patterns of musical thinking in relation to profiles of musical achievement--*within* and *across* the five individual student participants observed over the ten week research period (Yin, 2003). Description included in-depth and detailed analysis of the phenomenon within its context, e.g., the learning environment, the classroom climate and classroom interaction to help the reader begin to get the feel of the place and time not unlike the reader would make themselves had they been there (Becker, 1992; Merriam, 1998; Schön, 1983; Stake & Eastley, 1978; Stake 1978, 1983, 1988, 1995, 2005; Yin, 1993). Cross-case analysis deepened exploration, description, explanation and prediction of patterns of musical thinking (Glasser & Strauss, 1967, 1970).

Change was to be expected. A multi method focus was thus adopted to enhance the quality and credibility of data collection and analysis about students' musical thinking. The many ways in which the five individual student participants in this defined classroom grouping responded to a musical activity or experience were recorded, however particular, irrational, or even unnatural the behavior may have seemed. No single behavioral indicator could possibly fully illustrate achievement, nor can achievement be fully demonstrated by engaging in just one musical activity or experience. However, it was recognized that behaviors could be difficult to interpret. The multiple types and sources of data that included collection and analysis of documents and records, participant observation strategy that seemed to have the potential to provide a sense of the insiders' viewpoint, and folios, visual images and work samples attempted to be congruent with the focus of the study and the features of the research design. The multi method focus attempted to track changes in musical thinking within and across the five individual student participants through the 10 week research period.

The analysis of qualitative data involved creativity, intellectual discipline, analytical rigor and a lot of hard work. Computer applications facilitated the work of analysis. The array of software applications to support the work of qualitative researchers continues to emerge. Optical scanning technology potentially makes light work of converting scanned texts into a readable word processing format. Emergent voice recognition technology potentially makes light work of transcribing open-ended interviews. I found the application of the nVivo software package particularly helpful in the writing of the case studies. The application managed search and retrieval of codes and memo and annotate reflections about context and crucial nonverbal data.

There appears to be widespread agreement that unethical behavior be avoided requiring careful consideration and preparation before entering the field governed by structures of institutional review boards. Examples of organizations providing standards and oversight include Australia National Health and Medical Research Council (NHMRC) (1992a; 1992b); Council for Exceptional Children (1997); American Association for Music Therapy (1994); Canadian Association for Music Therapy (n.d.); Certification Board for Music Therapists (1991); National Association for Music Therapy (1988); World Federation of Music Therapy (1993); American Evaluation Association (1995); American Psychological Association (2002). Unethical behavior has no place in qualitative inquiry and evaluation.

CURRENT STATUS: DEVELOPING AND IMPLEMENTING A CURRICULUM, ASSESSMENT, AND REPORTING FRAMEWORK AND MUSIC PROGRAM

The standards-based curriculum, assessment, and reporting framework in The Arts (Music) key learning area in the State of Victoria feature curriculum focus statements and clear learning outcome descriptor of what students should know and be able to do at each of six levels (Prep Year to Year 10) of achievement in each of the five substrand organizers. A curriculum, assessment, and reporting framework for the research project was intentionally designed with a high degree of congruence with this framework. However, three of the five individual student participants in the classroom grouping did not appear to demonstrate achievement at or beyond the initial level (Level 1) of this public curriculum, assessment, and reporting policy initiative.

Curriculum focus statements and clear learning outcome descriptors of what students should know and be able to do at four levels of achievement in each of the five substrand organizers in the framework were informed by research evidence and theory relating to notions of differentiated instruction. The first level of the framework featured a curriculum focus statement and clear learning outcome descriptor of what students should know and be able to do at a level of achievement in each of the five substrand organizers that seemed to be similar to taxonomy of behaviors typically observed in infants and toddlers (perhaps up to three years of age) and often observed in students with severe, profound and multiple disabilities and impairments.

The second level of the framework featured a curriculum focus statement and clear learning outcome descriptor of what students should know and be able to do at a level of achievement in each of the five substrand organizers that seemed to be similar to taxonomy of behaviors typically observed in preschoolers (perhaps four and five years of age) and often observed in students with mild and moderate disabilities and impairments.

The third level of the framework was directly reproduced from Level 1 of the standards-based curriculum, assessment, and reporting framework in The Arts (Music) key learning area. The curriculum focus statement and clear learning outcome descriptor of what students should know and be able to do at this level of achievement in each of the five substrand organizers seemed to be similar to taxonomy of behaviors typically observed of students at the end of the Preparatory Year (first year) of schooling (perhaps five or six years of age) and often observed in students with mild disabilities and impairments.

The fourth level of the framework was directly reproduced from Level 2 of the standards-based curriculum, assessment, and reporting framework in The Arts (Music) key learning area. The curriculum focus statement and clear learning outcome descriptor of what students should know and be able to do at this level of achievement in each of the five substrand organizers seemed to be similar to taxonomy of behaviors typically observed of students at the end of Year 2 (third year) of schooling (perhaps eight years of age) and often observed in students with mild and borderline disabilities and impairments.

A ten-week unit of work embedded findings, understandings and explanations of contributions to research and theory and notions of Differentiated Instruction. The unit of work was developed and implemented from the theme (starting point) of an integrated curriculum unit.

1. ***Unit Focus*** that provided a summary of the main skills, knowledge, processes, and patterns of learning.
2. ***Relevant Learning Outcomes*** section that concisely described what students may typically achieve in a substrand organizer at a particular level.
3. ***Suggested Learning Activities*** section that typically included musical performance, improvisation, and composition activities and experiences that focused on the affective, emotional, and aesthetic aspects of their own and others' performances, improvisations, and compositions associated with the theme, or starting point.
4. ***Resources*** section that provided guidance and suggestions for facilitation of the prepa-

ration of materials and environment, including the application of continually emerging information and computer technology (a simple notator application (Band-in-a-Box), and a sequencer application (MicroLogic) and assistive peripherals (a banana keyboard researched and developed in Melbourne, Australia; and an EMS Soundbeam researched and developed in Bristol, United Kingdom) derived from individual abilities, experiences, and preferences as the class teacher.

Effort was concentrated on developing a well-grounded sense of local reality. Musical thinking was explored, described, explained and predicted over the ten week period in relation to the extended profiles of musical achievement *within* and *across* the five individual student participants observed using pattern matching logic. Multiple types and sources of data contributed to enhancing quality and credibility of exploring, describing, explaining and predicting patterns of musical thinking. Great care was taken when analyzing data (e.g., intent and meaning of particular physical movements, patterns of responses).

CONCLUSION: THE CONTINUING CHALLENGE AND OPPORTUNITIES

Consistent with the legacy of approximately 235 years and Jean Marc Gaspard Itard (1775-1838) to whom most trace the beginning of special education as we know it today, the chapter explored the extraordinary complexities in the development and implementation of differentiated curriculum, assessment, and reporting policy initiatives with the integration of assistive and augmentative information and communication technology.

Notions of integration, normalization, and least restrictive environment for people with disabilities and impairments still do not appear to have become sufficiently integrated into practice so as to become little discussed facts of life (Gavin, 1983; Gilbert 1977). Such notions still appear to continue to be of concern to all educators. Research evidence and theory suggests that education professionals have not been fully equipped, prepared, and readied to meet the social, political, and economic challenges and opportunities in the demands of teaching students with complex educational needs, preferring to leave the job to trained specialists. Times have changed. Law, regulation and policy initiatives in many sovereign states have changed. Classrooms today have at least some inclusive aspects to them. Whither to?

One of the most urgent tasks for both education and the many other allied health professionals that are the multidisciplinary teams that work with individuals with special needs is support in the development and implementation of differentiated curriculum, assessment, and reporting policy initiatives with the integration of assistive and augmentative information and communication technology. Space for dialogue and scholarly engagement must be created.

This study was limited to a very specific context, but could possibly be replicated in other contexts. For example, longitudinal studies of larger samples across a greater variation of contexts would further enhance quality and credibility. The multidisciplinary teams of education and many other allied health professionals are concerned not only about what they must know or be able to do in order to teach students with disabilities and impairments effectively, but also where they can acquire the requisite skills and knowledge (e.g., Farrell, 1994; Forsythe & Jellison, 1977; Hoffer, 1987; Kearns, 1986; Keller, 1977; Lam & Wang, 1982; Lehr, 1977, 1982; Thompson, Harvey, Kaplan, & Lehr, 1980). It would be useful to develop and deliver support materials and targeted high quality preservice and professional development programs.

A small-scale qualitative inquiry and evaluation for the research project was described (Farrell, 2007). The demand was that the results be true for the specific context at the particular time. Emerging insights and conclusions did not need to be true for all contexts all over the country for all time. The research project attempted to speak to the great need for a compassionate, critical and interpretive social science. Qualitative inquiry and evaluation has continued to gain momentum in spite of assault from multiple forms of resistance. The qualitative researcher must navigate among the oppositional forces which appear to deny advances made in qualitative approaches to inquiry and evaluation. Space for dialogue and scholarly engagement must be created.

Research experience needs to continue to be supported to provide reliable, valid and fair practices in the development and implementation of differentiated curriculum, assessment, and reporting law, regulation and policy initiatives with the integration of assistive and augmentative information and communication technology. It appeared critically important that the teacher-researcher acquire understanding of ethical, legal, legislative and political challenges that must be confronted. Given severe and profound psychomotor, personal, linguistic and cognitive difficulties, great care had to be taken when attempting to extract definitive conclusions about patterns of thinking within and across the small classroom grouping of students.

Development and implementation of differentiated curriculum, assessment, and reporting framework with the integration of assistive and augmentative information and communication technology endeavored to recognize and respond to diverse student needs (i.e., cater for different learning styles and challenge *all* students, including those with severe, profound and multiple disabilities and impairments who may not demonstrate achievement at or beyond the initial level of a public curriculum, assessment, and reporting policy initiative). A ten-week program was developed and implemented for a defined classroom grouping of five students with special educational needs from a differentiated curriculum, assessment, and reporting framework. The program featured a range of musical activities and experiences. Students appeared to particularly enjoy the assistive and augmentative information and communication technology. The program included activities and experiences associated with each of the substrand organizers in the framework. As the substrand organizers are related, students often engaged in the substrand organizers in the same learning activity or experience.

LESSONS LEARNED

The program appeared to have a positive impact on both the individual students and the group. The development, implementation, and evaluation of the framework and music program provided the opportunity to do the following:

1. Encourage special knowledge and modes of knowing; provide recognition of such contributions.
2. Enhance the possibilities of attracting a greater number of daring, experimental, and intellectually active people into curriculum discussion.
3. Imply challenging decision-making processes and collaborative planning.
4. Provide a basis for participants' recognition of themselves as possessed of special knowledge and competence through a sense of intellectual community.
5. Entail an understanding of implied changes in culture, structure and processes that facilitate effective proposed and actual changes.
6. Pressure for change in public curriculum, assessment, and reporting policy framework and program initiatives in special education sectors.

This chapter traced contributions to research and theory from humble beginnings to a rich history of over 140 years. Contributions to research evidence and theory seemed to have very much enhanced the broad understanding of the extraordinary complexities that encompass such a task. In my view, basic and applied research needs to continue to be supported to provide fresh research evidence and theory regarding thinking in students with disabilities and impairments. The development and implementation of differentiated curriculum, assessment, and reporting policy initiatives with the integration of assistive and augmentative information and communication technology must be embedded with this fresh research evidence and theory.

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KEY TERMS AND DEFINITIONS

Banana Keyboard: The "banana keyboard" is a unique system designed to allow people with disabilities access to the wonderful world of music and sound. The keyboard has 16 keys configured like an oversized piano, but curved to suit the radial movement of an arm. It may be placed on a wheelchair tray or bench. The keyboard has eight extra inputs so other types of adaptive switching, such "jelly bean" switches, can be plugged in to allow full user access.

Compic Pictographs: There are a variety of augmentative and alternative communication (AAC) systems and strategies that assist to address the communication needs of those with developmental, acquired and progressive disabilities. Compic pictographs are a library of easily understood computer generated visual representations of approximately 1800 words and concepts to convey information on a CD ROM. See Beukelman, & Mirenda. (2005).

Differentiated Instruction: A differentiated curriculum is a program of activities that offers a variety of entry points for students who differ in abilities, knowledge and skills. In a differentiated curriculum, teachers offer different approaches to *what students learn* (content), *how students learn* (process) and *how students demonstrate what they have learned* (product). Information can be retrieved from <http://www.curriculumsupport.education.nsw.gov.au>. Very useful research evidence relating to differentiated instruction in the form of a refereed article titled "*Differentiated Instruction*: *A Review of the Research*" can be retrieved in PDF format from <http://www.aare.edu.au/06pap/sub06080.pdf>.

Jellybean Switch: There are a variety of augmentative and alternative communication (AAC) systems and strategies that assist to address the communication needs of those with developmental, acquired and progressive disabilities. A "jelly bean" switch is one of an assortment of adaptive devices that may be used to access information and communication technology.

Phonological Discrimination: To consistently articulate a speech sound, the speaker must be able to discriminate segments of sound, or phoneme (from the φώνημα, phōnēma, "a sound uttered"). See Bauman-Waengler, 2007; Paul, 2001.

Protowords: Protowords are sounds that are similar to, but are not quite words. Common examples of protowords used by infants between 10-12 months of age include mama, dada and baba. Whilst repetitive babbling involves repeating sounds over and over again (e.g., babababababa), protowords are shortened, typically to 1-2 syllables. Protowords generally correspond to something concrete, e.g., mama for mother. In other words, a protoword is used consistently to refer to the same object.

Qualitative Research: Qualitative research is a method of inquiry appropriated in many different academic disciplines, particularly in the social sciences. Qualitative researchers aim to gather an in-depth understanding of human behavior and the reasons that govern such behavior. The qualitative method investigates the *why* and *how* of decision making, not just *what*, *where*, *when* in small, focused samples, rather than large samples. Qualitative methods produce information only on the particular cases studied.

Soundbeam: The Soundbeam is an interactive MIDI hardware and software system developed by The Soundbeam Project/EMS in which movement within a series of ultrasound beams is used to control multimedia hardware and/or software to generate MIDI messages. Digital videos and references can be retrieved from <http://www.soundbeam.co.uk>. Digital videos titled "*Welcome to the Soundbeam Part 1*" and "*Soundbeam Performances*" (MPEG format) can also be retrieved from <http://www.youtube.com>.

Substrand Organizers: A substrand organizer is a discrete subset of knowledge, skills, and understanding within a learning area.

Teacher-Researcher: The teacher-researcher becomes fully involved in an informal, interpretive and reflective (qualitative) model of inquiry with the participants (e.g., students in a school setting) to focus on the complexities of social situations such as those found in classrooms about whom the information is being collected and for whom the outcomes become a benefit and justification for the research (Allan, 1991; Glesne & Peshkin, 1991). Very useful research evidence relating to the teacher-researcher in the form of a refereed article titled "*Teacher-Research*: *The Benefits and the Pitfalls*" in PDF format can be retrieved from www.aare.edu.au/04pap/gre04828.pdf>.

ADDITIONAL READING

The Alfred Brash Soundhouse <http://www.theartscentre.com.au/Default.aspx> The Alfred Brash Soundhouse is a specialist education technology division based in the Arts Centre, Melbourne, Australia. The website contains a very interesting movie image of people with disabilities and impairments accessing a "banana keyboard" (an assistive and augmentative information and communication technology for a music program).

Technical Solutions Australia <http://www.tecsol.com.au> Technical Solutions Australia is the Australian retail outlet for the "jelly bean" switch and other adaptive devices that may be used to access information and communication technology.

ScopeVictoria <http://www.scopevic.org.au> ScopeVictoria is a community not-for-profit organization that works in the disability sector in Australia. The website contains further information regarding the use of compic pictographs.

Meyer-Johnson <http://www.mayer-johnson.com> Meyer-Johnson manufacture the library of computer generated compic pictographs of approximately 1800 words and concepts available on CD ROM.

Soundbeam <http://www.soundbeam.co.uk> The website contains information regarding interactive MIDI hardware and software system developed by The Soundbeam Project/EMS.

DISCUSSION QUESTIONS

1. **What emotions, hunches and feelings do I have about working with students with disabilities?** Consider how I feel about students with disabilities and impairments in my class.
2. **How can having diverse students benefit outcomes for teachers and students?** Consider why it is worth having students with disabilities and impairments in my class. Consider the potential challenges, risks. and barriers to having students with disabilities and impairments in a class. Consider what information your have and/or need about having students with disabilities and impairments in my class. Consider how you can work out the roles. Consider where you go from here in having students with disabilities and impairments in your class.

Chapter 12
Communication Technology Integration in the Content Areas for Students with High-Incidence Disabilities:
A Case Study of One School System

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ABSTRACT

A myriad of assistive/instructional technologies are available for students with high-incidence disabilities (Learning Disabilities/Emotional/Behavioral Disorders), but which do teachers actually use to teach content? This case study examines the current assistive technology implementation by teachers working with students with learning disabilities and emotional/behavioral disorders. Through the chapter, one can learn about top technologies used in elementary, middle, and high school settings in language arts, math, science, and social studies, as well as discover creative and innovative ways to use assistive and instructional devices/programs in content coursework.

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INTRODUCTION

The fascinating world of communication technologies grows rapidly. Each day new devices and programs are developed to help students with disabilities overcome many of their challenges. Assistive (AT) and instructional (IT) technology tools contribute to the academic improvements for students with high-incidence disabilities, specifically learning disabilities (LD) and emotional/behavioral disorders (E/BD). The effects of technology for students with learning disabilities and emotional/behavioral disorders were examined in all content areas including reading (e.g., Hall, Hughes, & Filbert, 2000; Wise, Ring, & Olson, 2000), writing (e.g., Higgins & Raskind, 2004, Lewis, Ashton, Haapa, Kieley, & Fielden, 1999, MacArthur, 1998; Williams, 2002), math (e.g., Bley & Thornton, 2001; Bryant, Bryant, & Hammill, 2000; Irish, 2002; Kelly, 2003) as well as science and social studies (e.g., Ferretti, MacArthur, & Okolo, 2001; French, McBee, Harmon, & Swoboda, 2003; Quintana, Reiser, Davis, Krajcil, Fretz, Duncam, et al., 2004). While a majority of these studies demonstrates the positive impact of assistive and instructional technology on improved performance by students with high-incidence disabilities, the research on the actual status of technology use to support students with learning disabilities and emotional/behavioral disorders seems to be limited and inconclusive (Edyburn, 2006; Dalton & Roush, 2010).

BACKGROUND

The emphasis of the major educational legislation has been on providing full access and active participation of students with disabilities in the general education curriculum. Both the No Child Left `Behind Act (NCLB, 2001) and the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) mandate that all students should receive content-based instruction and make progress in academics (Browder, Flowers, Ahlgrim-Delzell, Karvonen, Spooner, & Algozzine, 2004; Dymond & Orelove, 2001). These regulations are even more substantive due to the increasing numbers of students with high-incidence disabilities being served in general education settings (Edyburn, 2006). Technology has a great potential to provide the supports needed to accomplish tasks in all content areas (Forgraves, 2002; Quenneville, 2001).

In the last two decades numerous studies have demonstrated the impact of different devices and software programs that were found to be effective to foster academic success and independence of students with learning difficulties (Bryant, Bryant, & Raskind, 1998; Gardner, Wissick, Schwender, & Canter, 2003; Lenker, Scherer, Fuhrer, Jutai, & DeRuyter, 2005). Technology is able to compensate for many deficit areas associated with learning disabilities and emotional/behavioral disorders diagnoses. Thus, some students may reread or skip lines in oral reading, constantly losing their place on the page. Such a low-technology tool as an index card or a highlighting bar will aid poor readers through reading line by line. Students having difficulties decoding words, substituting or omitting letters, words, and phrases spend too much time figuring out each word, losing much of the content. To spare the effort and boost comprehension, text-to-speech technology works by translating text into speech, thus providing auditory input of information (Lewis, 1998).

Assistive Technology for Writing

Text-to-speech programs with and without on-screen highlighting of the spoken words has enabled students with reading difficulties to demonstrate better results in word recognition, reading comprehension, and retention (Allinder, Dunse, Brunken, & Obermiller-Krolikowski, 2001; Hecker, Bums, Elkind, Elkind, & Katz, 2002; Lewandowski & Montali, 1996; Wise, Ring, & Olson, 2000). Being able to hear the text relieves the burden of decoding allowing learners to pay more attention to the content of the story. The same text-to-speech technology has found another effective application in supporting struggling writers in proofreading their compositions, receiving auditory feedback and identifying more spelling and grammatical errors (Raskind & Higgins, 1995; Strangman & Dalton, 2005; Wanzek, 2006). Easier text manipulation and alteration is possible with the help of word processors (Hetzroni, & Schrieber, 2004; Zhang, 2000). Additional aids for editing are represented by various spell and grammar checkers (Ashton, 1999; Montgomery, Karlan, & Coutinho, 2001).

Word prediction is another category of assistive technology compensating for word recall, spelling, and handwriting difficulties of students with learning disabilities. While historically designed for users with physical disabilities, word prediction was determined to increase the typing rate and decrease spelling errors for all students (Tumlin & Heller, 2004). Selecting words from a list of choices available as the user begins to type the word, struggling writers may produce higher quality writing (Ashton, 2005; MacArthur, 1999; Sitko, Laine, & Sitko, 2005). Based on the existing, albeit limited research, writing readability/legibility and spelling of students with learning disabilities and writing difficulties improve with word prediction (Handley-More, 2003; MacArthur, 1998, 1999; Mirenda, Turoldo, & McAvoy, 2006; Williams, 2002). Moreover, various combinations of aforementioned technology can be used. For example, Gullen and Richards (2008) have utilized a talking word processor with a spell checker and word prediction software demonstrating increased accuracy, number of words, and overall district writing rubric scores by students with writing difficulties.

Students struggling with planning and organizing their writing may benefit from visual representation of ideas, easier clustering, and investigation of relationships between ideas and themes possible with outlining and brainstorming programs. Organizational software is essential for producing higher quality writing work, especially for secondary students (Anderson-Innian, Knox-Quinn, and Ilorney, 1996; Blair, Ormsbee, & Brandes, 2002; Sturm & Rankin-Erickson, 2002). Drawing a picture before writing a story is one of the strategies widely implemented with younger writers. Students with learning disabilities may also benefit from software programs incorporating both graphics and text as an alternative venue of communicating ideas (Dimitriadi, 2001; MacArthur, 1996; Quenneville, 2001). Furthermore, speech recognition programs transform spoken words into text allowing getting students' ideas on paper bypassing the mechanics of writing (MacArthur & Cavalier, 2004; Quinlan, 2004; Raskind & Higgins, 1999; Higgins & Raskind, 1995, 2000). The research found students' writing to be longer, more complex and accurate when using speech-to-text technology (Forgave, 2002).

Assistive Technology for Reading

In an effort to guarantee all students equal access to the general education curriculum, it is important to ensure their ability to read class materials, for example with the help of instructional materials in digital formats. Providing students with opportunities to be exposed to text is necessary in order to enhance reading comprehension, a mental process that depends on readers combining their prior knowledge and experience with text information (Silver-Pacuilla, Ruedel, & Mistrett, 2004). With an expanding pool of technological choices, their efficacy has been validated through quite a limited search. Computers may provide help in intensive, closely monitored, and individualized reading tutoring from drill and practice repeated learning programs to instruction in higher order thinking skills. Assistive reading programs allow children to develop phonological awareness (e.g., Elder-Hinshaw, Manset-Williamson, & Nelson, 2006; Wise, Ring, Olson, 2000); word recognition (Lee & Vail, 2005; Sheehy, 2005); vocabulary skills (e.g., Jitendra, Edwards, Sacks, &. Jacobson, 2004; Xin & Rieth, 2001); reading fluency (e.g., Kartal, 2006; Sorrell, Bell, & McCallum, 2007) and comprehension (e.g., Kim, et al., 2006; Palmer, 2003). Technology innovations such as portable optical character recognition and speech synthesis tools (e.g., Quictionary Reading Pen) find new niches in addressing students' specific areas of need (Higgins & Raskind, 2005).

Several technology applications are used to support reading comprehension of students with reading difficulties. Computer-supported digital text reproduction of popular trade books, embedded with research-based comprehension strategies and supports was associated with significant gains in comprehension on reading achievement tests (Dalton, Pisha, Eagleton, Coyne, & Deysher, 2001). However, while it helps students with reading difficulties to overcome substantial barriers imposed by the printed materials, electronic text by itself is rather limited in its usefulness (Anderson-Inman & Horney, 2007). Merely putting text in a digital format for display on a computer screen does not have an appreciable effect of students' understanding of that text. It is critical how users utilize opportunities afforded by digital text or the enhancements added to it (Okolo, 2006).

Hypermedia reading lessons may include text with enhanced vocabulary, enhanced syntactic and semantic structures, build-in comprehension strategies, opportunities for retelling, and vivid illustrative resources (Higgins, Boone, Lovitt, 1996; Horney, & Anderson-Inman, 1999; Proctor, Dalton, & Grisham, 2007). In turn, electronic talking books are widely used for teaching reading fluency since they provide a convenient environment for repeated readings. Furthermore, reading fluency has been found to positively affect reading comprehension (Oakley, 2002). The audio-books format has been found to improve reading fluency, comprehension, and reading attitude scores of students with reading disabilities (e.g., Boyle, et al., 2003; Esteves, 2008).

Assistive Technology for Math

Technology plays an important role among teaching techniques and adaptations used in introducing mathematic skills to students with learning disabilities. It is one of the standards developed by the National Council of Teachers of Mathematics (2000) to incorporate both low-tech technology, such as calculators, and high-technology aids, such as computer software, in math instruction (Bley & Thornton, 2001). The focus of research on the use of calculators has been on utilizing them as a testing accommodation (Bouck & Bouck, 2008). Teaching multiplication facts with the help of a multimedia program has been found to increase accuracy in computations (Irish, 2002). Computer-assisted learning was also noted to improve automaticity of basic facts (e.g., Wilson, Majsterek, & Simmons, 1996); number combination and acquisition of problem solving skills (e.g., Fuchs, et al., 2006; Mastropieri, Scruggs, & Shiah; 1997); and overall math skills on a standardized achievement test (e.g., Yin, 1999). A line of research on enhanced anchored instruction utilizing video anchors and interaction with the program demonstrate improvements in problem-solving skills and application of mathematical knowledge to real-life situations (e.g., Bottge, Heinrichs, Chan, Mehta, & Watson, 2003; Bottge, Rueda, Serlin, Hung, & Kwon, 2007). Still, more research is needed to determine technology's potential to enhance math learning (Bouck & Flanagan, 2009; Edyburn, 2003; Maccini & Gagnon, 2005).

Assistive Technology for Science and Social Studies

Assistive technology in science and social studies can be categorized to include: simulations such as dissecting animals (e.g., French, McBee, Harmot, & Swoboda, 2003); graphic organizers (e.g., Boone et al., 2006); voice versus text note taking, study guides, and other self-efficacy strategies (e.g., Ferretti, MacArthur, & Okolo, 2001; Horney et al., 2009; Jerome & Barbetta, 2005); computer-based conceptually framed text and other supported reading activities (e.g., Twyman & Tindal, 2006; Zorfass & Clay, 2008). All aforementioned tools support students with mild disabilities in such important tasks as preparing and implementing science experiments; core content comprehension, retention, and problem solving. Overall, in the literature synthesis of social studies and technology-based intervention research for students with high-incidence disabilities in elementary through secondary grade levels Boon, Fore, Blankenship, and Chalk (2007) identified only 18 studies published in the last 25 years. Despite benefits in achievement, engagement, motivation, and study skills, they emphasize the limited research base in the area of technology component in science and social studies instruction.

Instructional Technology

Instructional technology widely used in general education has also been found to improve performance of students with high-incidence disabilities in multiple content areas. Thus, Smart Board technology was successfully used to teach letter sounds to elementary students with learning disabilities (Campbell & Mechling, 2009). The Internet promoted learning by building bridges between students; providing resources to cover background gaps and enhance thematic unit activities and experiences; offering real-world math simulations (Bayha, 1998; Gardner & Wissick, 2002; Glazer, 2004; Silver-Pacuilla & Fleischman, 2006). Besides video-based anchored instruction mentioned earlier, video modeling featuring step-by-step problem solving processes was used for teaching geometry (Cihak & Bowlin, 2009) and vocabulary skills (Xin & Rieth, 2001). The value of video format is in opportunities for observational learning and interaction with the content. Finally, such programs as *Microsoft PowerPoint* offer opportunities to present lessons to students with disabilities in innovative, motivational ways (Elder-Hinshow, Manset-Williamson, & Nelson 2006).

Technology Tools for Students with Emotional/Behavioral Disorders

Indeed, technology-based interventions increase engagement and motivation of all students but more importantly of students with behavior problems, thus preventing disruptive, insolent, and disobedient behavior problems. Computers are used as tools to increase reading comprehension of this population of students as well as self-management, self-efficacy tools; aids for changing students' perceptions about various social behaviors; and ways to motivate students into active classroom participants (Blankenship, Ayres, & Langone, 2005; Fitzgerald, 2005; Gulchak, 2007). However, besides undeveloped research base in the area of assistive technology for students with emotional/behavioral disorders, many researchers also emphasize the lack of technological applications for these students in contrast to students with learning disabilities (Schweder & Wissick, 2009).

To summarize, both assistive and instructional technology tools contribute to the academic improvements when integrated appropriately into the curriculum for students with learning disabilities and emotional/behavioral disorders. However, the recent research study conducted by the National Assistive Technology Research Institute on assistive technology use in schools noted the low number of participating students with high-incidence disabilities questioning the ways technology is being considered and offered for students with learning disabilities and emotional/behavioral disorders (Quinn, Behrmann, Mastropieri, Bausch, Ault, & Chung, 2009). Indeed, while many researchers investigated the assistive technology applications in public schools with students with severe disabilities (Abner & Lahm, 1998; Derer, Polsgrove & Rieth 1996; Lesar, 1998), there is not enough information on the actual use of technology to support students specifically with learning disabilities and emotional/behavioral disorders (Blackhurst, 2005; Edyburn, 2003; McArthur, Ferretti, Okolo, & Cavalier, 2001).

SETTING THE STAGE

The purpose of this case study was to obtain information from teachers of students with learning disabilities and emotional/behavioral disorders on how and what technology they currently use for their students with high-incidence disabilities in one large suburban school district. Specifically we looked at (a.) the current technology tools students with high-incidence disabilities use; (b.) devices and/or programs most frequently used by students in relation to their grade level; (c.) devices and/or programs most frequently used by students in relation to the subject (reading, writing, math, science, and social studies.); (d.) innovative ideas to use assistive and instructional technology applications in content coursework.

Large Suburban School District

This case study is based on the suburban school district standing among the first dozen of the largest school systems in the nation. The district includes 197 schools and centers. Its total enrollment counts more than 170,000 students in K-12 grades including about 24,000 students who receive special education services. The school district is a national leader in the integration of assistive technology for students with disabilities. This service includes a comprehensive assessment component to determine which specific hardware, software, and/or adaptations a student might require. For example, a student with dyslexia might require alternative formats for all his/her instructional materials to effectively enable participation in all aspects of school curriculum and life. Once a specific device or software program is determined to be appropriate, training for the staff (and parent if appropriate) who will work with the student is provided and ongoing support is in place at the school from an assistive technology resource teacher. An Assistive Technology Services (ATS) staff member is assigned to every school to provide ongoing assistive technology support and a point of contact for all assistive technology issues. Most assistive technology staff members support from five to 12 schools.

During the assistive technology (AT) referral process, the Assistive Technology Services (ATS) specialist is focusing on building capacity at the school level to support the assistive technology needs of students by training school staff on how to integrate technology into specific curriculum projects so that all students have equal access to the content. At this time an Assistive Technology Collaboration (ATC) plan is jointly developed to provide assistive technology support to the entire school, not just individual students. The overall goal of the assistive technology Collaboration Model is to build or expand knowledge of assistive technology by working with schools to:

- Empower school-based staff to make initial decisions related to the assistive technology needs of students;
- Use school resources to meet assistive technology needs when possible;
- Utilize the expertise of ATS staff when assistive technology support is needed;
- Involve more school-based staff so that continued use of assistive technology will be encouraged.

The Assistive Technology Services office conducts website training, curriculum resource training, software or equipment demonstration, assistive technology training for small groups or the entire staff, classroom technology based projects, technical strategies for differentiating instruction, and meetings with key personnel to determine what assistive technology (AT) resources are available on-site. The intended outcomes of the AT

Collaboration Plan are that (a.) teachers will plan and design developmentally appropriate learning opportunities that apply technology to support the diverse needs of learners; (b.) teachers will use assistive technology resources and low tech strategies / activities to support skill-based needs of students and curriculum instruction; (c.) students will have ongoing access to assistive technology required to meet their individual needs.

There are several ways that Assistive Technology Services (ATS) staff supports teachers of students with learning disabilities and emotional/ behavioral disorders in technology use in the school district. ATS maintains a robust curriculum resources section on the internal Intranet site and accessible through Blackboard. The purpose of this section is so staff can share the resources they develop to meet the educational needs of their students with disabilities. These resources can be shared with staff all around the county so that no staff member has to recreate an activity that has already been developed. Teachers can search this resource section by key word, subject, Standards of Learning (SOL), and by the specific software program that the activities are created in. The training videos and handouts for various pieces of software/hardware such as: *Boardmaker*, *ChooseItMaker*, *Co:Writer*, *Draft:Builder*, *Inspiration*, *Neos*, *Read:OutLoud*, *Start to Finish Books*, and *Writing with Symbols* are also available on the Intranet site and can be accessed by all school staff at any time.

Building capacity in schools requires the development of teacher leaders to enhance school success. In the field of assistive technology, teacher leaders are important for providing school-based expertise in an ever-changing field. As part of building capacity, professional development opportunities are imperative. However, professional development must be an ongoing process, not a onetime event. One strategy that is used in this school division is a teacher leadership program in assistive technology, which helps ensure that there are school-based staff with knowledge about technology who can provide immediate assistance when the AT teacher is not available. These staff members may be special education teachers, general education teachers, related services providers, instructional assistants, or any other appropriate staff member. They are nominated by the assistive technology resource teachers. An important criterion used for identifying school-based teachers for the AT leadership program is the ability to integrate technology into instruction on a regular basis. Educators who participate in this leadership opportunity are not required to have expertise in the area of AT but rather need to understand the value of technology and possess a desire to learn more about the hardware and software available to meet the needs of students.

Assistive Technology Services staff have also developed numerous five-week courses related to assistive technology that teachers are offered on a regular basis. In addition to being able to learn new information, these courses allow teachers to earn re-certification points for their teaching license. One of the courses offered in the summer is a multimedia writing course. Teachers have the opportunity to attend one week of classes which provides them information about various software and hardware used to support writing. After one week of training, they work directly with students who are attending a one-week writing camp. The benefit of this approach is that the teachers can immediately put what they learned into practice. Additional assistive technology training opportunities are available to all interested personnel during an annual one-day conference with multiple sessions.

There are many types of assistive technology (AT) available to students and teachers in the school district. Assistive Technology Services maintains a lending library so that software programs, communication devices, and other hardware can be checked out to individual students or classrooms based on their needs. When the technology no longer meets the need of the student, it can be returned so that another student can use the same technology. Providing access to technology for entire classrooms has proven to be an effective approach for integrating AT into the classroom. For example, instead of providing one or two students in a team taught classroom access to portable technology such as a *Neo*, it is often more effective if the entire classroom can have access to this technology. Following the principle of Universal Design for Learning, this allows students to access the parts of the technology they need. Some students might need a word prediction applet installed to meet their specific needs while most students won't need that accommodation. Students don't feel different if they are all using the same technology but can individualize according to need.

Table 1. Demographic Data on Study Participants

Categories	Participants (percentages)
Male Female	17.1% 82.9%
Elementary school Middle school High school Other	34.2% 26% 30.9% 8.9%
Elementary subjects Language arts Mathematics Science, History, Social studies Other	18.7% 32.5% 17.1% 16.3% 15.4%
Baby Boomers (1946-1963) Gen Xers (1964-1981) Gen Y (1982-current)	52% 36.6% 11.4%
Self-contained settings Inclusion classrooms Resource classrooms Alternative schools	44% 39% 10.6% 6%

CASE DESCRIPTION

The purpose of this case study was to investigate the use of assistive and instructional technologies as an instructional tool by special and general education teachers working specifically with students with high-incidence disabilities in one school district in the East. Cross-sectional, semi-structured online surveys as well as the follow-up interviews were conducted with teachers of students with learning disabilities and emotional/behavioral disorders. Table 1 shows demographic information on participating teachers.

The years of experience among the participants ranged between 0 to 30 years ($M = 6.2$; $SD = 6.4$). The total number of students served by the survey participants was 2,867 (students with learning disabilities = 2,179; students with emotional/behavioral disorders = 688).

The participants in this study were initially selected from former and current students in one large special education master's program and graduate certificate program for state licensure in the endorsement areas of learning disabilities and emotional disturbance. Those initially selected participants were encouraged to invite their peers to participate in the study. As a result, 79% of the participants were graduates of this program, while 21% of the teachers attended other universities and colleges.

Instrument

The 20-item cross-sectional survey instrument used in this study was designed based on previous research (Copley & Ziviani, 2004; Derer, et. al., 1996; McGregor & Pachuski, 1996). It was adapted specifically for teachers working with students with high-incidence disabilities. The survey focused on (a) technology use in various grade levels and subject areas, (b) the extent to which technology training prepared teachers to use AT, and (c) self-reported knowledge about assistive technologies. The initial draft of the survey was reviewed by several AT experts and was revised based on their feedback. Part 1 of the survey consisted of questions that captured demographic data including, gender, age, grade, experience and prior education, current position, student load, grade and subject teaching, knowledge about assistive and/or instructional technology and other related information.

Then participants were asked to check each technology/program that their students with high-incidence disabilities were using. Based on the grade level and subject area participants were teaching at the time, they were offered different sets of technologies currently available on the market for that age and disability group of students. Some examples of assistive tools encouraged to use with students with high-incidence disabilities were as follows:

Low-Technology Tools

- Highlighters, highlighting tape, bar magnifiers, colored transparent overlays, book holders, and audio books
- White boards, raised line paper, pencil grips, magnetic letter, alphabet stamps, handwriting aids, and portable spell checkers
- Abacus, hands-on clocks, talking and on-screen calculators, spreadsheets, hands-on money, and manipulatives
- Post-its, index cards, visual schedules, and calendars

Medium and High-technology Tools

- Text-to-speech software (e.g., WriteOutLoud/ReadOutLoud http://www.donjohnston.com; E-reader http://www.cast.org; Read and Write Gold http://texthelp.com; ClaroRead http://www.claro-software.com)
- Programs for reading websites (e.g., BrowseAloud http://www.browsealoud.com; NETalker http://www.readingmadeeasy.com)
- Optical Character Recognition programs to scan and read (Kurzweil http://www.kurzweiledu.com; WYNN http://www.freedomscientific.com; Scan and Read Pro http://www.readingmadeeasy.com; OmniPage http://www.nuance.com)
- Word prediction software (e.g., Co:Writer http://www.donjohnston.com, WordQ http://www.wordq.com; WriteOnline http://www.cricksoft.com; Aurora Suite http://www.aurora-systems.com; SoothSayer http://www.ahf-net.com/index.htm)
- Voice recognition programs (e.g., SpeakQ http://www.wordq.com/speakqenglish.html; Dragon Naturally Speaking http://www.nuance.com; ViaVoice http://www.viavoice.com)
- Organizational/outlining/drafting software (DraftBuilder http://www.donjohnston.com; Inspiration/Kidspiration http://www.inspiration.com; ClaroIdeas http://www.clarosoftware.com; MindView http://www.matchware.com/en)
- Picture symbol processors (e.g., PixWriter by Slater www.slater.com; Communicate: Series http://www.widgit.com/http://www.donjohnston.com; SymWord http://www.clarosoftware.com; Boardmaker http://www.mayer-johnson.com)
- Proofreading program/grammar checkers (e.g., Online grammar checker http://www.gingersoftware.com)
- Onscreen keyboards (e.g., Discover Screen http://www.madentec.com; Cube Writer http://www.marblesoft.com)
- Programs on vocabulary skills, fluency (e.g., Read Naturally http://www.readnaturally.com), and reading comprehension (e.g., READ 180 http://teacher.scholastic.com; ClozePro http://cricksoft.com)
- Early Literacy programs (e.g., Simon SIO www.donjohnston.com; Lexia www.lexialearning.com, Edmark Reading www.riverdeep.com, Balanced Literacy www.intellitools.com, Earobics www.earobics.com, Laureate Learning Systems www.laureatelearning.com)
- Programs on spelling (e.g., SPELL-2 http://www.learningbydesign.com; Swim

Swam Swum http://www.laureatelearning.com; The Graphic Speller http://www.marblesoft.com) and grammar (e.g., Syntax Series and Sentence Master http://www.laureatelearning.com)

- Typing and handwriting programs (e.g., Type to Learn http://www.sunburst.com; Mavis Beacon Teaches Typing http://www.encore.com; Point Scribe http://ultrathera.com/pointscribe/index.html)
- Virtual manipulatives (e.g., http://nlvm.usu.edu; http://illuminations.nctm.org)
- Programs on early math skills (Millie's Math House and Mighty Math www.riverdeep.com), money and time (e.g., The Early Learning Suite http://www.marblesoft.com; Basic Coins, Spending Money, Dollars and Cents, Match Time, Time Scale from http://www.attainmentcompany.com; Talking Checkbook http://www.premier-programming.com)
- Programs on calculations (e.g., Access to Math www.donjohnston.com; Math Line http://www.howbrite.com) and problem solving (e.g., MathPad www.intellitools.com; Math Talk http://www.mathtalk.com; Virtual Pencil http://www.hentermath.com)
- Math accessibility programs (e.g., MathType, MathFlow, MathDaisy http://www.dessci.com/en)
- Programs on geometry (e.g., Blocks in Motion http://www.donjohnston.com; Geometer SketchPad http://eee.keypress.com)
- Multimedia Encyclopedia and Atlas (e.g., Encyclopedia Britannica http://www.avanquest.com) and programs on social studies (e.g., TimeLiner and Neighborhood MapMachine http://www.tomsnyder.com; Oregon Trail http://www.riverdeep.net)
- Talking globes and interactive maps (e.g., GeoSafari Talking Globe http://www.educationalinsights.com; http://www.sheppardsoftware.com/;
- Virtual labs (e.g., http://www.seed.slb.com/en/scictr/labindex_virtual.htm) and digital tools (e.g., digital microscopes: QX3 Plus http://www.digiblue.com; ProScope http://www.scalarscopes.com; Digital Probes http://www.vernier.com)
- Data collection programs/databases (e.g., InspireData http://www.inspiration.com; Graph Club and Graph Master http://www.tomsnyder.com)
- Science Software (e.g., Digital Frog International http://www.digitalfrog.com; Tools Factory http://www.toolfactory.com; Tom Snyder Series http://www.tomsnyder.com; Thinking Science http://www.riverdeep.net)
- Software programs on social skills (e.g., Know the Code Behavior Cards http://attainmentcompany.com; Taking Charge of Your Behavior http://pcieducation.com)
- Electronic organizers (e.g., Picture Planner http://www.cognitopia.com; Time Pad and Step Pad by http://www.attainment.com) and hand-held PDAs (e.g., Schedule Assistant and Pocket Coach http://www.ablelinktech.com;)
- Audio talking books (e.g., http://www.bookshare.org; ghPayer http://www.gh-accessibility.com; Clicker5 http://crick-soft.com; My Own Bookshelf http://www.ablenet.com; Story Builder http://www.marblesoft.com) and portable e-readers (IntelReader http://www.intel.com; Classmate Reader and Victor Reader http://www.humanware.com; knfbReader http://www.knfbreader.com
- Content-based programs (Start-to-Finish Series and Incite! Learning Series http://www.donjohnston.com, Intellitools Classroom Suite http://www.intellitools.com)

- Portable word processors/keyboards (e.g., Neo 2 and Dana http://www.renlearn.com)
- Portable spell checkers/dictionaries/thesaurus (e.g., Franklin http://www.franklin.com) and reading pens (e.g., Quicktionary Reading Pen http://www.wizcomtech.com; LiveScribe Pulse Smartpen http://www.tfeinc.com).

Teachers were also asked if their students were using such instructional creativity/authoring programs as *Windows*, *PowerPoint*, *Hyperstudio*, *Graphic Programs*. It is common to see these tools in teaching students with learning disabilities and emotional/behavioral disorders. Other technology options that can further enhance learning experiences of students with high-incidence disabilities in any grade and subject area are video, Internet, Web quests, email, virtual environments, multimedia, technology for assessment. The last section of the survey acquired teachers' previous knowledge, readiness and attitudes towards technology. It was interesting to see if teachers received any training and in what form, how they rated their knowledge and readiness about assistive technology, and what they thought were the main barriers and benefits of technology for students with learning disabilities and emotional/behavioral disorders.

Data Collection Procedures

An online survey was used to determine current use of assistive technology by students with learning disabilities and emotional/behavioral disorders. The survey was distributed to approximately 350 teachers of students with high-incidence disabilities purposefully selected from one large suburban school district, including former and current students in the special education master's and graduate certificate program in learning disabilities and emotional disturbance. They were contacted by email message, which included the link to the online survey. Individuals were asked to participate in the study if they were indeed teaching students with high-incidence disabilities, specifically students with learning disabilities, emotional/behavioral disorders, or both. In addition, they were asked to forward the survey link to other teachers working with students with high-incidence disabilities in their schools. The first closed-ended question on the survey requested participants to give their consent to participate in the study. The participants would not be allowed to continue with the survey unless they agreed to participate. Participants were contacted three times with two weeks between contacts in an attempt to achieve a high response rate. Due to the fact that teachers were asked to further distribute the survey, it is hard to estimate the exact return rate. However, 123 surveys were returned yielding a possible 35% return rate. The follow-up telephone interviews were conducted with 12% of the participants who provided their contact information to triangulate the findings from the surveys.

CURRENT STATUS OF THE CASE

Based on 123 survey responses and 15 (12%) follow-up interviews, the most widely used low-tech, medium-tech, and high-tech technologies used across grade levels and subject areas were determined.

1. Low- and Medium-Technology Strategies

The following low- and medium-technology strategies rated among the first three in the following grade (see Table 2) and subject areas (see Table 3).

The top low-tech tools utilized in the most classrooms for various content-based instruction are as follows.

Table 2. Low- and Medium-Technology Strategies Used Across Grade Levels In One Large Suburban School System

Elementary School	Middle School	High School
1. Hands-on money/clocks 2. White boards 3. Audio books	1. Index cards 2. Post-its 3. Math manipulatives	1. Highlighters 2. Calendars 3. Visual schedules

2. High-Technology Devices and Programs

High-tech assistive technology found in various grade levels and subject areas is demonstrated in Figure 1.

Overall, technology use appropriately corresponds with the subject area and grade level. Thus, students in elementary classrooms were reported to use *AlphaSmart* portable keyboards, while more sophisticated *Neo* and *Danas* were found in the majority of secondary settings. Also, optical character recognition programs such as *Kurzweil* were utilized by students with high-incidence disabilities in upper grades. Major writing software programs were found in language arts while programs on calculations and problem solving were used in math classes. Science instruction was supplemented with data collection programs and databases while social studies was enhanced with multimedia encyclopedia, interactive maps, and text-to-speech programs to allow easier access to content. Word processing programs were tracked across subject areas. This is not surprising taking into consideration the availability and the accessibility of the latest word processors. However, some unusual findings also exist. For example, math manipulatives were used more often in upper than elementary grades. It was interesting to see that high school students benefited from visual schedules while none of the teachers reported the use of this low-tech strategy with elementary and middle school students. It was also surprising that despite the fact that several teachers of students with behavioral problems participated in the study, only five surveys indicated the use of the software programs on social skills predominantly in the elementary grades. Possibly it can be explained by the lack of technology tools developed specifically for this group of students (Schweder & Wissick, 2009).

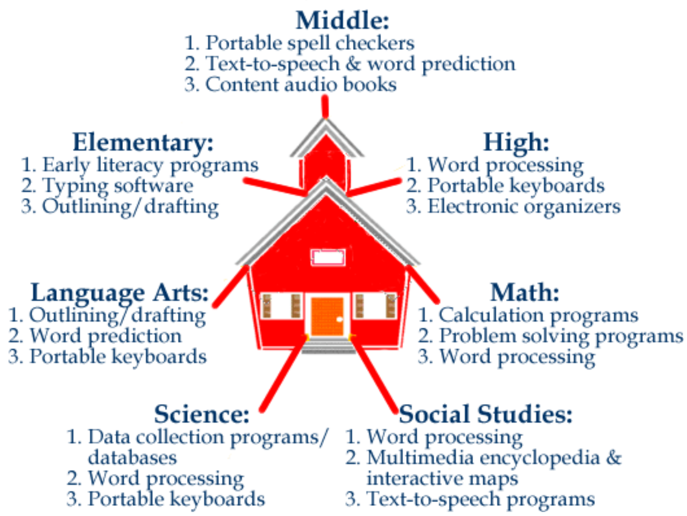
3. Assistive vs. Instructional Technology

Assistive technology (AT) is defined in the Individuals with Disabilities Education Improvement Act ([IDEIA], 2004) as: "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 a child with a disability" (§ 1401 (1) (A)). In turn, Edyburn (2000) defines instructional technology as technology that is used to enhance teaching and learning. Several survey respondents isolated the unique contributions

Table 3. Low- and Medium-technology Strategies Used Across Subject Areas In One Large Suburban School System

Language Arts	Mathematics	Science	Social Studies
1. Index cards 2. Post-its 3.Highlighters & pencil grips	1. Manipulatives 2. Hands-on clock/money 3. Onscreen calculators	1. Post-its 2. Highlighters 3. Adapted microscopes	1. Index cards 2. Calendars 3. Talking globes

Figure 1. High-tech Assistive Technology



of assistive and instructional technology tools by providing analogies based on the differences between the two:

"[Assistive technology] AT is helping to learn, while [instructional technology] IT is helping to teach."

"AT provides access to curriculum, while IT conveys/enhances grade level material."

"AT is individual, while IT is for all students."

"AT is an accommodation, while IT is an instruction in a technological format."

"AT is helping achieve the impossible, while IT simply presents the information."

Indeed, it is not the name of the technological tool but the purposes for which it is used that determines its assistive technology (AT) or instructional technology (IT) nature. Thus, word processing can provide unique supports to students with writing difficulties compensating for their areas of need, while also being used by all general education students. According to the survey participants, such instructional technologies as *Internet* (76.4%), *Microsoft PowerPoint* (56.9%), *Video* (53.7%), *Microsoft Word* (48%), *Multimedia* (34.9%), *Webquests* (30.9%), *Testing Software* (30.1%), and *Email* (19.5%) are widely used for educational purposes with students with learning disabilities and emotional/behavioral disorders.

4. Innovative Ways to Use Technology

Assistive Technology Services at the school district offer their teachers of students with high-incidence disabilities some ideas on innovative ways to use assistive and instructional technology in their content-based instruction. Some examples include:

Neo2 Portable Keyboard in Language Arts Classrooms

"The ways Neo2 portable keyboard is being used in some self-contained middle and high

classrooms where all students have access to the same technology at the same time include: (a) word processing: access to keyboard, spell check, thesaurus, wireless printing to default printer or teacher laptop; (b) 2Know! software for informal assessments when reviewing for tests and interactive activities in the classroom; (c) KeyWords applet for keyboarding skills and practice; (d) AccelTest, to individually score assessments and providing immediate feedback benefiting all students; (e) Neo Share, to transmit information between teacher laptop and student Neos (i.e. teacher can send assignment, students can submit work electronically)"

Read: OutLoud Program in the Social Studies Classroom

"Many students with learning disabilities and emotional/behavioral disorders are finding Read:OutLoud program really beneficial. Specifically, all fifth grade students in our county are required to complete a global awareness project. This is a research project, which involves lots of technology. Some students have been using Read:OutLoud to access Internet materials and have the information read to them if needed. In addition, the outline feature allows them to keep notes. Then the students are provided various means of representing their knowledge using common tools like MS Word or PowerPoint templates."

Livescribe Smartpen in Any Subject Area for Note Taking

"The Pulse smartpen records and links audio to what is written. This technology is starting to be used by students who have difficulty taking notes in class. By using the smartpen, students no longer have to try and capture so much of the lecture. They can write key words that are linked to the audio that the teacher is saying at that time."

Microsoft Word Strategies in the Writing Classroom

"Various MS Word strategies are used to help students with the writing process. For example, using the record tool in MS Word, students respond orally to questions/prompts that the teacher has created. After the student records their voice, they listen to it and type what they were thinking. This is used for pre-writing or for those students who are accustomed to dictating to a scribe. Other strategies such as using autosummarize, changing background colors, word spacing, character spacing, and changing the layout are being used as simple accommodations to help students with writing."

In addition, teachers participating in this case study were also eager to share creative ways of integrating different kinds of technologies. Some real-life examples include both low-technology strategies and high-technology tools as follows:

Low-Tech Aids During Writing Activities

"If a student has difficulty staying on a line when writing, the following low-tech adaptation can help. Cut out a window the size of a line on a writing paper out of the transparency (either colored or regular), attach this overlay on the page with paper clips, and move the window down as the student finishes writing on each line. It makes miracles for students with disgraphia, especially on elementary level when not too much writing is involved."

Power/Bag Clips with Magnets for Enhancing Language Arts Activities

"Power/Bag Clips with Magnets commonly used for clipping snack bags can be used to supplement each page in the book with activities for students with learning difficulties. Just place the clip on the page; add Velcro on the top of the clip; print

literacy activities, summary of the page using picture symbols, etc.; stick them to the Velcro, so they are above the page."

Alternative Ways to Use Outlining/Drafting Software Programs

"The mapping programs Inspiration/Kidspiration don't know limits in use. Another idea is to use Inspiration/Kidspiration outline to teach paragraph structure organizing main idea, topic sentence, supporting details, closing sentence, etc. Later students can simply add one sentence to each "bubble" to get a complete paragraph."

Teaching High-School History Through Podcasting

"The audio podcasting adds a new dimension to teaching history. I've tried to record audio lectures with the help of Audacity software (http://audacity.sourceforge.net/) and asked my high-school students to listen to them before each history class. These podcasts are available through iTunes and internal website at our school county. The students tried to create their own podcasts as well and responded very well to this activity. They interviewed different people and made a joint final group presentation to demonstrate different political philosophies for the History-12 standard of learning. We are hoping to move to video podcasting in the nearest future."

PDAs and Blogging to Complete Activities in Any Subject

"My high-school students really enjoyed using blogging to complete class work. They could add postings to our collaboration blog from anywhere. Besides their own posts, students were required to provide feedback to at least 3 classmates and their ideas. Thus, each student contributed their own unique information as well as shared their opinions and thoughts on the work of others. We've used PDAs with Wi-Fi to update our blog."

Final PowerPoint Portfolios in Geometry

"In my self-contained geometry classes, I am having the students create a power point portfolio serving as a final exam. Provided with a list of vocabulary terms, each student must create a power point slide show with each term, definition, picture explaining the concept, and a picture of the vocabulary term in the real world (e.g., acute angel; an angle with a measure between 0-90 degrees; a picture of acute angel; a picture of a butterfly with an acute angle between the wings). It must be unique, colorful, creative, organized, and detailed. They may add sound for a few extra points. I used to do this in notebooks, but the students became much more interested in it when I switched to a tech-version."

Web-Based Project to Get a Glance into the Future

"This is a project for juniors and seniors to gain a glance into the future. I use it with all of my kids in the self-contained environment. It is a web-based project that shows them where they are on the path towards their personal goals (academically). They learn what they need to do at their current place in life to get to "where they want to be", including school, finances, environment, etc. Each student must research the following: (a) GPA and earned course credits (e.g., Do they qualify for the school they wish to attend? Do they have skills to gain employment in the area they have chosen?); (b) Choose a future career path (e.g., http://mappingyourfuture.org/planyourcareer/careership); (c) Find an apartment (e.g., www.realtor.com); (d) Pay for utilities (e.g., http://www.netquote.com/); (e) Afford additional bills (e.g., http://www.shoppersfood.com/); (f) How will they afford to support themselves and their life styles in school or during employment (e.g.,

will they need loans or work?); (g) If their plan looks unrealistic - what do they do now?; (h) Final report of findings. This project really teaches them about realistic goals and expectations in life!"

Improving Self-Esteem of Students with High-Incidence Disabilities

"I like to teach my students with learning disabilities a few typing lessons ahead of the rest of the class. Thus, when the whole inclusion classroom gets to those lessons, my students with LD can walk around and help their classmates with the program. It really helps with their self-esteem."

CONCLUSION

Ultimately, all students with disabilities are entitled to the consideration of technology accommodations (Quinn et al., 2009). Nowadays, the ever-growing market of available tools supports learners with very diverse ability levels and needs. However, according to the National Assistive Technology Research Institute, the students with low-incidence disabilities are much more likely to use technology than students with learning disabilities. More research is needed to discover the potential of assistive technology for students with high-incidence disabilities (Hasselbring & Bausch, 2006). It is not surprising that the descriptive statistical analysis in this case study allows reporting that students with high-incidence disabilities used more assistive technology in language arts and elementary grades. This finding can be explained by the notion that widely used technology, such as *Microsoft Word* with a spell checker, can be considered "assistive" for students with learning disabilities and emotional/behavioral disorders (Sitko, Laine, & Sitko, 2005). Such technology is accessible and available for teachers to use, while more content specific AT programs are less common and have to be carefully selected and obtained. Indeed, only 17 articles were found for the recent meta-analysis conducted by Bouck and Flanagan (2009) that synthesized AT and mathematics for students with high-incidence disabilities and six of those articles focused on anchored instruction specifically. Obviously, more research is needed on the potential of technology on math education for students with learning disabilities and emotional/behavioral disorders.

In turn, it seems that a majority of the used assistive technology devices and programs is designed for younger students and may not be age appropriate for higher grades. According to the results of this study, for each grade level increase, the number of utilized AT devices/program decreases if everything else stays constant. However, there is no evidence that the number of available technologies decreases in the higher grades. Further research in this area is necessary to support such a conclusion. Assistive technology use can be predicted from the students' placement, demonstrating higher use in special education settings. It can be concluded that the special education placement group uses more AT devices/programs. One possible explanation comes from the individual nature of AT tools. The use of technology, especially assistive technology, suggests more individualized instruction addressing each student's specific needs. It may also be suggested from previous research (Bowser & Reed, 1995; Dalton & Roush, 2010; Michaels & McDermott, 2003) that teachers report insufficient knowledge about how to integrate technology into general education curriculum.

The compensatory nature of technology provides access to content-based materials for students with learning disabilities and emotional/behavioral disorders, while interventions directed to strengthening and improving skills are associated with remediation (Hasselbring & Bausch, 2006). At first glance, the majority of technologies used in one school system in this case study compensate for students' areas of need. However, besides compensatory function, the majority of the technologies used by students with high-incidence disabilities described above are also associated with remedial benefits. Thus, students using text-to-speech programs listening to the text while reading showed significant improvements in decoding and word recognition (Wise & Olson, 1995; Torgesen & Barker, 1995). According to Higgins and Raskind (2000), both continuous and discrete speech recognition tools may also have remedial application positively affecting reading comprehension, spelling and word recognition of students dictating their work. Furthermore, computer-based programs with high interactivity levels result in better achievement and retention of the content than software requiring passive attention (Jerome & Barbetta, 2005). In addition to compensatory and remediation functions, both assistive technology and instructional technology can improve students' self-esteem, motivation, work efficiency, productivity, as well as to avoid behavior problems (Cumming et al., 2008; Forgrave, 2002; Quenneville, 2001).

Results of this case study suggest that students with learning disabilities and emotional/behavioral disorders still do not use assistive and instructional technology to its full potential. More work is needed to introduce teachers of students with high-incidence disabilities to the benefits of AT/IT and prepare them to utilize existing technological options with this population. In addition, while technology appears to be relatively developed for students with challenges in reading and writing, more programs are needed to support students in math, science and social studies, as well as the tools should be age appropriate. Technology is not magic and needs to be skillfully applied to achieve positive results (Forgrave, 2002; Hasselbring & Bausche, 2006). However, the right technology can provide a student with a disability unimaginable learning opportunities (Edyburn, 2002; Maccini & Gagnon, 2005)

LIMITATIONS AND FUTURE RESEARCH

The results of this study should not be taken into consideration without the following limitations. This study collected data from teachers working in one school district. Such overrepresentation of only one suburban school system makes it harder to generalize findings to the whole population. An additional limitation comes from teachers self-evaluating and reporting of technology use. Thus, this case study could be replicated by involving teachers' observations.

Future research is needed to determine the technology preparedness, knowledge, and AT use by teachers working with students with high-incidence disabilities across the nation. It is important to make sure to include in the future studies teachers with different educational and technology training backgrounds working in different population density areas. Future research could also incorporate more detailed analysis of the training type teachers prefer to better prepare them for technology integration of several low and high technologies specifically designed for students with learning disabilities and emotional/behavioral disorders. It would be interesting to see whether the AT devices and programs used for this population in special and inclusive regular education settings is different, as well as whether AT implementation impacts the general technology use with all the students. Finally, based on their study, Dalton and Roush (2010) conclude that the majority of assistive technology literature is not based on rigorous research methods. More up-to-date experimental research is needed to determine the true value of assistive and instructional technology tools for enhancing performance of students with learning disabilities and emotional/behavioral disorders in various subject areas.

EPILOGUE

Overall, this case study provided professionals working with students with high-incidence disabilities with a glance at the current state of technology use by students with learning disabilities and emotional/behavioral disorders in one large school district. Anecdotal experiences and teaching tips presented in this chapter will hopefully enhance special education services and avoid underutilization of communication technology with this student population. More research needs to be done in the area of assistive and instructional technology for students with mild disabilities. In addition, translation of research to practice would provide teachers with more ideas on using technology in various content-based areas.

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KEY TERMS AND DEFINITIONS

Anchored Instruction (AI): Teaching and learning activities situated or anchored in complex meaningful macro contexts presented via video multimedia formats (CTGV, 1990).

Assistive Technology (AT): 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 a child with a disability (IDEIA, 2004).

Emotional/Behavioral Disorders (EBD): Challenging behaviors characterized by excesses and/or deficits in behaviors that deviate from expectations of others and may put them at risk for failure in school and/or home (www.cec.sped.org).

Instructional Technology (IT): Technology that is used to enhance teaching and learning (Edyburn, 2000).

High-Tech Tools: Complex or specialized technologies such as computers and software programs (King-Sears & Evmenova, 2007).

Learning Disabilities (LD): Neurological disorder that may cause difficulties in reading, writing, spelling, reasoning, recalling and/or organizing information (http://www.ldonline.com).

Low-Tech Tools: Simple, non-electronic tools used to support students with disabilities such as highlighters and index cards (King-Sears & Evmenova, 2007).

Medium-Tech Tools: Simple electronic equipment such as tape recorders and books-on-tape (King-Sears & Evmenova, 2007).

Personal Digital Assistant (PDA): Handheld device, such as a Blackberry or Droid, providing Personal Digital Assistance.

Universal Design for Learning (UDL): Educational framework developed by the Center for Applied Special Technology (CAST) to guide the design of flexible instructional goals, methods, materials, and assessments to meet the needs of students with various abilities, needs, learning preferences, and styles (Rose, Meyer, & Hitchcock, 2005).

DISCUSSION QUESTIONS

1. **What is the status of existing research on assistive and instructional technologies for students with learning disabilities and emotional/behavioral disorders?** More research is needed to make any conclusions about the effectiveness and efficiency of assistive and instructional technology tools for students with high-incidence disabilities. This field of study is characterized by limited and inconclusive findings. In addition, several areas such as assistive technology for math, science, and social studies, as well as for students with emotional/behavioral disorders are really understudied ether due to the limited research or due to the lack of age-appropriate technology tools. More work is needed to fully investigate the potential of both assistive and instructional technologies for this population of students.
2. **How can teachers support their students who have difficulty figuring out words as they read text passages?** Text-to-speech software allows translating text to speech, so that students with learning disabilities and emotional/behavioral disorders can listen to text focusing on comprehension rather than word decoding. In addition, optical character recognition software allows scanning existing paper-copy texts to create digital text formats that once again rely on auditory input of information.
3. **What are some major assistive technology categories/tools that support students with learning disabilities and emotional disorders during writing?** Some examples of assistive technology tools for writing include (but are not limited to): text-to-speech programs, stationary and portable word processors, word prediction programs, outlining and brainstorming software, and speech recognition programs.
4. **According to the example of one large suburban school district, what are some ways to facilitate and support an effective and extensive use of assistive technology in a school system**? First, it is important to conduct comprehensive assessments of the AT need for each individual student and provide appropriate training to that student and all the staff on how to use the AT as well as on how to integrate it into the curriculum. Ongoing assistive technology support should be available from both the AT specialist as well as from within the school. AT Collaboration Model will allow building a capacity for assistive technology use at the school level by empowering teachers to select and successfully integrate AT into instruction. All teachers whether they are AT leaders or simply AT users can benefit from website training, curriculum resource training, software or equipment demonstration, assistive technology training, as well as other ongoing professional development opportunities. Creative ideas on technology use can be supported through the curriculum resources where teachers can share any developed activities and projects. Finally, when possible, providing access to technology for the entire classroom has shown to be an effective approach for continuous integration of AT.
5. **What are the major low-tech tools that are used for teaching students with learning disabilities and emotional/behavioral disorders in different grade levels?** Hands-on money/clocks, white boards, and audio books are widely used in elementary school. Index cards, post-its, math manipulatives are permanent features in middle grades, while highlighters, calendars, and visual schedules can be found in most high-school classrooms. These tools seem to be appropriate for the content taught at these different grade levels (e.g., learning to read the clock or count money in elementary school; learning to manage and self-monitor personal schedules on a high-school level).

6. **Is there a difference between an instructional and assistive technology and can a tool belong to both instructional and assistive technology categories?** By definition instructional technology is just an additional resource for enhance teaching and as a result students' learning. Assistive technology aims at improving person's capabilities and providing opportunities to live and learn, which may be impossible otherwise. However, an instructional technology such as a simple word processor or an educational video may provide unique supports to a student with disabilities that make learning possible; and thus serve as an assistive technology tool for that student. So it is the purpose that defines an instructional and assistive technology and not the terminology.
7. **Based on some innovative ideas of technology use provided by the study participants, what are the emerging trends in assistive technology (AT)?** Emerging technologies include podcasting, blogging, handheld technologies, as well as digital note taking. The field of assistive and instructional technologies continues to evolve bringing newer, better, and more sophisticated gadgets.

Chapter 13
Signage as a Classroom Prompt:
An Evidence-Based Practice?

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ABSTRACT

No Child Left Behind emphasizes evidence-based practice (EBP) as a benchmark for educational interventions. Research summaries and meta-analyses have been forthcoming for teachers in content areas like reading and mathematics instruction. Less has been summarized about strategies for promoting targeted classroom behaviors. Visual prompts, in the form of signage, are explored as potentially effective strategies for facilitating a well run classroom. Single-subject design studies that provide initial support for signage in promoting target behaviors are described. Variables from these studies are considered as they may be related to an effective classroom environment.

INTRODUCTION

Lloyd, Forness and Kavale conclude their article *Some Methods Are More Effective Than Others* this way: "We certainly want to tailor educational programs for students with disabilities to meet their unique educational needs. As we do so, it makes sense to incorporate those methods that have the best chances of providing educational benefits" (1988, p. 199). This emphasis on what works appears in IDEA's rules and regulations indicating that students will not be determined eligible for special services if their deficits are "due to a lack of appropriate instruction" (§ 300.309, U.S. Department of Education, 2006). Thus, determining a student's eligibility for special services should be based on "a child's response to scientific, research-based intervention" (§ 300.309). The question for schools in a response to intervention (RTI) climate is "what constitutes research-based instruction?" Data in the form of meta-analyses

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like the one cited above are appearing more and more in professional journals.

The Council for Exceptional Children (CEC) uses "evidence-based" to describe research-supported instruction and cautions that criteria for determining such strategies vary (Council of Exceptional Children, 2006). Standards for evaluating the effectiveness of instructional procedures appeared in a special issue of *Exceptional Children* (Graham, 2005) and have been applied more recently to reading, math, and writing and behavior in the same (Graham, 2009). Given a choice of academic interventions, teachers can expect greater gains for students when such evidence-based practices (EBP) are implemented in the classroom.

One promising management practice that warrants scrutiny for research comes from applied behavior analysis (ABA): Visual prompts/signage. In this paper the relationship between signage and behavior is examined. Several single-subject design studies will be discussed in which signage was used to occasion a change in the performance of a behavior. Variables related to these signage studies will be described and considerations for classroom settings will be presented.

PROMPTING

Teachers routinely "prompt" students to elicit a variety of behaviors. Examples include a bell or buzzer to promote a rapid line up for a fire drill, or posting a number line or a cursive-letter alphabet on a bulletin board to promote math and written expression, respectively. Prompts are described as "supplementary antecedent stimuli used to occasion a correct response in the presence of an S^D [stimulus for a behavior] that will eventually control the behavior" (Cooper, Heron, & Heward. 2007, p. 401). In effect, "prompts are used to increase the probabilities of success in a task" (Walker, Shea, & Bauer, 2004, p. 113). Cooper and colleagues propose three kinds of prompts; verbal (e.g., "The animal that 'oinks' is?"); modeling (e.g., a P.E. teacher placing her toes behind the back line to illustrate from where to serve a volleyball); and physical guidance (e.g., physically positioning a student's thumb on the "C" key of the piano to begin a C scale).

Alberto and Troutman (2009) add to this list, *visual* expressions. A multiplication/division matrix, periodic table, student photos over preschool cubbies, and signs for hand washing in the bathroom are examples seen in schools. Alberto and Troutman add several examples in which vocational skills are taught using a sequence of pictures to illustrate what an individual should do to assemble a product or complete a process (e.g., preparing a hamburger, wrapping a sandwich in a fast-food restaurant). They contend that posting such information in plain view can reduce instructional time and promote classroom order. Adults are familiar with a visual prompts in the form of a "post-it" note that serves as a reminder to perform a domestic task like picking up milk on the way home.

Visual prompts can function in two instructional ways. Response prompts are provided when an expected behavior does not occur spontaneously. A stimulus "has been presented and has failed to occasion the response" (Alberto & Troutman, 2009, p. 313). For example, when typing this manuscript, an incorrectly spelled word becomes underlined in red by MS-Word® (Microsoft, 2007) to signal a potential misspelling to the writer. According to Walker and colleagues (2004), once the behavior occurs, such prompts should "eventually be eliminated" (p. 113), a procedure termed "fading" (Maag, 1999).

While the goal of teachers is to have students respond automatically to multiple classroom stimuli (e.g., 7 X 8 = __, "Please take out your spelling books."), some prompts are intended to be stimuli for target behaviors. The most common are signs. This second type of prompt, a stimulus prompt, is an "alteration of the stimulus to increase the probability of correct responding" (Alberto

& Troutman, 2009, p. 427). Placing a box on the lower left of a piece of paper to indicate where a signature should go when writing a business letter exemplifies this in a letter-writing lesson.

Signage is a form of visual stimulus prompting. We see signs on highways, in restaurants and in stores. Travel examples include "Click it or Ticket" and "Litter And It Will Hurt - $101 Fine." In public restrooms a drawing of a faucet, bubbles, and hands is a cue to employees (and customers) to "wash their hands before leaving the restroom." Finally, businesses routinely use signage to promote products, evoking our attention with words like "new and improved," and "SALE."

SIGNAGE IN THE CLASSROOM

Prior to reviewing signage studies that could have implications for teachers seeking evidence-based practices, a brief summary of classroom research on the signage's effectiveness warrants consideration. Unfortunately, this must be brief because few studies systematically evaluate classroom variables, despite the fact that virtually all comprehensive discussions regarding a management topic like classroom rules include a directive to "post" the rules (e.g., Shores, Gunter, & Jack, 1993). For example, in one study involving two classrooms (Madsen, Becker, & Thomas, 1968) the researchers found that both reviewing and posting classroom rules "without" additional modification of teacher behavior (e.g., ignoring inappropriate behavior and showing approval for appropriate behavior) did not reduce inappropriate behaviors. A combination of classroom rules, ignoring and showing approval did do so, however.

Another study (O'Leary, Becker, Evans, & Saudargas, 1969) found that the posting of rules (on the chalkboard) did not reduce the disruptive behavior of seven target children in a classroom. Similar to the previous study, a combination of signage (posted classroom rules) and a reinforcement program did reduce disruptions. However, as the ignoring and showing approval conditions of the Madsen and colleagues study and the reinforcement program of the O'Leary and colleagues study were always yoked to the classroom rule condition, one might reasonably conclude that the rule condition, involving the signage, contributed to the reduction in the inappropriate behavior. The two studies also highlight a problem in what little research exists regarding classroom signage. In both cases the posting of classroom rules is always linked to the frequent and ongoing discussion of such rules in the classroom. It is as if the researchers assume that simply posting rules without discussion and reinforcement would be ineffectual in modifying behavior. For those who work with children, this may seem like common sense.

In the signage reviews that follow, it should be noted that the prompts appear with little explanation beyond the wording. Rather, the hypothesis is that the signage itself will occasion behaviors that were targeted for change. Our goal is to focus on the variables as they might have contributed to study outcomes. Our contention is that patterns in such variables may provide clues that lead to more evidence-based signage procedures in school-based settings.

SIGNAGE BEYOND THE CLASSROOM

Several non-classroom studies have indicated that signs-as-prompts can produce positive results. Consideration, however, must be paid to the message. "Descriptive" and "injunctive" messages have been compared for their effectiveness (Cialdini, 2003; Cialdini, Demaine, Sagarin, Barrett, Rhoads, & Winter, 2006). Descriptive "norms (sometimes called norms of "is"), refer to what is commonly done. …injunctive norms (sometimes called the norms of "ought"), …refer to what is commonly approved/disapproved, and which motivate by promising social rewards and punishments" (Cialdini et al, 2006, p. 4). The relative effectiveness of such different messages provide a start in understanding variables associated with a sign's power to change behavior.

On two paths in Arizona's Petrified Forest National Park, signs were placed, either saying "Many past visitors have removed petrified wood from the Park, changing the natural state of the Petrified Forest" (descriptive), or "Please don't remove the petrified wood from the Park, in order to preserve the natural state of the Petrified Forest" (injunctive) (p. 107). The former sign had a picture of three people taking wood; the latter, "a lone visitor stealing a piece of wood, with a red circle-and-bar symbol superimposed over his hand" (p. 106). The results: More theft occurred in the area of the descriptive sign. Cialdini argued, "Experiences that focus individuals on the all-too-frequent occurrence of an offense against the environment have the potential to increase the occurrence of that offense" (p. 105). Like the classroom studies that indicated merely posting does not change classroom behavior, this study makes the point that other variables may be at play in a sign's effectiveness. Teachers must consider how they couch their message to students to alter behaviors.

An actual area of school concern relates to building maintenance. One strand of adult research attempted to reduce graffiti in restrooms. An initial work (Watson, 1996) was conducted in three restrooms on a college campus. After painting the walls in the first bathroom, the number of marks was tallied over five days and followed with a repainting of the restroom. Signage, in the form of the following message was posted:

A local licensed doctor has agreed to donate a set amount of money to the local chapter of the United Way for each day this wall remains free of any writing, drawing, or other markings. Your assistance is greatly appreciated in helping to support your United Way. (p. 123)

After six and nine days had passed for the intervention, a second and third restroom, respectively, were repainted and posted with the same message.

In all three cases, repainting and signage reduced the graffiti to zero through the end of the study, fifty days from its outset. At the end of the intervention, the signs were removed. Follow-up visits to the restrooms one, two, and three months later found zero marks in all three. In the discussion section, the author suggests that the sign "specified an altruistic contingency" versus a "punishing consequence, a warning, or a direct reinforcing consequence to the reader for compliance with the sign" (p. 123).

In the tradition of gaining evidence by extending earlier findings, four years later Mueller and his colleagues (2000) conducted a similar study "at a university in the southeastern United States" (p. 89). Using six men's restrooms and three different signs, the researchers compared the amount of graffiti at baseline, during interventions that lasted from 17 to 26 days, and after withdrawal of the signs through the end of a semester. As before, following the baseline, the bathrooms were repainted and the signs posted.

The first sign was a duplicate of Watson's (1996) original. The second implied a negative contingency: "If you are caught writing, drawing, or marking the walls, you will be prosecuted according to university policy" (p. 90). The remaining, randomly chosen two restrooms received signs with no contingency: "Please do not write, draw, or mark on these walls" (p. 90).

Mueller and colleagues (2000) indicated that increasing graffiti during baseline was followed during the interventions "by either elimination or considerably fewer instances of graffiti throughout the intervention" (p. 90). Four of the bathrooms had zero marks during the intervention. One positive-contingency bathroom had one day (out of 17) of graffiti, and one negative contingency bathroom had four days (out of 21) of graffiti. Unlike Watson (1996), removal of all signs resulted in a resurgence of graffiti.

In these studies, the assumed-to-be rewarding injunctive message appeared to occasion a reduction in graffiti. The threatening injunctive message had a similar impact, as did the neutral request for compliance. Given a resurgence of graffiti afterward, the signage, in itself, appears to have prompted a change in behavior.

These findings lend themselves to classroom applications of signage. That is, the tenor of the message used for signs may be a function of the climate they wish to cultivate in their classrooms. However, based on these studies, it seems that signs that send a message, "you can help your class, school, community" have evidence for its effectiveness and might be worth posting to promote target behaviors.

One adult-focused signage study that may provide evidence-based support for teachers focused on promoting safety in another public forum, a bar. Due to the high incidence of alcohol-related deaths and injuries, Brigham, Meier, and Goodner (1995) explored whether signage could increase the number of persons who voluntarily opt to be the designated drivers. A college bar was selected that had an established designated driver program in place. It was known that a designated driver could receive a free soft drink or coffee. After determining how many people used the existing program (baseline) a signage-based intervention was inaugurated:

Three framed signs... were strategically mounted around the bar, and ten placards…were placed on tables. The announcements were multicolored and contained the following text: "Designated drivers, tell your server who you are, your drinks are on us! Free O'Douls, Cutter, Sharp's or other non-alcoholic beers & wines, mixed drinks & coffee. (p. 83)

Substantial gains in the number of persons who designated themselves in a safety-promoting role "shows that the prompts, incentives, and rewards had a clear and substantial effect on numbers of self-identified designated drivers" (p. 84). Specifically, the median number of designated drivers in the first baseline was 3; in the first intervention it grew to 7.5. The second baseline-to-intervention is characterized as a median increase from 3 to 7. Regarding the power of signs in this study, the researchers described the increased number of designated drivers as a function of two variables, "prominent announcement and instructions" (signage), and "more desirable alternative beverages" (p. 83). The relatively simple intervention (signs with attractive alternatives to alcohol) potentially reduced the number of drinking drivers on the days it was implemented.

Comparison of the type of message was not the intent of this study. That is, a presentation of what "is" (high death tolls associated with drinking and driving), or an injunction to have a responsible designated driver were not the focus. The mere announcement of available reinforcing alternatives to alcohol was sufficient to increase designated driver participation at the bar. Again, drawing attention to alternatives behaviors (i.e., non-damaging public space & selecting an alternative to alcohol consumption in the form of being a designated driver) yielded positive behavioral consequences. Such evidence-based signage posting may encourage teachers to consider similar positively focused in-school messages to elicit pro-social behaviors in their classrooms/schools.

Young children routinely learn about appropriately responding to "WALK"–"DON'T WALK" signs and flags or paddles held up by crossing guards. A study strand focused on socially approved behaviors to safely navigate public areas. A Canadian study examined the effects of traffic signage related to conflicts between pedestrians and drivers at crosswalks (Huybers, Van Houten, & Malenfant, 2004). The typical "YIELD HERE TO PEDESTRIANS" sign was found to reduce conflicts and increase the yielding distance from the crosswalk. A series of reflective triangle markings painted on the roadway were also evaluated. These were positioned from 10 to 25 m ahead of the crosswalk and resulted in increases in yielding distance.

In a second experiment the triangle marking alone, and in combination with signs, were compared. The marking alone were as effective as the paired prompts leading the researcher to conclude, "the pavement markings were the essential component for reducing conflicts and increasing yielding distance" (p. 445). Here, evidence suggests that non-word signage (e.g., floor markings, arrows indicating where assignments should be deposited) can increase the likelihood of desired behaviors after signage is used to indicate the prescribed behavior.

Drivers are probably familiar with the "rolling stop" that some motorists employ at stop signs. A Michigan study (Austin, Hackett, Gravina, & Lebron, 2006) employed volunteers stationed at a two-way stop on a university campus. Placards they held read on one side, "PLEASE STOP–I CARE," and on the reverse side, "THANK YOU FOR STOPPING." Side two was shown if the motorist stopped completely. Stopping at one side of the intersection (with signage) was compared with stopping at the opposing stop sign. As might be expected, complete stopping increased at the placard side (13% to 52%). An improved stopping behavior also occurred in the opposing non-signed area (6% to 28%). Potential effect variables included having a person watching a legally enforceable situation. Similar "I CARE" signs, used by volunteers to actively prompt a responsible driving behavior were used to increase motorists buckling up and reducing cell phone usage while driving with comparable results (Clayton, Helms, & Simpson, 2006). The evidence seems to support that human-borne signage can improve behavior.

Finally, a long-term study by Cox, Cox, and Cox (2005) found that "BUCKLE UP, STAY SAFE" fixed signs in senior living communities consistently increased the behavior by residents compared to data from the baseline and from communities that had no sign. The researchers concluded, "the simple and low-cost intervention of erecting signs to prompt safety belt use has persistent benefits that affect driver and passenger behavior alike" (p. 533).

Based on these traffic-safety studies, teachers might consider classroom signs that indicate a 'known' rule in the context of caring. For example, "PLEASE WALK WHEN YOU CARRY SCISSORS–LINCOLN SCHOOL CARES," or "WAIT HERE FOR THE BUS TO TOTALLY STOP–MARSHALL TEACHERS WANT YOU SAFE." The follow-up reinforcing "thank you" message seen in the yield study may be more difficult to display as a sign, but easy to include as a teacher's positive feedback on the performed behavior.

To begin our discussion of signage we cited how the tenor of the message can produce different outcomes. In closing, it seems appropriate to consider how advertisers employ signage toward a positive social end. A New Zealand study by Farrimond and Leland (2006) sought to discern the effects of signage on food bank contributions. As in the United State, stores periodically collect food products for distribution to persons in need. Non-perishable items were purchased by customers and deposited into a bin at the front of the store. Throughout the market, signs reading, "HOW ABOUT BUYING ONE FOR THE FOODBANK BIN." "THANK YOU" and included directions about how to contribute and the agencies sponsoring the effort. Signs were positioned at the point of sale, that is, adjacent to the actual items that were on sale, and were moved as different sales took place. During all phases of the study (two baselines, two interventions, and one follow-up period) the marked food-bank bin remained at the front of the store. Results indicate that point of sale signs increased donations of target items over the "no sign" condition, leading to the conclusion, "prosocial behavior can be increased using systematic prompting procedures (p. 251). Evidence suggests that positioning signs throughout the classroom has potential to promote positive student performance. For example, a pro-social message like, "USE THE HEADPHONES–LET YOUR CLASSMATE READ IN QUIET" in a listening/reading center seems justifiable for fostering a learning atmosphere.

CONCLUSION

Evidence from a variety of "adult" single-subject studies appears to support teachers who wish to implement signage in their classrooms. The graffiti studies suggest support to reduce clutter in common areas (e.g., art centers, reading areas, gym storage). The *caring* variable in these studies suggest that accruing benefits to others may be key in the message (e.g., A CONTRIBUTION TO PURCHASE A NEW COMPUTER FOR THE LIBRARY WILL BE MADE EACH DAY THIS COMPUTER HAS NO EXTRA FOLDERS ON THE DESKTOP).

Simply informing students of the availability of some attractive reward is a principle illustrated in the designated driver study. To increase responsible behavior (e.g., holding a teacher's hand on a field trip) small wristband signs might be given to all students to wear. "HOLD A HAND. GET A SNACK" might be the message. Of course, the reward (e.g., praise, grapes, conversation) must be perceived as valuable to the student.

Traffic safety studies are based on the fact that existing policies are in place. The signs cue drivers to behave accordingly because someone cares. Classroom applications can take many forms using this pattern. Remaining on task so learning can occur is one case. A middle school expression might appear in a study hall: "GET 'ER DONE NOW. USE THE STAFF ON DUTY–THX."

The realtors' counsel, "location, location, location" is an evidence-based additional consideration. Visual prompts around the room, like those in the supermarket, can be reminders of a specific behavior. "RETURN TO YOUR GROUP. THEY NEED YOU" could be a sign near the sink or pencil sharpener in a class that incorporates group activities.

The focus of this article has been signage in its more traditional media and its implications for teachers in a K–12 setting. Fortunately, modern technology affords many opportunities to create signage within schools. Should a principal wish to convey messages to parents, students, and community members, perhaps announcing athletic events, upcoming holidays, or theatre productions, outdoor marquees need not be static billboards. Today, eye-grabbing, electronic signs can easily be programmed to display announcements. On a much smaller scale, the margins of paper-based newsletters can include reminders of critical deadlines, or solicit parental volunteers for fieldtrips. Even the signatures of e-mail messages sent by teachers can include encouraging quotations or provide URLs to district websites.

If we look closer at the screens of the computers in classrooms and labs, further opportunities exist for increased signage. The desktop wallpaper of the computers themselves can include messages to students, "Please limit your computer use to 15 minutes, if someone else is waiting." "Print one practice copy before sending any more to the printer." Many screensavers can be programmed to display text such as "be sure you have finished your classwork before playing any games." Some screensavers can even be set to display Really Simple Syndication (RSS) feeds that can be regularly updated in one central location and broadcast to the entire school or district.

Crossing the line between home and school, the classroom website has evolved to a point where teachers are now able to update classroom blogs and threaded discussions with reminders and updates. Students can even receive online course announcements within many course management systems. Should schools decide to migrate their daily announcements to e-mail listservs or podcasts, the technology is available, inexpensive, and easy to use. Even emergency school closures or safety updates can be sent via e-mail lists. The options are almost unlimited.

More classroom-based signage studies are needed. However, based on the studies presented here, teachers can conclude that signage, used with explanations, is an effective tool for eliciting behaviors. Studies that have shown this are injunctive, typically emphasize positive versus punitive messages, suggest a caring attitude and include an expression of thanks.

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KEY TERMS AND DEFINITIONS

Descriptive Norms: People's perceptions of what is commonly done in specific situations.

Injunctive Norms: People's perceptions of what is commonly approved or disapproved of within a particular culture.

Prompting: Cues given to elicit desired behavior.

Signage: Text or images created to display information to a particular audience.

Stimulus: A cue that triggers a response.

Visual Prompts: Tor illustrations used to elicit desired behavior.

DISCUSSION QUESTIONS

1. **The authors speak about prompting through signage. What other types of visual prompting might you find in a classroom?** Written materials; Teacher demonstrations; Completed example projects.
2. **Why do you think so few studies about signage in classrooms exist?** Signs are often viewed as simply part of the classroom environment and not as a means for a teacher to guide behavior. Researchers prefer to study explicit teacher behaviors.
3. **Can you think of other ways technology can contribute to classroom signage?** (An open question designed for brainstorming and application.)
4. **Can you give examples of descriptive and injunctive norms?** People should make efforts to be cordial, even when angry. (Injunctive) People are not very cordial when they are angry. (Descriptive)
5. **How might you adapt signage for children who, for whatever reason, might have great difficulty reading?** Incorporate images; Minimize text to single words or short phrases.

Chapter 14
Using Social Bookmarking to Make Online Resources More Accessible

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ABSTRACT

There are a multitude of high-quality Web-based resources available for teachers to use with students across the curriculum. Having a systematic way to store, categorize, and share those resources with learners is critical. This is particularly true for students with learning disabilities for whom the task of searching through the vast array of online content to find relevant information can be quite daunting. This review looks at Diigo® (http://www.diigo.com/), a social bookmarking tool, and the affordances it provides for teachers trying to make online content more accessible for students with disabilities.

INTRODUCTION

The seemingly limitless amount of information on the World Wide Web is both a blessing and a curse. It is undeniable that we now have more information available at the click of a mouse then we could have ever imagined, but the task of weeding through that information and making sense of it presents a significant challenge for Web users of all ages. Most keyword searches result in hundreds of thousands of websites spread across numerous pages sprinkled with enticing ads that all serve to distract the learner from the task at hand. This is particularly overwhelming for students with learning disabilities as they try to decipher search results, weed through websites, and identify relevant and credible information. One way to support students as they access information online is through the use of social bookmarking tools such as Diigo® (http://www.diigo.com/).

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Social bookmarking is a process whereby you save websites to a web archive that is accessible on any Internet enabled device. This archive can be shared with individuals or groups so that others have access to the websites you bookmark. This process is in contrast to the traditional method of bookmarking a website on an individual computer where it is only accessible to a single user on the specific computer where it was first saved. As the following review will demonstrate, Diigo allows you to do far more than just save and share websites with others. It has a wide range of tools and features that make it useful when working with K-12 students.

DIIGO OVERVIEW

To simply call Diigo® a social bookmarking tool is understating the range of power and features this technology has to offer. The goal of the Diigo developers, as stated on their homepage, is to create the ultimate online information management tool and they are well on their way to doing that. In addition to being able to save websites, Diigo allows you to add comments, descriptions, and tags to each site. You can also annotate sites with a highlighter tool or sticky notes as a way to draw attention to specific content. The best way to learn about the wide range of features Diigo has to offer is by watching the brief video tour on their homepage (http://www.diigo.com/index). The following sections highlight how specific features can be used to support K-12 students with learning disabilities as they access online information.

Diigo Educator Accounts

Diigo® educator accounts (http://www.diigo.com/education) are free and available to any K-12 or post-secondary educator. With an educator account teachers can sign-up an entire class of students easily and without having to provide e-mail addresses for each student. Students within a given class are automatically added to a common group, which allows them to share saved websites with each other quickly and easily. Since bookmarked sites are attributed to the user who saved them, teachers can easily identify students who decide to share inappropriate sites with the group. The teacher retains the authority to delete student accounts as well as any site added by a student. Privacy settings on student accounts restrict them from becoming members with users from outside their assigned classroom meaning that students can only interact with peers from their own class. The Diigo educator account makes it easy for teachers and students to work together to collaboratively build an archive of relevant websites that can be easily accessed and modified by any member of the group.

Bookmarking Sites

At its core, Diigo® is a bookmarking tool that allows users to save websites to the "cloud" so that they can later access those sites from a wide-range of devices. When you save a site you also have the option of writing a description or summary of the site that can serve as a reminder to you and as a helpful synopsis to others, such as your students, who may view the site. Diigo also makes it possible to categorize saved sites making it easier to keep track of a large collection of sites within a single archive. For instance, you can add keyword tags to each site making it possible to search and sort an entire library of sites by those tags. A website about the planet Saturn could be tagged with words such as planets, solar system, and outer space. These tags can be helpful to students trying to sort through a large library of saved sites as they make it possible to quickly narrow done the collection to just those sites with the relevant tag.

Annotating Content

In addition to adding sites to a classroom library, Diigo® also makes it possible for teachers and students to annotate the pages they save. This includes the ability to highlight text in a variety of different colors much like you would use a traditional highlighter in a hardcopy book. This can be an effective way to draw attention to specific content, which can be a benefit for students who may have trouble attending to details. You can also add interactive sticky notes to a page to provide extra instruction where needed and assist students in the reading of a particular passage. Annotations are saved and will appear on the respective site each time it is accessed by students. It is also possible to go back and add, delete or modify annotations at any given time.

Making Groups

As mentioned previously, students added to a teacher account are automatically included in a class group with their peers. Additional groups can be created around specific topics (i.e. solar system, Civil War, global warming) or any other parameters deemed appropriate by the teacher. Saved sites can then be shared with specific groups based on the relevance to that group, making it possible to target instruction and resources for different students.

SUPPORTING STUDENTS WITH LEARNING DISABILITIES

There are a variety of ways a tool such as Diigo® could be used to support students with learning disabilities. First of all, by building a library of hand-picked websites for students to access and share, the teacher is able to more adequately ensure that the sites students access will have relevant and appropriate content, accurate information, and be at an accessible reading level. Students will still get practice searching and sorting through the collection of sites by using targeted keyword tags much like they would if they were conducting a full-scale search of the Internet. The difference is that they would only be searching through sites already selected and approved by the teacher and the annoying and distracting ads that normally accompany search results would not be present.

Teachers can also use groups to support students at different ability levels. For instance, students could be placed into groups based on their reading ability and sites could then be shared to those groups based on the respective reading level. Innocuous group names such as “red” and “blue” could be used to avoid labeling students negatively. This type of targeted sharing of resources would better ensure that students were engaging with content that was at their level and increase the likelihood that they would be able to comprehend the information.

The annotation features of Diigo® present several benefits to both teachers and students. As a teacher, you can mark-up websites to help guide student learning and focus attention on relevant information. The sticky note feature could be used to provide additional information such as definitions for key vocabulary used on a given site or to provide a basic summary of key passages. Students could be taught to use the highlighter and sticky notes to mark-up sites they find as well, which could help them become more adept at picking out relevant information. It may also be revealing for the teacher to see what students are choosing to highlight and knowing what students are attending to on a given page could help guide instruction around a set of topics.

CONCLUSION

Diigo® is an easy-to-use, feature rich technology that has much to offer teachers and students. It provides a reliable way to save, categorize, annotate, and share websites across an entire classroom of students. Teachers can use this tool to support students as they access online content in order to help them become more proficient researchers and conscientious consumers of digital information.

ADDITIONAL READING

CNET. (2006) *Get smart: Top ten research tools.* Review of Diigo® http://reviews.cnet.com/4520-9239_7-6654999-1.html

Diigo® http://www.diigo.com/

KEY TERMS AND DEFINITIONS

Annotation: The addition of explanatory or critical comments to a text, website or other artifact.

Cloud Computing: Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand, like the electricity grid.

Keyword Search: using specific words or terms to search for information online using an Internet browser.

Social Bookmarking: A method for Internet users to organize, store, manage, share and search for bookmarks of resources online by creating an archive of sites that can be accessed from any Internet enabled device.

Tags: A label that describes a piece of data, concept, website or resource to facilitate later retrieval and categorization of information.

Web Archive: an online archive of information, resources, websites and artifacts that can be accessed, modified and shared through any Internet enabled device.

Web 2.0: Applications that promote the sharing of ideas, files, resources and tools online.

DISCUSSION QUESTION

1. **What is the value of a social networking tool?** Discuss searching and building a library, teacher supervision, and the ability to avoid distractions.

Chapter 15
Reflections on Teaching Students with Special Needs in an Online Master's Program

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ABSTRACT

Accommodations for a student with a traumatic brain injury in graduate level class go beyond extended time for completing assignments. Additional accommodations include breaking major papers into stages with peer editing at each stage, using shorter articles for article review assignments, and substituting threaded discussions for some article reviews. Greater attention to the affective dimension of teaching and learning also assists students with exceptionalities and can include specific threaded discussions where students give each other tips on completing assignments. Teaching students with special needs can enhance instructor consideration of the needs of all students and make the class better for all the students involved. Additional graduate program and societal involvement is needed to make college and graduate level education more accessible for students with exceptionalities.

BACKGROUND

I recently received a call from Anne, a graduate student with a learning disability who needed into one of my classes. In the last few years I have revamped assignments in my graduate classes to meet Anne's needs and I immediately began thinking about the assignments in the class and how I could adapt to Anne's needs.

I teach at a small private university with a large non-traditional student population. My undergraduate and graduate communication classes—public speaking, interpersonal communication, leadership—are classes where conditions

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like social anxiety disorder, Asperger Syndrome, and learning disabilities are immediately evident. Some faculty might feel these students are a burden, but I find that in adapting my assignments and teaching methods to accommodate students with disabilities, I have made the classroom experience better for all my students. This process has been much more difficult for me at my current institution, however.

My university has only a rudimentary system for notifying instructors that a student in their class needs some sort of accommodation to succeed. The lack of attention to the issue of student accommodation shocked me at first. I had grown accustomed to notes from student services, but at my current university, I receive little to no help in determining what an appropriate accommodation might be for the students in my class. As the former director of our master's program in communication and leadership, I am especially concerned with our graduate students' needs for accommodations.

CASE DESCRIPTION

Our master's program in communication and leadership has a student, Anne, with a learning disability caused by brain trauma. The disability has slowed her reading to a crawl, and she obsesses about every writing assignment. She was very hesitant to let anyone see her writing before she was happy with it. This is perhaps the toughest accommodation I have made in my teaching career. Anne takes our graduate classes in eight week sessions online. The reading load in graduate classes is significant and that, coupled with the accelerated 8-week term, makes our classes challenging for the average student. I battle internally with how much extra time to give Anne to complete assignments in a way that I do not with undergraduates. I worry because I cannot read her nonverbal communication in class to tell when she is having a tough time.

I asked Anne to keep up with the reading for the class and the class discussion, but any assignment that does not affect the group can be completed later. She usually takes an extra two weeks to finish the course. Anne has affected my teaching positively in three major ways.

First, Anne has reshaped the way I give writing assignments to the entire class. I now divide every major assignment into many steps. Now, for a literature review, for example, students turn in a bibliography, an annotated bibliography, a "doggie draft" (so named because it's a rough, rough draft), a rough draft, peer edit, and then turn in the final draft. I give Anne no extra time for the bibliography, the doggie draft, the rough draft, and the peer edits but I time due dates so that she has extra time on the annotated bibliography and final draft. Anne later completes other short writing assignments scheduled between the bibliography and the annotated bibliography.

I typically assign a number of reviews of scholarly articles in each class. To accommodate Anne's slower reading and writing rate, I have replaced a couple of those assignments with a threaded discussion of an article the entire class reads. I also pay more attention to the length of articles that I assign.

The final way Anne has influenced my teaching, is in the support I offer the entire class. I do not remember a professor in graduate school ever reassuring me or my classmates that we could accomplish a task or talking about their own struggles in graduate school. As a teaching assistant, I drew support and comfort from my peers. Now, thanks to Anne, I have created discussion threads where students share problems and tips. I post examples of my graduate school work and point out the flaws as well as the strengths so all students come to see that even imperfect writing can be improved and even imperfect study habits can be altered.

Students have responded positively, generally, to the focus on writing as a process, the class discussions, and my self-disclosures.

LESSONS LEARNED

I have learned several major lessons from working with Anne.

First, *attitude is everything.* Because I approach accommodating the student with special needs positively, I can alter my teaching in ways that accommodate different learning styles and student strengths. The conflict I feel over the accommodations I offer helps me balance the requirements of the course, the needs of all the students, and the needs of the student with exceptionalities.

I have also *learned to change my teaching methods*. Non-traditional students all benefit from more attention to the process of writing. For Anne, the experience of sharing writing before it was done was initially painful, but she is less reluctant now and more confident about her writing. All the students procrastinate less, learn more from their peers, and produce better writing with my new and revised assignments.

All students benefit from discussion of the same article in the online classes and from selection of shorter articles, particularly in my research methods class. Our students work full-time and take classes. The 10-page article that they actually read communicates more than the 20-page article not read because of length.

The final lesson about teaching methods I have learned from Anne is that *all students benefit when the teacher pays attention to the affective dimension of education.* Students have difficulty learning when they feel stressed and overwhelmed. The online classroom highlights this isolation. Creating ways to overcome the isolation, letting students see their peers struggle too, releases the pressure on everyone. Additionally, supportive messages from the instructor and instructor self-disclosure help students realize everyone has strengths and weaknesses and motivates students.

Preparing Students for College

There are also lessons here for students, high school and college teachers, our doctoral degree granting institutions, and support organizations.

Because colleges do not offer uniform assistance, high school teachers and counselors need to teach college bound students how to communicate with faculty to get the accommodations they need.

Courses in educational psychology and education of students with exceptionalities need to be part of the graduate curriculum for all Ph.D. programs. Each discipline should research the best teaching methods and accommodation strategies for students in their college classrooms.

Finally, organizations devoted to specific disabilities need to reach out to college faculty—every organization's web page should include a link to information about accommodations for students in the college classroom.

CONCLUSION

I do not mean to minimize the difficulties students with disabilities face in the classroom. I do think, however, that recognizing the difficulties students like Anne face serves to reinforce that we all face difficulties of some sort. In the end, our commonality is our differences. It is not about educating the "special" student. For instructors, it is about realizing what each student needs to succeed.

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DISCUSSION QUESTIONS

1. **Do you believe the instructor's accommodations are appropriate in this situation? Why or why not?** Answers will vary but should include some discussion of the appropriateness of the extra time and student peer review practices.
2. **What sort of student services are available for students and instructors at colleges in your area?** Answers will vary based on area.
3. **Think of a student with a disability with whom you interact on a regular basis. How might you help prepare this student to be his/her own advocate in college?** Answers will vary but should include providing students with materials on the disability and recommended adaptations for general classes.
4. **Think of an organization such as the Learning Disabilities Association of America. Evaluate their resources for college instructors. What do they do well? What else could they do to help college instructors such as this author?** Answers will vary based on organization selected.
5. **Think about students with disabilities taking online classes, what are some common problems they might face and how might they overcome them?** Answers will vary but might include a discussion of the special equipment needed for the visually or hearing impaired, the time constraints, etc.
6. **At the end of the article the author says "I do think, however, that recognizing the difficulties students like Anne faces serves to reinforce that we all face difficulties of some sort. In the end, our commonality is our differences." Do you agree or disagree? Why?** Answers will vary but ensure that answers are more than just emotionally based. Answers should identify reasons why the author is correct or incorrect. Answers may deal with the consequences of the "disability" blind world this suggests.

Chapter 16
Using Tactile Prompts to Increase Social-Communicative Skills with Children with Autism

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ABSTRACT

Tactile prompts can be worn by children with autism to cue them to make social initiations to peers and make eye contact and respond to adults' facial expressions. Two previous studies and this author's research document the efficacy of tactile prompts. Teachers and therapists should use tactile prompts to increase social-communicative behavior with children with autism.

INTRODUCTION

Children with autism and other developmental disabilities exhibit delays in communication and social skills (American Psychiatric Association, 2000). It is often the case that children, especially at the higher functioning end of the autism spectrum, have social-communicative skills in their repertoires but do not display them in sufficient quantity. In other words, children with autism often do not communicate spontaneously (Charman, et al., 1997).

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TACTILE PROMPTS

A tactile prompt (e.g., MotivAider) is a device worn on the hip or in a pocket and when it vibrates, it cues children with autism to engage in a social-communicative behavior. This has been shown in two studies (Shabani, et al., 2002; Taylor & Levin, 1998). Taylor and Levin evaluated the tactile prompt with a 9-year-old boy with autism. They used most-to-least prompting and a second adult prompter to teach the child to make an initiation (e.g., "Mary, I drew a tiger") when the tactile prompt vibrated. The device was set to vibrate every 60 seconds. A multi-phase alternating treatments experimental design verified that the child made more social initiations when he had the tactile prompt in his pocket than when it was not in his pocket.

Shabani and colleagues replicated and extended the effects of the tactile prompt with three children with autism, ages 6-7. The device they used was called a JTECH Series 27 pager that vibrated for 3 to 5 seconds when activated by a remote control. Using a similar most-to-least prompting strategy, the participants were taught to make a social initiation with a toy (e.g., "Look what I have") whenever the pager vibrated. During the teaching phase, edible items were given to the participants when they exhibited social initiations. In an evaluation phase in the context of a reversal design, the participants made more social initiations when the pager vibrated than when no pager was in the participants' pockets. Shabani et al. faded the frequency of pager prompts for two participants and one of those participants maintained high levels of initiations with fewer prompts. These findings were important as the pager prompt was unnoticeable by the participants' peers, and making social initiations provided access to increased opportunities to engage in play with peers.

Given the interesting findings of these two studies, the author of this chapter is conducting a study with three 6-year-old children with autism evaluating the use of a tactile prompt to increase eye contact and responses to facial expressions. Looking at and responding to facial expressions has gained considerable attention in the neurological (Ashwin, Baron-Cohen, Wheelwright, O'Riordan, & Bullmore, 2007; Kleinhans, et al., 2008) and behavioral (Gena, Krantz, McClannahan, & Poulson, 1996; Schrandt, Townsend, & Poulson, 2009) research literature. In this author's study, children were observed in 4-minute sessions playing with toys with the experimenter and 4-minute sessions engaging in conversation with the experimenter. The intervention was putting a tactile prompt on the children's waists and telling them to look at the experimenter and say something about his facial expression (e.g., "I'm doing good," "You look bored") when it vibrated. The children were given practice and feedback. A multiple baseline across participants experimental design (Cooper, Heron, & Heward, 2007) showed that the children made more eye contact and responses to faces with the tactile prompt than without it. The research extends previous research on using tactile prompts to teach social-communication skills.

CONCLUSION

A tactile prompt is a useful device for teaching children with autism spectrum disorders to make social initiations, eye contact, and responses to facial expressions. Its inconspicuousness makes it a non-stigmatizing intervention and there is some evidence that social communicative responses maintain once the tactile prompt has been faded. Teachers and therapists should use tactile prompts to increase social-communicative skills with their children with autism spectrum disorders.

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KEY TERMS AND DEFINITIONS

Tactile Prompt: A device worn on the waist that can be set to vibrate on any given interval.

Pager Prompt: See "tactile prompt."

Autism: A developmental delay characterized by delays in communication, social skills, and repetitive movements or restricted interests.

Social Initiation: Approaching a peer and making a verbalization or communicative gesture.

Eye Contact: Looking at someone else's eyes.

Facial Expressions: Movements of the face expressing emotion, such as happy, upset, and bored.

Spontaneous Communication: Interacting verbally or with gestures with others in the absence of prompts or other supports.

DISCUSSION QUESTIONS

1. **What are three examples of social delays seen in children with autism?** Not making initiations to peers, not making eye contact, not responding to others' facial expressions.
2. **What is a tactile prompt?** A device worn on the waist that can be set to vibrate on a time schedule.
3. **How has a tactile prompt been used to improve social skills with children with autism?** Children were taught to make social initiations when the tactile prompt vibrated. Children were taught to make eye contact with an adult and respond to his facial expression when the tactile prompt vibrated.
4. **Given an increase in a skill with a tactile prompt, do you think it would be possible to observe maintenance in emitting the social skill after removing the tactile prompt?** We do not have much empirical data to support that yet. A consideration is what natural cues and consequences would support the maintenance of a social skill.
5. **What other skills could be increased with the use of a tactile prompt?** Raising a hand, self-management of on-task behavior, sharing a toy, switching work tasks.

Chapter 17
Personal Reflections on the Educational Potential and Future of Closed Captioning on the Web

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ABSTRACT

This chapter explores the value of closed captioning in universal design. While closed captions positively impact a wide range of our students—deaf, hard of hearing, and hearing—they also have the potential to create more robust and interactive digital learning systems. Caption technology can address the current limitations of video search and retrieval by offering students fully searchable, fully clickable interactive transcripts. The future of closed captioning on the Web will offer students a means to search the video collection of an entire course, or even across all of the videos produced in all of the courses of a department, college, or university. In this future learning environment, captions will enable students to use keywords not only to find and review course content across multiple videos but also to insert their own "margin" notes, share comments with students, and create customizable video mash-ups as study guides.

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INTRODUCTION

As closed captions on the Web become more common, and online captioning technology becomes more sophisticated, we are beginning to see captions deliver on the promises of universal design (Chisholm & May, 2009) to make digital video more accessible to every student, regardless of hearing ability. This chapter describes how captions are enabling more robust data mining techniques by facilitating digital video search, retrieval, analysis, and synthesis.

BACKGROUND

On television, nearly all English language content is required by U.S. law to be transmitted with closed captions (FCC, 2010). On the Web, Section 508 of the Rehabilitation Act of 1973, as amended in 1998, requires federal agencies that "develop, procure, maintain, or use electronic and information technology" to make their products and services, including their websites, accessible (Section 508). §1194.22b of Section 508 mandates the use of synchronized alternatives (e.g. open or closed captions) for video content: "Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation" (Section 508). In the private sector, businesses that have contracts, or hope to have contracts, with the federal government must ensure that the products they deliver to the government comply with Section 508. The Americans with Disabilities Act (ADA) *may* also require closed captioning for the Web's private sector. For example, the judge presiding over the landmark *National Federation of the Blind v. Target* case ruled in 2006 that the Americans with Disabilities Act (ADA), which was signed into law before the advent of the Web, applies to private businesses regardless of whether goods and services are offered in brick-and-mortar stores or online. "Judge Marilyn Patel rejected Target's position that their site couldn't be sued under the Americans with Disabilities Act (ADA) because the services of *Target.com* were separate from Target's brick-and-mortar stores" (Chisholm & May, 2009, p. 16). But because Target settled the case in 2008 "without admitting any wrongdoing," "the question of the ADA's applicability to the Web [is] somewhat unresolved" (p. 16). Regardless, the Department of Justice has declared that the ADA does indeed apply to the Internet. According to Thomas E. Perez, Assistant Attorney General in the DOJ's civil rights division,

It is and has been the position of the Department of Justice since the late 1990s that Title III of the Americans with Disabilities Act (ADA) applies to websites. We intend to issue regulations under our Title III authority in this regard to help companies comply with their obligations to provide equal access. (quoted in Evans, 2010)

Finally, the "21st Century Communications and Video Accessibility Act," signed into law by President Obama in September 2010, requires all TV and comparable programming, when (re) transmitted on the Web, to be available with closed captions (see Valentino-DeVries, 2010). This landmark legislation will ensure that when TV shows and movies are redistributed on the Web by the original TV networks and authorized retransmitters like Hulu™ and Netflix™, they are accompanied with closed captions (e.g. see Zdenek, 2009).

In an educational setting, captions are designed to provide a synchronized text transcription of speech and other significant sounds for students who are deaf and hard of hearing. But captions also benefit our non-disabled students, particularly when these students are temporarily or *situationally disabled* due to "changes in one's abilities based on environment, device, or other temporary conditions" (Chisholm & May, 2009, p. 12). For example, a hearing student who tries to study with her laptop in a noisy student union building (assuming she left her headphones in her dorm room) may have difficulty fully hearing and thus fully understanding an instructor's uncaptioned video lecture. If this student is also a visual learner who retains information better through written language, then closed captioning may be necessary to help this student reach her potential, regardless of whether she studies in a quiet or noisy area. A wide range of our student population stands to benefit from captions: students who are deaf or hard of hearing, very young children learning to read, children and adults learning a second language, military veterans with hearing loss who are returning to college,[1] college students reviewing a professor's video lectures in preparation for an exam, late-career adults and seniors returning to school to pursue a second or third career,[2] and so on. Captions have an arguably much wider appeal than we have hitherto assumed. Instructors should never settle for showing uncaptioned videos in the classroom. Whenever possible, captions should also be available to students reviewing course content outside of the classroom, regardless of the student's age, class level, or presumed hearing ability. Captions are key to universal design and achieving the goal of an optimally accessible learning environment.

Because closed captions on the Web are saved as text files, they can be fed to search engines and retrieved by keyword searches. Search engines are not very good at indexing the content of audio or video files. Indeed, Google's™ search engine has been metaphorically compared to both a blind and a deaf user (see Chisholm & May, 2009, p. 14). But search engines thrive on plain text: Tags, keywords, text descriptions, text transcripts, and, at least in the case of YouTube, closed captions (Ballek, 2010; Stelter, 2010; Sizemore, 2010). Without the benefit of searchable text captions, students will often find it difficult and frustrating, to say the least, to manually scan lecture videos looking for that one example, anecdote, or solution that they vaguely remember from class but can not locate quickly or easily in the recorded video lectures.

Interactive transcripts raise the value of captions further by allowing users to click on a single word in a video transcript and be transported to that moment in the accompanying video where that word is spoken or appears. I first became aware of, and then immediately recognized the immense game-changing power of, interactive transcripts on TED.com. Because captions on TED.com are crowdsourced out to regular users ("TED Open Translation Project"), many of the videos on the site are available in an impressive number of languages. One could, for example, listen to Aimee Mullins (2009) speaking in English, read the captions in a second language such as French, and browse the interactive transcript in a third language such as Japanese. (Or one could simply load captions and interactive transcript in English, which is what I do.) In the case of Mullins' (2009) TED talk, users can choose from thirty-two languages. YouTube™ has also started offering interactive transcripts for the captioned videos in its collection (Chitu, 2010). Companies such as 3Play Media™ and ProTranscript™ also provide, as part of their regular video transcription service, a video player plugin that serves up interactive, clickable transcripts alongside closed captions. 3Play Media™ also supports "archive searching" across a website's video collection, and has recently introduced a "clipping plugin" that allows users to "[c]lip video segments simply by highlighting the text. Rearrange clips from multiple sources and create your own video montages" (3Play Media). The video clipping plugin will output a Uniform Resource Locator or URL for sharing montages with other users. When these users are college students attending the same university, or enrolled in the same course, the video montage—fully accessible because it is built on closed captions—could be a powerful, accessible learning tool indeed.

Figure 1. A Screen Grab from Course Screencast (Interactive Transcript Plugin ©2010, 3Play Media.com. Used with permission.)

CASE STUDY

In my graduate-level course on Web Accessibility and Disability Studies, I have begun experimenting with interactive (clickable and searchable) transcripts for my video screencasts. Interactive transcripts exemplify inclusive multimedia design as well as provide students with a more accessible way to mine the video content of my course. I ask students to imagine an open, fully searchable university populated by hundreds or thousands of lectures and other videos. Because I teach in a technical communication program, I also ask students to consider the value and limits of searchable, captioned media as a form of user documentation. In Figure 1, the video is closed captioned. Each word in the transcript below the video is time-stamped and clickable. The transcript is fully searchable and automatically scrolls in time with the video. Individual words are highlighted as they are spoken.

Interactive transcripts already provide users with an excellent way to search for and find information within a single video. As video becomes more popular and captioning technology provides a way to index large databases of video context, students will be able to search the video collection of an entire course, or even across all of the videos produced in all of the courses of a department, college, or university. In this future learning environment, captions will enable students to use keywords not only to find and review course content across multiple videos but also to insert their own "margin" notes, which could take the form of time-stamped text comments or pop-up idea bubbles (e.g. see BubblyPly.com), their own video responses or notes produced on the fly with their web cams, links to other related video moments in the course's video collection, links to external Web resources, and comments from other students that have been made public. This added content may or may not be searchable/

captioned, but it would at least be tagged and easier to find as visible nodes in the student's personalized video stream. The instructor's lecture video would thus be transformed into the student's personalized study guide and an opportunity for collaborative learning. In addition, keyword searches would not simply return a list of matching video clips but also, perhaps, a single mash-up comprised of all the clips that satisfied the search query, plus any accompanying student commentary. The inherent limitations of uncaptioned video would thus be addressed by a robust video captioning and search system that allows students to personalize and reconfigure the content of a course according to their needs. The promise of universal design could be realized, in other words, by an accessible system that levels the playing field for all students—deaf, hard of hearing, and hearing.

CONCLUSION

We need to continue to push for and applaud advances in caption technology that will leverage the power of searchable text to provide a more inclusive, more accessible learning environment for our students. While it is naïve to think that a fully accessible video library is cheap or easy to achieve—particularly at a time when some academic librarians are opting for cheap and inaccessible solutions like Netflix™ (Kaya 2010),[3] users are uploading uncaptioned, so-called "disposable" videos (Reid, 2008) by the millions each month to Facebook™ and YouTube™ (Bilton, 2010), and many others are simply unaware of either the need for or the benefits of captioning—it is nevertheless important for Web accessibility advocates to continue to publicize all of the reasons (ethical, legal, business, user-centered, etc.) that accessibility makes sense for our students and our pedagogies. I am optimistic about the ongoing efforts of Google™, Hulu™,[4] and others to address our pressing need for better solutions to the problem of video search, retrieval, analysis, and synthesis. As the number of distance learning, video-enriched courses grows on our college campuses, educators and students will require solutions that combine the richness of video with the data mining benefits of text-based captions and transcripts.

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ADDITIONAL READING

AccessibleRhetoric.com Captioning Tools. https://billcreswell.wordpress.com/other-caption-resources/captioning-tools/

Captioning Key. http://www.dcmp.org/captioningkey/index.html

How People with Disabilities Use the Web. http://www.w3.org/WAI/EO/Drafts/PWD-Use-Web/

Online Captioning Bibliography. http://joeclark.org/access/captioning/bpoc/bibliography.html

Web Content Accessibility Guidelines. (WCAG 2.0). http://www.w3.org/TR/WCAG20/

WebAIM.org Web Accessibility Initiative. http://www.w3.org/WAI/

KEY TERMS AND DEFINITIONS

Closed Captioning: An accommodation that provides access to the audio portion of a video file for viewers who are deaf or hard of hearing. Closed captions are written transcripts of dialogue and other significant sounds that are synchronized to display on the screen as the sounds occur. Captions are either closed or open. Closed captions can be turned on or off. On TV in the U.S., closed captions are delivered through line 21 of the video data area. On the Web, closed captions are delivered in a separate text file and activated when the user selects the caption function/button on the video interface. Open captions can not be turned off. They are burned into the video itself. Captions are live or pre-recorded. Live captions are transcribed by a human stenocaptioner and delivered to viewers with a slight delay of 2-3 seconds usually. Captions are usually either one of two types: scroll-up or pop-on.

Interactive Transcripts: Written transcripts of the audio portion of a video file. The transcripts are searchable and clickable, so users can interact with the transcript. By clicking on a word or sentence in the transcript, the user is transported to that moment in the video where that word is spoken. Vendors include 3Play Media and ProTranscript. YouTube also supports interactive transcripts.

Web Accessibility: The practice of making Web pages and applications accessible to the largest number of users possible, especially users with disabilities. Web accessibility focuses on the major categories of disability: visual, auditory, motor, and cognitive. U.S. laws such as Section 508 and international guidelines such as Web Content Accessibility Guidelines (WCAG 2.0) allow web developers to adhere to a set of accessibility guidelines and best practices.

ENDNOTES

1. "According to the Deafness Research Foundation, hearing loss is the No. 1 diagnosis for U.S. soldiers in Afghanistan and more than 65 percent of Afghan war veterans are suffering from hearing damage" (Hemstreet, 2010).
2. "One third of all senior citizens have hearing problems" (CaptionsOn 2010). Moreover, the number of Americans 65 years of age and older—a population group more likely to benefit from accommodations such as closed captioning—is projected to rise from 13% in 2010 to 20% by 2050 (U.S. Census, 2008).
3. Netflix™ has only recently started offering streaming movies and TV shows with closed captions (see Netflix, 2010). But their closed captioned streaming library is small (only about 100 titles out of thousands). In addition, because Netflix™ provides no way to search for closed captioned content, Netflix's™ streaming service is at this time virtually inaccessible to users who require or prefer captions.
4. While the number of closed captioned full episodes and movies on Hulu™ remains small at approximately 4 to 6% (see Zdenek, 2009), Hulu™ has taken steps to exploit the power of captioned media to provide more fine-grained search experiences. Search results match specific time-stamped moments in captioned episodes. In addition, users are able to see visually on a "Heat Map" graph "the parts of the video that have been viewed the most; you can also click on the chart to

navigate to any point within the captions" (Hulu). According to Eric Feng, the chief technical officer at Hulu™, captions have "turned into a very important part of our user experience" (quoted in Stelter, 2010).

DISCUSSION QUESTIONS

1. **Ask participants to share their experiences with video used for educational purposes (e.g. video lectures, screencasts, YouTube videos in the classroom). Is video becoming a more popular means of delivering course content, especially in distance learning contexts?What are some of the challenges of using video in the classroom? How do video and audio differ from writing?** These questions are intended to encourage participants to reflect on some of the challenges involved in searching and annotating uncaptioned video. For students who are deaf and hard of hearing, uncaptioned video is inaccessible. But uncaptioned video can also be difficult for hearing students to use. For example, consider how difficult it can be for students to search and retrieve a specific piece of information from a long, uncaptioned lecture video, or to use a professor's uncaptioned video as a study guide prior to an exam.
2. **If participants have access to a computer lab, ask them to visit TED.com and view one of the TED videos that is accompanied by an interactive transcript. The talk by Aimee Mullins (see the References to this chapter) is an excellent example. How might interactive transcripts be used with video in the classroom?** What are some of the advantages of interactive transcripts over uncaptioned videos? What are some of the drawbacks and challenges for instructors? How might interactive transcripts be coupled with search technology to give students integrated access to entire collections of videos? These questions are intended to encourage participants to consider closed captioning in the wider context of universal design.

Chapter 18

Parental Communication About the Needs of their Children: As Expressed in an Online Support Group

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ABSTRACT

The purpose of this chapter is to analyze parental use of an online support group about their children with disabilities. A content analysis was conducted of 1,718 emails from a listserv support group for parents of children who have been diagnosed as eligible for special education services. The findings suggest that parents use the group for the following purposes: (a.) expressive story-telling, (b.) seeking and giving advice, (c.) seeking or offering validation or encouragement, (d.) seeking or providing information, (e.) seeking or suggesting resources, and (f.) sharing celebrations and telling success stories for hope. Parents often discussed: How to deal with professionals (e.g., teachers, physicians), family, testing and diagnosis of disability, communicating with educators and the school context, Individualized Education Program (IEP) team meetings and reports, and family dynamics. The communication skills parents are most concerned about are writing and reading.

INTRODUCTION

Access to private opinions about children is a difficult area to research. With the advent of online discussion groups, however, many parents are willing to disclose information about their ideas and feelings about their children. This online phenomenon provides research information in multiple ways. First, one can analyze the overall functions of the online discussion support group. Second, one can analyze what individual group members have to say about their communication with educators about their children with special needs.

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The purpose of this chapter is to examine the nature of parental communication about their school-age children who have been diagnosed as eligible for special education services. First, by examining the group's communication functions, the educator can better understand the needs of parents of children with exceptionalities. Second, teachers may gain insights into more effective instruction for children with developmental disabilities. For the purpose of this research, a content analysis was used to consider parental concerns in communicating with and about their children with educators during their participation in an online support group.

The Nature of Online Support Groups

With the advent of electronic listservs and the Internet, opportunities for support and information-sharing have increased through the use of online communities. These groups are available on a range of topics, which can bring together people from diverse locations. Online support groups have provided a new area of research interest. Royal (2005), for example, analyzed research about the Internet and women. There seemed to be equal access, but less comfortable participation by women and a less welcoming context for women. Ye (2006) found that international students in an online support group received more information and felt less stress. Kuster (2007) also found information value in online groups, including the fact that support groups can provide information through Internet links. There is some question about the reasons people select an online discussion group instead of a face-to-face group. These reasons may include frequency of interaction, availability, a sense of anonymity, convenience, and the lack of pressure to talk in a group. Mesch (2006), for example, suggested that people with low self-esteem were more likely to be frequent Internet users.

These groups provide opportunities for learning and empathy for people who share interests or concerns. There are numerous online groups specifically for people with interests in or concerns about children with disabilities. An updated version of the ERIC Clearinghouse on Disabilities and Gifted Education list includes 55 different online discussion groups on the topic of learning disabilities and special education (http://www.hoagiesgifted.org/eric/ld-sped.html). The value of online support groups can be as important to the members as a face-to-face support groups are to their members (Turner, Grube, & Meyers, 2001). Further, the sense of anonymity in the nature of online interaction may actually increase the quality and depth of member responses through personal disclosure, reciprocity, and personal acceptance (VanLear, Sheehan, Withers & Walker, 2005).

Creating Narratives

Narratives were an essential component of the discussion in this support group. Story-telling is a crucial communication skill, which requires cognitive, knowledge, and language skills (Soto & Harmann, 2006). Communication scholars, educators, and psychologists have examined the purpose and effects of story-telling in many contexts. For example, story-telling helps people to make sense of their experiences through interpretative processing, particularly when using reflection about difficult experiences (Bochner, Ellis, & Tillmann-Healy, 1997; Koenig Kellas & Trees, 2006). Self-disclosure about difficult situations can have positive effects on an individual's well-being (Clark, 1993; Pennebaker, 2003). Thus, story-telling can be viewed as important for personal and therapeutic reasons in multiple contexts. Genereaux and McKeough (2007) contended that narratives are crucial in meaning-making and social-psychological understanding.

Black (2008) suggested that people in groups mediate differences based on their dialogic interactions, which can be particularly important in an online group. Koenig, Kellas and Trees (2006) observed that families used joint-narratives to make collaborative sense of experiences. Kyratzis (2005) suggested that story-telling is a primary way that families convey values and culture to their children. Family stories tend to be highly personal (Sherman, 1990) To some extent, the online discussion support group provides the same possibility of making sense of difficulties with children, schools, family members, and professionals through shared story-telling.

Mroz and Letts (2008) suggested that families with children who have been diagnosed as eligible for special education services often face complex challenges, which include difficulties in diagnosis and variations on the kinds of services and supports received.

METHOD

This research analyzed public archives of emails from an online support group for parents of children with exceptionalities. The online discussion group was selected for study because of the support group's focus, the large number of active parent participants, and diverse concerns. A content analysis was conducted on 1,718 emails from this online discussion group of parents of children diagnosed with disabilities. Their children included young children through adults.

Participants

The group is an open forum for parents to discuss their children who have exceptionalities. The discussion includes conversation about school services, working with teachers, seeking correct diagnoses, interventions that work, parenting methods, sources of information and support, and health and nutrition concerns. The discussion group is open to anyone who has a connection to a child with disabilities, such as a parent or teacher. Among those who post, there are parents, teachers, and professionals, females and males, adult through retirement age, and members who live in the United States and other English-speaking countries. Nearly all the people who post to the discussion are mothers—many single mothers--of children with disabilities who live in the United States. Given the societal trend of the mother having major responsibility for parenting, the predominance of women in the group appears appropriate. More than 70 people posted during the period studied. Nearly all parents reside in the United States. In some situations the child has undiagnosed exceptionalities.

Data Analysis

The postings were categorized according to parental comments about communication. Concern for a topic was analyzed according to the nature of the content and the number of words posted about the subject. Postings with a large number of words suggested high concern, with the interpretation that the more parents discussed the topic, the most concern they felt toward the topic. Non-duplicated content revealed more than 300,000 words in the emails analyzed. The content was then categorized so that the number of words could be used to determine the percentage of discussion about each communication topics.

In cluster criticism (Burke, 1966), the analyst uses a qualitative research approach, but actually counts individual words used in communication. The analyst can examine the *frequency, intensity, and clustering* of certain words. By looking at the frequency of word use, the communicator gives a clue to what is most important. If one looks at the manuscript of a speech for example, one can easily count words and determine the important concepts based on the sheer number of times certain words are uttered. While that analysis may be more difficult when listening in a normal conversation, the strategy can be adapted to help one figure out *What is going on in the communication event?* In one sense the counting of words guides the analyst into the literal meaning. By discovering the most important words, one can focus so that the myriad of other words does not confuse the literal meaning, and the analyst can understand the content.

Here are questions one can ask while listening and interpreting a communication event.

1. *Frequency. What words are used most often?* When one identifies some high frequency words, they can give insight into what the person thinks is most important.
2. *Intensity. What words are used that suggest an intense emotional reaction?* This analysis may help us discover parental concerns. When a parent listens to a teacher's feedback, for example, perhaps the teacher uses the word "stupid," when referring to "stupid mistakes." The word "stupid" is clearly an intense word. The parent may think the teacher thinks the child is stupid or wonder how any mistake because of a learning problem could be stupid. While this strong word may prompt a defensive reaction from the parent, if the parent can approach the interaction as an objective analyst—certainly difficult in an emotion-laden situation—the parent may gain meaning by asking about the intense word. For example, "I'm sorry you're upset about my son's work, and I'm trying to understand the problem. What did you say was 'stupid?'" The teacher might respond: "I don't know, these spelling errors are ridiculous." Although a different word is used, "ridiculous" is intense and suggests that the teacher is upset about the student's spelling errors.
3. *Clustering. What words cluster around frequent and intense words?* Perhaps, for example, a parent said about a teacher that she: "ignored important details," "submitted an IEP with terrible errors," "needs to stop being so lazy about accommodations." The intense words of *important*, *terrible*, and *lazy* suggest that nearby words are also important: Details, IEP, and accommodations. This kind of analysis may be difficult or even impossible at the time of the communication event, but an analysis of emails can add insights into determining parental concerns.

PURPOSES OF GROUP PARTICIPATION

As one might expect with any online support group, the emails seemed to serve multiple communication purposes. The online discussion seemed consistent with research on other support groups. Babinski, Jones, and DeWert (2001), for example, analyzed emails in an online support group for new teachers and found that the content reflected 5 categories, including fostering a sense of community (34.8%), providing advice (21.3%), sharing knowledge (20.1%), relating a personal experience with the issue (16.0%), and encouraging reflection (7.9%). In this study, group members posted several types of emails involving story-telling, which could be categorized as self-expression, advice, encouragement, information, resources, and hope.

Expressive Story-Telling

Story-telling is a way of conveying values, while allowing the story-teller to express thoughts and feelings. Story-telling is common in support groups because it allows the story-teller to make sense out of experiences.

Seeking and Giving Advice

One area of conflict appears to be denial over the child's diagnosis. While the mother struggles with figuring out how to adapt to the child's exceptionalities, the father, family members, and friends often deny that anything is wrong. Postings suggest that the mother is often blamed for being an alarmist or the cause of the problem with the child. Parents talked about motivation and pros and cons of using rewards. Other topics included seeking financial aid for their children's education.

Seeking or Offering Validation or Encouragement

In one subject line, a mother wrote "Need validation here." Being evicted from her apartment and immersed in family conflict, she reached out to group member to tell her she is a good parent.

Seeking or Providing Information

For many parents in the group, they were struggling with a new or lack of diagnosis for their children. In some cases, they knew something was different about their children, but they longed to know what was wrong so they could find a solution. For other parents, they recently received a diagnosis and sought information about the implications of the diagnosis. For other parents, they believed their child had a diagnosis they thought was wrong. In each of these cases, parents sought information. These parents wanted to know if other parents thought the professionals were right. They had searched the Internet and wanted to know what sites contained correct information.

Another area of information sharing was about the meaning of tests because parents who were new to working with the IEP often didn't completely understand their children's test results, what it meant regarding their learning or ability to succeed in school.

Seeking or Suggesting Resources, Such as the Internet, a Book, or Qualified Professional

Books, magazines, nonprofit organizations, and website information were shared. In cases where parents lived in the same city, state, or region, they offered the names of professionals, psychologists, and physicians whom they trusted. Many parents did not want to know information directly from other parents as much as they wanted to know how other families learned what they needed to know about a child's diagnosis. Although many of the emails were about schools and learning, other emails were about parenting, family relationships, getting along with neighbors, and other topics.

Sharing Celebrations and Telling Success Stories for Hope

These parents are often seeking new information from other members, particularly regarding medication, treatment, and strategies that will help their children. One parent told her child's psychologist about a treatment, to which he inquired if she knew anyone who had used the treatment. The mother said she did know people online who had used the treatment.

PARENTAL TOPICS OF DISCUSSION

General topics of discussion included an array of subjects. Participants discussed personal and academic topics. When talking about academics, for example, parents most frequently talked about reading, writing, and mathematics. In looking for discussion of research-based interventions to improve communication skills, relatively little discussion took place. Word frequency implies the following topics were of interest to the parents in the discussion group: how to deal with professionals (e.g., teachers, physicians), family, testing and diagnosis of disability, communicating with educators and the school context, Individualized Education Program (IEP) team meetings and reports, and family dynamics. In addition, parents often discussed student motivation, specific instructional strategies, physical activities, finding positive leisure and recreation experiences, advocacy for children with special needs, and communication strategies for working with educators. Parents often discussed communication related to professionals, schools, and advocacy.

The frequency of words suggests the order of importance of discussion topics. Word frequency implies the following topics were of interest to the parents in the discussion group:

1. How to deal with professionals (e.g., teachers, physicians).
2. Testing and diagnosis of disability.
3. Communicating with educators and the school context.
4. Individualized Education Program (IEP) team meetings and reports.
5. Family dynamics.

In addition, parents often discussed student motivation, specific instructional strategies, physical activities, finding positive leisure and recreation experiences, advocacy for children with special needs, and communication strategies for working with educators.

The findings suggest that parents are concerned about communication with educators focused on the Individualized Education Plan (IEP), classroom learning, and accommodations. Of particular importance is effective communication in an IEP team meeting. These meetings determine the nature of services the child will receive and report on yearly progress toward goals.

A major portion of the discussion group dealt with effective communication between the parent and the professional, particularly the educator. In this case, 23% of the postings about communication were about how to communicate more effectively with educators about the Individualized Education Program (IEP). This discussion focused on the Individualized Education Plan meeting, ensuring appropriate accommodations for student learning, and the contents of the resulting report. An additional 15% of the postings about communication were about communicating with the classroom teacher. In some cases the parents talked about wonderful and caring teachers who have a major positive influence on their children. In other cases, the educators failed to meet the children's needs or the parent's expectations. Disheartening talk about having an excellent teacher followed by a child's regression under an ineffectual teacher showed the delicate needs of some children who have been diagnosed as eligible for special education services.

Dealing with Professionals

A word count showed the subject of *dealing with professionals* was used 1,464 times. Participants discussed advocacy and how to work with professionals to achieve the best for their children. This subject area was a major concern to participants and included ideas about advocacy and law. Parents talked about working with professionals, for example, and how to find professionals who can provide diagnosis and treatment help. The professionals of most concern to parents—based on frequency of discussion--include teachers (964 comments), physicians (168 comments), and psychologists (187 comments).

Testing

Testing appeared to be an important topic among parents. A word count showed the term was used 1,403 times. Participants discussed testing, test meaning, and statistical interpretation, which were important to parents because of the influence on diagnosis, treatment, and intervention.

School Interactions

These postings focused on the family and child communication with educators, including school administrators and teachers. A word count showed the term school was used 911 times. Although participants discussed home and other context, they seemed most concerned about interactions with the school and school professionals (e.g., teacher, principals, superintendents, school counselor). Considerable negative discussion suggested opinions that school is often in a low-trust or adversarial role and the child is often experiencing anxiety over the educational process. Some parents talk about going to home schooling or transferring schools in hopes of finding better solutions for their children. Some parents feel like educators are failing their children, and the parents are responsible for educating their children: "NONE of us should have to do the school's job for them. But sadly, we all have to. And some schools require more work than others." Clearly, school interactions create high stress for many parents and their children.

Individualized Education Program (IEP)

These postings focused on how to approach the Individualized Education Program (IEP) team meetings for the best results for the child. Postings strictly about test results and diagnosis were excluded from analysis. A word count showed the term Individualized Education Program (IEP) was used 425 times. The participants discussed how to obtain an Individualized Education Program (IEP) meeting, approach the IEP team, and communicate in the IEP team meeting, for example.

Anxiety

A word count showed the term *anxiety* was used 371 times. Participants discussed their child's anxiety in home, school, and other contexts. This discussion was considered only when it included a discussion of communication skills or strategies. Group members also discussed the family stresses of families who have children with disabilities. Explanations for the high stress levels included having premature children, divorce, single parenting, an extended family that lacked tolerance regarding the child's disability, the complication of one of the parents having a disability, and health and social problems associated with the child diagnosed with disability.

Family

Two areas of expressed concern were those of family talk and family conflict related to their children with disabilities. There was extensive discussion, for example, about how to deal with family problems, coping with extended family's negative reactions to the child with exceptionalities, and dominance of family time created by the child with exceptionalities. Postings about the family talked about the effect of the child on family dynamics, denial by family members, the problems of having family members with the same exceptionalities as the child. Many of these families have significant stress caused by dealing with their children's exceptionalities. There were discussion of various parenting skills and strategies. Parents talked about the importance of shaping child behavior while being respectful. There appeared to be many concerns about communicating in a way that does not add pressure to the child.

Medication

A word count showed the term *medication* was used 302 times. Participants exchanged opinions and information about medications and their effects. Understandably, there were extensive discussions about medication, but the discussion is outside the scope of this study.

Diagnosis

A word count showed the term *diagnosis* was used 225 times. Participants discussed the definition of diagnosis of various disabilities. Many parents discussed an array of frustrations, misdiagnosis, conflicting diagnosis, and other struggles during the process of obtaining a diagnosis for their child. As one mother explained, "Well, at the beginning my husband was part of the chorus that told me that our daughter was 'fine.' Yes, I think that he was in denial. Yes, this difference of opinion put LOTS of stress in our marriage." One parent told a story about receiving an extensive diagnosis report from a psychologist. After spending thousands of dollars, the report was full of typing errors which showed that they had just received a report designed for another child, with their child's name substituted. The name was not even substituted in all places. While it may be true that their child was similar to some other child the psychologist had diagnosed, clearly there must have been key differences between the children, which warranted a different kind of report.

This discussion was outside the scope of this study unless related to ways to communicate about the diagnosis.

Accommodation

A word count showed the term *accommodation* was used 228 times. Participants discussed accommodations, supports, interventions, and strategies for helping their children learn and adapt. The participants discussed rules and routines, for example, which help their children learn and adapt to social environments. An area of parental frustration seemed to be the lack of individualized accommodations that genuinely help the child.

Stress

A word count showed the term *stress* was used 180 times. Participants discussed stress factors in home, recreational, and school contexts. This communication included stress on the child and stress caused by the child. One mother explained that her faith enabled her to get through the challenges of having a child with special needs: "These last years were so miserable and faith helped lots." Particularly important seemed to be pressure on the child from the school context, which most often stress prompted by the behavior of the child's teacher. This element was considered regarding how the nature of communication affected child or family stress. Parental struggles are evident: "And we all make heart-breaking choices each and every day regarding the balance of work, family, home life, and relationships. Each choice has repercussions." Baxter, Cummins, and Yiolitis (2000) suggested, for example, that stress caused by the presence of a child with an intellectual disability can create a general stress affecting the family.

PARENTAL CONCERN ABOUT A CHILD'S COMMUNICATION SKILLS

A student's communication ability is the single best predictor of school success because of the correlation between communication skills and positive peer relationships and academic achievement (Sage, 2001, p. 423). Although effective communication can be a challenge for any child, students with disabilities often have additional communication problems that interfere with their successes (Meadan, Ostrosky, & Halle, 2006; Rinaldi, 2003). Mack and Warr-Leeper (1992) found that boys with behavior disorders often have poor or inconsistent language skills. Sanger, Maag, and Spilker (2006) suggested that for girls classified as "juvenile delinquents," interpersonal communication skills are particularly problematic. Ritzman and Mitzo (2007) found that students who had been violent improved social adjustment, academic performance, and behavior when they receive speech and language services. The difficulty of some children is exemplified by this parent's words: "Socially, he was teased and was more or less an outcast."

Assuming that communication skills are a factor in student success, this author sought to determine parental perceptions about the communication of their children. This parent's words gave insight into the challenges of children with behavior disorders, for example: "The child is so discouraged that he doesn't believe that he is able to control his behavior." Two areas of expressed concern were those of family talk and family conflict related to their children with disabilities.

Peer Communication and Social Interaction

These online discussions included how the child interacts with peers, uses table manners, and employs social skills. Parents discussed storytelling as a way of teaching social skills. Parents discussed situations where their children are isolated or ostracized. As Polloway, Miller, and Smith wrote: "Conversational competence takes on greater importance as students strive to fit in with their peers, participate in social peer groups, and move toward greater independence from parents" (p. 222). One parent sought information on helping her child: "It was suggested that my child also might need social interaction facilitation by an adult in unstructured settings and a peer buddy to help with peer interactions (how do we find these?)."

Reading and Writing

The findings suggest that the communication skill about which parents are most concerned is reading (49% of content). Parents also expressed concern about their children's social communication (19%) and written communication (13%). Less discussion took place regarding listening, speech communication, and nonverbal communication. For many parents, their children's behaviors were an important discussion point, including behavior triggers.

CONCLUSION

An over-arching goal of the group seemed to be problem-solving. Problems and conflicts related to their children seem to be discussed more than solutions and successes. The frequency of problems and conflicts is understandable because the group provides a problem-solving forum for many members.

On the positive side, parents often posted comments of this kind: "Our school was very accommodating. Their solution was... " or "His teacher was excellent. He made progress through..."

The nature of the interactions suggests the online support group provides important roles and somewhat unique communication for many community members. Parents vented, sought information, made sense of their own personal situation, and tried to help others.

EPILOGUE

So, how can one gain insight through the study of an online parental support group? First, by examining the group's communication functions, the professional can better understand the needs of parents who have children with exceptionalities. Second, professionals may gain insights into more effective collaboration with families. Any professional in the area of special education could benefit from subscribing to an online parental support group and learning about what happens in the day-to-day processes of families. This author found the process of reading the emails of this support group to be interesting, informative, and heart-wrenching.

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ADDITIONAL READING

Annotated List of Parent Support Groups for Special Education http://www.childrensdisabilities.info/advocacy/groups-special-education.html

OnlineAcademics.org Special Education Resources and Glossary http://onlineacademics.org/SPED/

KEY TERMS AND DEFINITIONS

Accommodations: Adaptations provided to increase student success.

Double Exceptionalities (2e): A person who has been diagnosed as having more than one special need or exceptionality. Often one exceptionality is classified as a disability, while another is giftedness.

Individualized Education Program (IEP): Also called Individualized Education Plan. The educational plan created by the educational team to assist a student with an exceptionality.

Listserv: A computer-mediated communication method in which a group of people can converse through email or discussion board format.

Support Group: A group where individuals with similar concerns come together to discuss and solve problems and help themselves and others to cope with challenges.

DISCUSSION QUESTIONS

1. **Why do you think story-telling is so important for many parents in this group?** Discussion may include making sense of one's own story and other factors, such as the following:
    - Expressive story-telling
    - Seeking and giving advice.
    - Seeking or offering validation or encouragement. Parents often give supporting comments to each other. "And you are doing a fabulous job." "Hugs, and wishes for a good resolution to this extremely painful episode."
    - Seeking or providing information
    - Seeking or suggesting resources, such as the Internet, a book, or qualified professional
    - Sharing celebrations and telling success stories for hope.
2. **In this study, what were the key topics parents were concerned about?**
    - Accommodation
    - Anxiety
    - Dealing with Professionals
    - Diagnosis
    - Family
    - Individualized Education Program (IEP)
    - Medication
    - School Interactions
    - Stress
    - Testing
3. **In this study, what were the key communication skills parents were concerned about?** The findings suggest that the communication skills about which parents are most concerned are writing and reading. Less emphasis was placed on discussion regarding their children's listening, speech communication, and nonverbal communication.
4. **What are the implications of this information for professionals and how they can better collaborate with families?** Discussion may include the perception of an adversarial relationship, the intimidation and lack of respect parents may feel from professionals, and similar ideas.

Section 4
Leading Change

Chapter 19
Are you SMARTer than a SMART Board™?
How to Effectively Use this Technology Tool to Communicate in a Classroom with a Diverse Group of Learners

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ABSTRACT

Interactive whiteboards (IWBS) became obtainable in the early 1990's. An IWB is an electronic, interactive board which is either mounted or mobile. While interactive whiteboards are just one of many different engaging technology tools available today, it is the most commonly seen in the classroom. IWBs offer opportunities for teachers to become facilitators of knowledge while students demonstrate their learning through physically moving components on the interactive whiteboard. Students from all different learning styles and backgrounds have come together and shown their enthusiasm through these one-touch systems which become the center of their classroom. This chapter will focus on the various ways interactive whiteboards, specifically SMART Board™, can be used in the classroom and also challenges associated with this type of technology usage. Interactive whiteboards provide environments where all types of learners have a common interest, interacting with technology which is both educational and fun.

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INTRODUCTION

There are educators who, unfortunately, due to lack of professional development and training, merely use interactive whiteboards as a presentation tool. This occurs when teachers are expected to use this technology tool without any instructional support. Districts often have instructional technology or information/instructional technology (IT) staff, information technology staff to support the management of technology. These individuals typically are not trained in how to use the technology for teaching and learning. Instructional technology coaches can be referred to as those who train and instruct teachers in how to use the technology placed in their classrooms effectively to meet the needs of all their learners. Due to economic changes and budget cuts, instructional technology coaches may not be available.

Interactive whiteboards are costly tools which must be used properly to engage learners in the classroom. This chapter will showcase how to use interactive whiteboards, specifically SMART Board™ to create an engaging, effective learning environment. One of the issues associated with interactive whiteboards is the misunderstanding of their purpose. Interactive whiteboards were created for *students*, not the teachers. Unfortunately, some teachers use them solely for a presentation tool. They are meant to be used to interact and engage students in the classroom.

The average interactive whiteboard is 6-7 feet wide and about 4 feet tall. They are mounted or mobile interactive whiteboards. The mounted interactive whiteboards are commonly mounted on an existing whiteboard securely to a wall. Some versions come with an attached liquid crystal display (LCD) projector. Others use a ceiling mounted projector, which is installed to precisely project the image directly onto the interactive whiteboards. The mobile interactive whiteboards are attached to a rolling base which can be moved around the room. This interactive whiteboard also needs a LCD projector. Both types of interactive whiteboards require a computer system to run the software. Specific drivers must also be downloaded to the computer to complete the installation of the interactive whiteboard system. Users can decide if they wish to use their finger or an electronic tool to use the interactive whiteboard.

The interactive whiteboard can last for many years if taken care of properly. The software updates become the key player in staying current with the resources available with the interactive whiteboards. Depending on the model, the interactive whiteboard will include an electronic pen or electronic marker to be used to write on the interactive whiteboard. Often times, users will simply use their finger as the tool to write. The interactive whiteboard allows the user to choose finger, electronic pen, or wireless mouse, which way best suits their style when operating the system. Some models offer a virtual keyboard which will pop up on the screen. This allows the user to type at ease without retuning to the computer to type in using the necessary keys on the keyboard. Less interruption and distraction to the flow of the use is imperative for effective teaching and learning.

The increase in "touch" technology tools has created an increase of the popularity with the interactive whiteboard market. There are a variety of brands and models available to school districts. School districts look at managing their funds related to technology seriously, especially because technology can be outdated quickly. Districts usually consult with their IT staff on which technology tools to purchase and, unfortunately, teachers are rarely consulted. Obviously this is where the system breakdown occurs. A staff member is in control of purchasing a technology tool in which he or she will not necessarily use. It is crucial for teachers to be aware of the make, model, and type of interactive whiteboard they are receiving or currently have in their classroom. It is common for teachers to explain to others they have a SMART Board™, when indeed they do not, they have an interactive whiteboard created by an entirely different company.

Why SMART Board™?

Why the SMART Board™? There are limitless ways to use the SMART Board™ and resources which accompany the SMART Board™ in the classroom. Along with the IWB is the SMART Board™ notebook software. This notebook provides many avenues of resources which teachers, students and even parents can use to support student learning. Below is a list of reasons to purchase a SMART Board™ system.

- The screen is durable for all types of users.
- Software updates keep the content current, therefore the actual IWB does not need to be replaced frequently.
- SMART Board™ exchange (http://exchange.smarttech.com/index.html#tab=0) is a website that offers ways to gain free resource materials, collaborate with other educators and download lessons for free.
- The SMART Board™ is compatible with all other programs used on the teacher's desktop computer.
- IWB can be purchased without having to purchase the projector from the same company which can reduce costs.
- The SMART Board™ Notebook can be purchased and used with the IWB.
- The SMART Board™ Notebook presents an incredible variety of resources for the whole learning community.
- The SMART Board™ Notebook has versions for teachers and students.

Your Learners and Your Interactive Whiteboard

The first question to be addressed is "what type of learners do I have?" The SMART Board™ can be used to meet every type of learner if done so with specific focus on the student's needs. For example, with a group of non-verbal learners; a set of images, videos, interactive media can be used in which the student is able to physically interact and write his or her answers, by moving words or symbols to other areas of the slide or board to answer the question. The first step is to identify each student's needs in your classroom and make a list of variety of uses for the SMART Board™. Some examples of uses are given:

Students who need to be mobile:

- Use the pen to write answers on the board
- Have the students use their finger to write or move images
- Use the notebook for students to drag over images from the gallery
- Access the interactive multimedia from the gallery

Students who need nonverbal communication

- Have the student write words on the interactive whiteboard with a pen or finger
- Have the student drag words, sounds, images from the gallery to explain what they would like to express verbally
- Videos can be watched through the SMART Board™ and then the student could write notes in their own SMART Board™ notebook and share
- Use of the Internet with the interactive whiteboard to locate other images, words or identify sounds.

Students who need motivation to learn basic concepts:

- Access the "essentials for educators" folders and toolkits through the SMART Board™ software or online website for games

- Have the student write questions on the interactive whiteboard and have other students answer
- Student can click and drag a wide variety of manipulatives from the SMART Board™ Notebook Gallery.

SMART Board™Notebook offers these options: Interactive slides, Gallery, Attachments, Games, Video, Database of online lesson plans created by educators.

CHALLENGES WHEN USING AN INTERACTIVE WHITEBOARD

Being Mounted Too High

Since interactive whiteboards are typically mounted on existing whiteboards, the top of the interactive whiteboard becomes too high for users to reach. This happens primarily in elementary classrooms. Students are unable to reach the entire area of the interactive whiteboard. The tool bar in the SMART Board™ Notebook, by default, is at the viewed top of the interactive whiteboard. This can be switched to the bottom of the Notebook by clicking on the appropriate icon.

Keeping the Software Updated

Staying current with the updates prompted from the software associated with the IWB can become challenging. Teachers usually do not have administrative authority to complete downloads and updates. The technology staff member responsibility for these updates must be contacted for these updates to be completed. Keeping the system current is crucial as it will maintain access to free or already purchased resources.

Orienting

You must orient the SMART Board™ prior to each use. When you orient the SMART Board™ it registers the precise area of that touchpoint. If the interactive whiteboard is mounted, there should be less of an issue with the interactive whiteboard becoming "unoriented." The mobile interactive whiteboards can become quickly unoriented if the mobile stand, computer or projector is slightly bumped.

Loss of Pens/Eraser

Most interactive whiteboards come with an electronic pen, pens, markers or erasers. Most interactive whiteboards will not work properly without these compatible tools. The system recognizes that there is a missing piece. Sometimes you can place another option in the "slot" until the electronic pen or marker can get replaced. These tools can be purchased through the company separately if lost.

Shadows

Projectors can create a shadow onto the interactive whiteboard which can impede proper use or cause difficulty in visually identifying the images on the interactive whiteboard. The user must position his or her body out of the shadow. This will become more natural with practice.

CONCLUSION

Finding effective ways to communicate with your learners through the use of technology can be extremely motivating and exciting for all. The risk of overuse becomes an issue with the increased use of any technology tool. The educator is a facilitator of knowledge and learning in the classroom. Being selective with when, how and where you implement a IWB in your lessons, daily routines and activities is crucial for creating, maintaining and sustaining the excitement and motivation you wish to see in your diverse group of learners.

ADDITIONAL READING

Florida Department of Education http://rmtc.fsdb.k12.fl.us/tutorials/whiteboards.html

SMART http://smarttech.com/

KEY TERMS AND DEFINITIONS

Electronic Pens and Markers: Tools which can accompany IWBs to be used to interact with the IWBs for navigation and writing purposes.

Gallery: A database of images, interactive media, backgrounds, games, videos available through the SMART Board™ Notebook.

Interactive Whiteboard (IWB): An electronic, interactive board which is either mounted or mobile.

Orienting: When the user specifically identifies the touchpoints from the IWB to the software system.

SMART Board™: A specific model of interactive whiteboard.

SMART Board™ Notebook: Software associated with SMART Board™ interactive whiteboards.

Touchpoint: An area pinpointed on the IWB which identifies where the uses is touching the interactive whiteboard.

DISCUSSION QUESTIONS

1. **What are some advantages of interactive whiteboards?** Discuss how they can adapt to all types of learners.
2. **How effectively do you use an interactive whiteboard for student learning?** Discuss personal perspective.

Chapter 20
Reading by Listening:
Access to Books in Audio Format for College Students with Print Disabilities

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ABSTRACT

Advances in technology have produced a variety of ways for students with a print disability to access written material through audio format: from Recording for the Blind and Dyslexic's pre-recorded books to text-to-speech technology, such as Kurzweil's screen reader. This chapter will describe the need for books in alternate formats, how they can be used, who the end users are, the pros and cons of various formats, where to access information about the technology available, sample products, and tips for their use. Note: The authors are not promoting or endorsing any specific technology, and received no reimbursement nor are affiliated with any of the products mentioned in this chapter.

INTRODUCTION

For many students, college is difficult. For students with print disabilities, either visual or learning disabilities, success in college can seem almost impossible. Luckily, there have been major advances in adaptive and assistive technologies that enable students with print disabilities to not only go to college, but also to be successful.

In this chapter, the rapidly growing field of assistive technology (sometimes called AT) for students with print disabilities is highlighted, briefly summarizing its history, benefits, and the rights of students with print disabilities. Additionally, we offer guidance for disability services personnel on how to access this technology, and provide readers with definitions of key terms as

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well as examples of the technology presently available, both for purchase and at no cost. It is important to note that since this field is growing so rapidly, a comprehensive review of available assistive technologies would be outdated in a very short time. Nonetheless, it is our intention to raise awareness of the myriad of *reading by listening* options for today's college students with print disabilities.

BACKGROUND

What is a Print Disability?

An individual is deemed to have a print disability if he or she cannot effectively read print because of a visual, physical, perceptual, developmental, cognitive, or learning disability (Wolfe & Lee, 2007). This means that a person with a print disability may have a visual impairment or a reading disability, or perhaps be unable to hold a book. A print disability is legally defined by the Higher Education Opportunity Act as "a student with a disability who experiences barriers to accessing instructional material in non-specialized formats" (Title 20 USCA § 1140k).

All students with print disabilities experience the same barrier—inaccessible materials—when the primary learning resource in their core curriculum is a printed textbook. Students who are unable to see the words on a page, hold a book or turn its pages, or who are unable to decode the text or comprehend the syntax that supports the written word may each experience a range of challenges, and they may each require various supports to extract meaning from the printed information; but the barrier for each is the same.

What is the Prevalence of College Students with Print Disabilities?

In the United States, there are 22 million people who are unable to read ordinary print. Of these, 7.7 million have a visual impairment and thus cannot see print, and 14.3 million possess a learning or cognitive disability that prevents them from being able to read effectively (U.S. Census Bureau, 2001).

The exact number of college students with print disabilities is not known, though an estimated 428,280 students with disabilities were enrolled in colleges in the United States in 1997-1998; almost half of whom were diagnosed as learning disabled (Skinner & Lindstrom, 2003). The National Center for Educational Statistics reported in 2006 that the number of students with disabilities in higher education doubled in a decade. According to the National Council on Disability (2003), nearly 10% of all undergraduate students enrolled in post-secondary institutions in the United States reported having disabilities, and of those, 11% had a learning disability or an attention deficit disorder.

Students with learning disabilities continue to be the majority of students receiving support through postsecondary disability services offices (Gilson, Dymond, Chadsey, & Yu Fang Hsu, 2007). Most of those students seeking accommodations for learning disabilities have reading disabilities (Hallahan, Kaufman, & Pullen, 2009). Although the literature about college students' use of assistive technologies is accumulating, the majority of writing and research in this field has focused on K-12 interventions (Male, 2003; Ulman, 2005).

What Purpose does Assistive Technology Serve for College Students with Print Disabilities?

Many individuals who do not have print disabilities enjoy the benefits of audio format technology that enables them to listen to books while driving, exercising, mowing the grass, or riding on a train. However, for individuals with print disabilities, the use of audio material is not merely a leisure time convenience.

If not for assistive technology that converts text to sound, the only way individuals who are blind can access printed books is through conversion to Braille or an audio reproduction of the book. But books converted to Braille are about double the number of pages of the original book (Braille Plus, Inc., 2010). Even more significant than the obstacle of Braille books being heavy and cumbersome, is the reality that only about 10% of legally blind children today are learning and using Braille (American Printing House for the Blind, 2007). As Bryant and Bryant (2003) noted, "For people without disabilities, technology makes things easier. For people with disabilities, technology makes things possible" (p. 2).

Although many college students with reading disabilities may not have benefited from access to assistive technology for reading, we cannot deduce that providing these resources is unnecessary. Students with reading disabilities often labor over written material--sometimes word by word-- and once they have decoded the words, they still have to decipher the meaning of the sentences and paragraphs.

All students are expected to read, absorb, and apply information that is assigned to them, with the assumption that they will benefit from this, regardless of whether reading printed material is a challenge or even an impossibility for certain students. It is therefore each college and university's obligation to provide equity by providing students with the opportunity to benefit from access to printed information. Caverly and Fitzgibbons (2007) asserted that it is important to view assistive technology as "a scaffold to support students with disabilities to extend their access to information, their abilities to convert that information to knowledge, and their communication of this knowledge to others" (p. 38).

Benefits of Reading while Listening

Although students with learning disabilities may have the ability to read, some may have reading impairments that render them unable to read at the pace that is required to keep up with college coursework. Others may be capable of reading rapidly, yet not processing or comprehending what they have read while reading it. When students use a screen reader to listen to what they are reading, each word is highlighted as it is read, giving the student the opportunity to see and instantly replay a word, get its syllabic break-down, click to see and hear its synonyms and definition, and even bookmark the word for future reference. Students who are blind also benefit from having the text version accompany the audio, as they can use these same features, as well as hearing the word spelled out.

Students with reading disabilities generally have deficits in phonemic awareness and analysis, word identification, reading fluency, and comprehension (NICHHE, 2000). Struggling readers can improve their comprehension, fluency, word recognition, and vocabulary through the use of text-to-speech engines, which allows them to hear words they may otherwise stumble over in the context of a passage, without disrupting the flow of comprehension (Silver-Pacuilla, Ruedel, & Mistrett, 2004). When unencumbered by the challenge of decoding, the reader who is listening to what he or she is simultaneously reading can focus more on the meaning of the text, and therefore comprehension is enhanced (Wise, Ring, & Olson, 2000).

Text-to-speech technology allows students to read while listening, which presents a bimodal (auditory and visual) experience that supports students in each of these areas. Researchers have found that a bimodal reading experience improves the reading comprehension skills of students with learning disabilities (Montali & Lewandowski, 1996); and particularly college students with learning disabilities (Raskind & Higgins, 1995). Further, text-to-speech software provides information both accurately, and at a potentially accelerated rate, allowing students to receive text information that is not impacted by their decoding ability.

Table 1. U.S. legal actions impacting the ability of students to gain access to assistive technology

Higher Education Opportunity Act (2008)	The 2008 amendments to this 1965 act defined Universal Design for Learning and established an advisory commission on accessible instructional materials in postsecondary education for students with print disabilities.
Rehabilitation Act (Assistive Technology Act, 2000)	Authorized in 1973 and last amended in 1998, this act brought about the Office of Vocational Rehabilitation. Section 508 of this act mandates that individuals with disabilities have access to all media produced and funded by the federal government (ATA, 2000).
Telecommunications Act (2004)	Widening the scope of Section 508 of the Rehabilitation Act, the 1996 Telecommunications Act enhanced accessibility to electronic media, including screen captioning, tagged descriptions of images on the web, and the development of the technology that enables access to web-based content for individuals with disabilities.
Assistive Technology Act (2000)	Also known as the 1998 Tech-Act, was the first piece of legislation to define AT, or AT. Its purpose was to provide federal funds to support the development of resources designed to improve individuals with disabilities' access to technology services and information. The Tech-Act further mandates that individuals with disabilities must have access to the AT necessitated by their disability and was amended in 2004 to support grants to states to address the AT needs of individuals with disabilities.
Individuals with Disabilities Act of (IDEA) (2004)	Signed into law in 1997 and amended in 2004, section 300.105 of IDEA states, "Each public agency must ensure that AT devices or AT services, or both… are made available to a child with a disability if required as a part of the child's…IEP." It was amended again in 2004 reemphasizing AT for students with disabilities.
Americans with Disabilities Act (ADA) (2008)	Signed in 1990 and amended in 2008, a key component of the ADA is the stipulation that for any individual whose disability substantially limits a major life activity, *reasonable accommodations* must be made. Today, providing books in audio format is acknowledged as a reasonable accommodation for students with a print disability.

Students with a reading disability who only listen to an audio version of a text might be missing out on opportunities to not only familiarize themselves with the printed version of words they will need to know for the course, but of potentially increasing their own reading speed by setting the screen reader's output at whatever speed they desire, and then following along with what is being read.

What Legal Rights do Students with Print Disabilities have to Access Assistive Technology?

Providing books and printed materials in audio format for students with print disabilities is not merely a supplement that colleges have the option of offering; this service is legally mandated, but colleges do have great flexibility regarding what type of service to provide. Congress has passed or amended several major pieces of legislation that have dramatically improved the civil rights of individuals with disabilities and insured access to both assistive and conventional technologies (Marinez-Marrero & Estrada-Hernandez, 2008). The landmark laws supporting individuals with print disabilities and summaries of how they have paved the way for increasing access to assistive technology are shown in Table 1.

For more information on these and many other education-related acts, go to www.wrightslaw.com.

THE EMERGENCE OF TEXT-TO-SPEECH TECHNOLOGY

Recording for the Blind and Dyslexic (RFB&D)

The first opportunity for students to have widespread access to books in audio format occurred in the middle of the 20th century through a U.S. Government-funded organization first called Recording for the Blind. It later changed its name to Recording for the Blind and Dyslexic, and, for 6 decades, was commonly referred to as RFB&D. The organization was founded to record college texts for World War II veterans who were blinded or visually impaired from war injuries. Providing them access to audio versions of written material enabled them to take advantage of the U.S. Servicemen's Readjustment Act of 1944 (G.I. Bill) (1944). For decades, volunteers for Recording for the Blind and Dyslexic have been reading and recording books for members and institutions to use. Initially recorded on cassette tapes, today, these recording came to be available on CDs or through downloads which can be saved as MP3 files. An annotated text version of the book, which can be converted into Braille, can accompany the book. To ensure copyright protection to authors and publishers, RFB&D established passwords and anti-duplication technologies to prevent widespread sharing and unauthorized distribution of its materials.

Today the target audience for conversions of text to speech has changed and, in response, Recording for the Blind and Dyslexic changed its name in 2011 to Learning Ally. The year prior, RFB&D reported that more than 75% of users were children and adults with reading disabilities (Hochman, 2010) But on its 2011 website, Learning Ally reported, "over the past year, we conducted research and focus groups with hundreds of students, parents, educator, volunteers, and funders," which revealed a diverse pool of members with a clear desire not be typecast or labeled—particularly since many are neither blind nor dyslexic. This shift in end users of books in audio format is not only a reality for Learning Ally, but for numerous organizations that were originally formed to meet the reading needs of the blind and visually impaired.

Kurzweil Readers

Among the most long-standing, well-known companies formed to serve individuals with print disabilities is Kurzweil Education Systems, founded in 1996. The company was formed more than 25 years after Ray Kurzweil first invented his text-to-speech reading machine, enabling users to scan text and have that text read aloud by a synthetic voice (Kurzweil Educational Systems, n.d.). The *Kurzweil 1000* was designed for people who are blind or visually impaired, while the *Kurzweil 3000* was designed for sighted students with a physical or learning disability. The Kurzweil readers, and others like them, act as *reading machines,* in that students can place any text on a connected scanner and the machine will scan the text, present it visually on the computer screen, and read what is written.

One drawback to the Kurzweil and similar systems is that they require scanning page after page of a book. Because this process can become tedious, it is common for college disability services personnel to order electronic copies of books directly from publishers at no additional cost. They merely need to verify that they are doing so for a student with a documented disability. Publishers who have the capacity will either send an e-text of the book on a CD or send a link to download the book in a PDF or other format. This can then be placed on a flash drive, which students can plug into a computer with the Kurzweil (or any other text-to-speech) software installed on it to hear the book read aloud by a synthetic reader. Using the *Kurzweil 3000* (and other similar products), a student can not only adjust the reading speed, but also change font and font size, magnify images, and vary the color combinations, which is especially helpful for sighted students with visual impairments.

Just as assistive technology has evolved, so have the *Kurzweil 1000* and *3000*. There is a USB version that allows students to carry the software with them and convert any computer to a "reading machine," and schools can also now buy a network version, and loan the software license each semester (Kurzweil Educational Systems, 2006). For institutions who purchase these innovations, students do not need to go to where the screen reader(s) may be located on campus; they can just use their own computers. Alternatively, students can save a text to an MP3 format (for an iPod, CD, or flash drive), and take advantage of the multiple options of hand-held text-to-speech devices now available. While earlier models and many low-cost versions of text-to-speech devices have produced rather robotic-sounding speech, recent improvements in digital speech technology have made listening to digitally-generated speech much more pleasing and easier to understand.

Digital Audio-Based Information System (DAISY) and National Instructional Materials Accessibility Standard NIMAS

As the world was beginning to shift to digital technology, libraries around the world began looking for ways to address the dilemma of replacing the soon-to-be outmoded analog cassette tape, which was how the vast majority of recordings had been previously preserved. An audio CD was an improvement, as CDs can hold about 74 minutes of audio. A recorded textbook, however, often requires between 13-20 hours to record (DAISY Consortium, n.d.). To overcome this difficulty, libraries collaborated to create an international standard for compressed audio data. Additionally, they searched for a way to allow users the ability to go straight to a desired page or chapter in both the printed and audio text. Finally, just as it is crucial for railroads to agree to a standard for a track gauge, it was of paramount importance to establish one universal standard for converting books to audio format.

It was from this quest that the Digital Audio-based Information System standard (often called DAISY) was created. The acronym DAISY stands for **D**igital **A**udio-based **I**nformation **SY**stem, and it refers to a technique for producing accessible and navigable multimedia documents synched with audio representation of the text (see Definitions at the conclusion of this chapter. DAISY is a globally recognized technical standard to facilitate the creation of accessible content. The global organization, called the DAISY Consortium, was founded in 1996 with the purpose that all published information be available to people who are blind or have print disabilities at the time of publication. Furthermore, it is the DAISY Consortium's goal that this information be available in a highly functional, feature-rich format, at the same price as the print version (DAISY Consortium, n.d.). Individuals converting a DAISY formatted document to audio can take advantage of other advanced features, such as bookmarking, skimming, keyword searching, annotating and navigation by chapters, sections, and page numbers.

Still, as the talking book was growing in popularity, there was no nationally coordinated standard in US America for converting text to audio format with acceptable navigability, particularly not for math and technical textbooks. The National Information Standards Organization (NISO), and the American National Standards Institute (ANSI), had approved the 2002 DAISY standard, but they sought improved features that would support the universal access to digital talking books. From 2002-2004, the National File Format Technical Panel, which was comprised of forty technology specialists, educators, disability advocates, and publishers, collaborated to create what came to be called the National Instructional Materials Accessibility Standard (NIMAS), based on the DAISY 3 specifications (NIMAS, n.d.).

In a landmark announcement for students with print disabilities, the U.S. Department of Education endorsed the National Instructional Materials Accessibility Standard (NIMAS) standard in 2004 at an event commemorating the 14th anniversary of the Americans with Disabilities Act (2008).

Officially published in 2006, this standard defines the format and content of the electronic file set that comprises a digital talking book (DTB) and also established a set of requirements for DTB playback devices. This new standard essentially mandated that all K-12 textbooks be produced by publishers in NIMAS format in addition to the traditional print format.

To further advance the accessibility to printed material by individuals with print disabilities, the U.S. Department of Education's Office of Special Education Programs tasked the non-profit Center for Applied Special Technology (CAST) with establishing two national centers to further develop and implement the NIMAS standard, and to provide technical assistance to publishers and manufacturers (CAST, n.d.).

Many product and publishing companies now refer to their compliance with both specifications as being "NIMAS/DAISY" compatible. Having these standards in place to guide the production and electronic distribution of digitally produced instructional materials, particularly textbooks, facilitates their hassle-free, inexpensive conversion to Braille, text-to-speech, and other accessible formats.

ACCESSING BOOKS IN AUDIO FORMAT

Obligations

Publishers are not directly bound by the civil rights laws, Section 504 of the Rehabilitation Act of 1973 or the Americans with Disabilities Act (ADA) of 1990, as they relate to educational access (Copyright Act of 1996). Postsecondary institutions, however, are. Colleges and universities have a legal obligation to provide effective access to all course materials to students with disabilities. In the case of printed or text-based materials, meeting that obligation typically requires providing materials in an alternate format.

Preparations

The first step in preparing to accommodate students with print disabilities is to develop a strategy for obtaining books in alternative text formats, as well as determining methods for converting those digital texts into audio format; which may include purchasing one or more relevant types of assistive technology devices, software, and/or hardware. This chapter provides examples of all of these, as well as ways to access assistive technology at no cost.

Given that most students buy printed, rather than digital versions of their textbooks, being aware of options regarding how to obtain those books in digital format is critical. While there are a growing number of third-party resources that provide such options, a small handful are most accessed by post-secondary disability services offices, including: Alternative Media Access Center or AMAC (www.amacusg.org), Bookshare (www.bookshare.org), and what was formerly known as Recording for the Blind and Dyslexic (RFB&D) and is now Learning Ally (www.learningally.org). While organizations need to pay a membership fee to access AMAC and Learning Ally, Bookshare is free for educational institutions, and purports to offer over 70,000 digital books, textbooks, periodicals, and assistive technology tools. Disability services personnel can easily enroll students with a documented print disability. Multiple students can use the same textbook through a copyrighted link to the school's network, accessible only by the students who have been authorized. Internet searches will also yield a treasure-trove of links to "how to" tips regarding Bookshare that have been created by school districts across the country.

Once the relevant membership(s) and technology have been obtained, it is important for all disability services personnel (and hopefully one or two staff members from the library as well) to try them out. It is very difficult to explain to a student how to use something you have never tried yourself, and a lot of confusion and frustration can be avoided by developing a good understanding of how things work. Those tasked with presenting the assistive technology options to students will also be much better equipped to do so having already had experience with each.

Reconnaissance

As soon as the college administrator coordinating disability services (hereafter referred to as "the disabilities specialist") is aware that a student is eligible for accommodations for a print disability, he or she should have a conversation with that student. For the purpose of illustration, this student will be called "Chad." Chad has a reading disability so we ask the following questions to determine the following:

- What has been Chad's experience regarding reading?
- Has he found that it takes him longer to read an assignment that it takes his peers?
- Has he struggled with decoding, fluency, vocabulary, or comprehension?
- Has he ever had accommodations for reading in the past?
- Has he ever used assistive technology? If so, what? What did or did he not like about it?
- Is he familiar with any assistive technology that presents printed material in an audio format?

Once these questions have been answered, the disabilities specialist should have a good idea of what Chad is familiar with and what he may or may not need or want. He or she should then present the options to Chad, including what would be provided by the school for free, as well as what Chad might want to look into purchasing on his own or downloading as a supplement to what the school has to offer.

The Easiest Way to Get Books

For his needs as a student, as well as for non-academic reading, it would be prudent for Chad to set up his own accounts with both Learning Ally and Bookshare. The sign-up process is explained on each organization's website. Both require that an "appropriate professional" complete a membership registration form and verification of a disability. These can be faxed or mailed to them, and within a few days, Chad will receive an e-mail providing him with a login and password for his individual Learning Ally and Bookshare memberships, which he can then access from any computer and download books. As an individual user, Chad can also access the free text reader software available to individual student members (*Victor Reader Soft* or *Read: OutLoud Bookshare* version or *ReadHear* for books accessed through Learning Ally).

Both organizations provide easy-to-use search options where students can enter the name or ISBN number of a book they are looking for and see if that book is available. If Chad is able to locate and download the book through Bookshare or chooses to order it on CD through Learning Ally, he will then need to use a screen reader program such as TextHELP's *Read & Write Gold*, SOLO's *Read: Outloud*, the *Kurzweil 3000*, or another screen reader so as to be able to see the text as well as hear it read aloud. (Note that Chad's classmates who are visually impaired might be more likely to choose *JAWS* or *ZoomText* screen readers.)

Ordering Books from Publishers

If the book is not available through Learning Ally or Bookshare (as is often the case, given the countless number of books and textbooks in existence), Chad might also try seeing if any of the books he is looking for can be found in the collection of 33,000 free eBooks from The Gutenberg Project by going to www.gutenberg.org. These eBooks are uploaded by volunteers, so the downloading format might be unpredictable, ranging from HTML to kindle to ePub, to a simple text format. This free eBook then can be read on a PC, iPad, Iphone, Kindle, Sony Reader, or other portable device. Note that there are dozens of websites offering free downloadable eBooks, but the odds of them offering books most college students need for their classes are rather slim. Finally, Chad can use the book catalog at www.blio.com. Blio has partnered with Baker & Taylor, the world's largest distributor of print and digital books, to provide eBooks in their original layout.

If none of these free options have the book(s) Chad is looking for, the next step is for Chad to purchase the book. He would then provide the disabilities specialist with the name of the book, the author, the publisher, and the ISBN number. Some publishers will also ask that the requestor be in possession of the book's purchase receipt, which is usually necessary when ordering books in alternate format from publishers.

One of the most convenient ways to locate the contact information for the publisher is through a publisher look-up service website that was created through a joint venture of the AccessText Network and the Association of American Publishers. The website is: www.publisherlookup.org and it was created to support students with print-related disabilities by helping college and university disability support services professionals find the correct publisher contact from whom to request electronic files of textbooks. Some publishers will provide an email address to which to send requests; some will provide an online request form, and others will simply say that they will provide permission to create an eBook, but that they fail to offer books in alternate formats.

An extensive list of alternate format content providers is also available at www.AltFormat.org. Both services are free. The downside is that not all publishers are currently willing and/or able to provide the books in alternate format, even in states with E-text Textbook laws. For those who do, it can take up to 6 weeks to receive the electronic text (which is generally in *.pdf* format). Some colleges and universities who need to procure a high volume of alternate format texts subscribe to the AccessText Network, which assists in keeping track of all books ordered and their recipients, and may, in some cases, be able to secure books more effienctly. To prevent Chad from being without an audio version of his book while waiting for the CD or download, the disabilities specialist should obtain reproduction permission from the publisher; then scan the first few chapters and put that on a flash drive for the student, which can then be read by a screen reader.

Do-It-Yourself Options

Considering that it is not always possible to procure a book in alternate format, a growing trend among postsecondary institutions has been to develop conversion capabilities and create their own alternate format books. The creation of the NIMAS and DAISY standards and the organizations that support dissemination of their technology have contributed to the ease with which schools who have the tools can now meet all of their students assistive technology needs in-house. At the University of Illinois, for example, Angella Anderson is a disability specialist and supervisor of text conversion who has been providing books in audio format for 18 years. Anderson reports that when she first started, student and community volunteers did all recordings on 4-track cassette tapes (personal communication, June 13, 2010). Most only read about 10 pages in an hour, so students who relied on the tapes were terribly behind in their reading. How far technology has come!

Some schools now not only produce their own alternate format books, but they share them with others. Susan Kelmer, adaptive technology specialist and coordinator of campus technology and educational support services of St. Louis Community College at Meramec produces over 100 books each semester and makes them available through the Alternate Media eXchange

(AMX) Database at www.amxdb.net. The AMX Database is a resource provided and maintained by the High Tech Center Training Unit for the California Community Colleges, but is available to all institutions of higher education within the United States. The intent of the AMX Database is to support cooperative production as well as use of materials produced to assist students with disabilities. Participation in the AMX Database is based on reciprocity; educational institutions must agree to the terms of use prior to using the system.

The High Tech Center Training Unit is a grant-funded resource provided through the California Community Colleges Chancellor's Office, and provides assistance and support to 114 California community colleges and satellite centers. This is one of a number of facilities across the county created to provide training and/or support for college faculty and staff wishing to acquire and improve skills related to assistive computer technology, alternate media creation, and Web accessibility.

One of the most challenging aspects of creating digital talking books for students with visual impairments is the handling of visual information, from graphs and tables to diagrams and math equations. This challenge is because information is frequently presented visually in the areas of science, technology, engineering, and math, or STEM. Because it is essential that STEM images are accompanied by detailed descriptions, guidelines for such images have been established by WGBH's Carl and Ruth Shapiro Family National Center for Accessible Media (NCAM), who undertook STEM research and subsequent dissemination efforts thanks to two grants from the National Science Foundation (NSF). Individuals and organizations can enroll to participate in educational webinars on STEM guidelines by contacting *stemdescription@mail4.wgbh.org*.

Meanwhile, there is hope on the horizon for more publishers to make their books available in alternate format. The American Association of Publishers has established an Alternative Formats Solutions Initiative that is collaborating with numerous stakeholder groups to develop practical solutions to current problems in the delivery of accessible materials.

ACCESSING AUDIO FORMATTED ASSISTIVE TECHNOLOGY FOR FREE

Until recently, none of the options for accessing printed material in audio format could be obtained without a substantial cost. That has changed dramatically, and individuals with print disabilities now have a variety of choices.

Bookshare

We have already discussed one of the most popular sites for accessing free books in audio format: www.Bookshare.org. Bookshare is a not-for-profit agency that serves individuals of all ages who have a print disability. Bookshare used to require a registration fee, but thanks to a grant, they have waived their registration fees and membership is now free for the next five years to any individual with a documented print disability. Unfortunately, it is sometimes hard to find books students need on their site, but it is still worth looking. Bookshare may also be used for downloading audio versions of newspapers, magazines, and novels.

Learning Ally, formerly Recording for the Blind and Dyslexic (RFBD)

Although membership in Learning Ally is not free to institutions, thanks to the U.S. Department of Education, and the support of private donors, Learning Ally's individual membership is now free to individuals with a documented print disability. According to their website (www.learningally.org), member benefits include:

- 24/7 online member services and phone support.

- Easy-to-use online catalog.
- Free access to the largest audio book library of textbooks and literature titles in the United States.
- Human-narrated audio books with descriptions of images, tables and graphs.
- Various audiobook downloadable formats, including DAISY and Windows Media Audio (WMA).

Note that users report pros and cons to having books read by actual people, rather than listening to synthetic speech. While some greatly appreciate the inflections and differing characters' voices that a talented reader might incorporate, there are also those who complain of books whose readers do not read as they would prefer, or that one person may start reading the book and another may take over. Some prefer the ability to adjust the speed with which text is read (which will alter a human voice, but not a digital voice), while others find it challenging to listen to synthetic screen reader voices.

Project Gutenberg

Unlike websites designed primarily for individuals with reading disabilities, Project Gutenberg was created to make ebooks accessible to all who sought them. They have no membership or requirements, and the books in their library are free because the copyright on all of them has expired. The books have all been digitized with the help of thousands of volunteers, and are in a variety of formats, including ePub, Kindle, HTML and simple text formats. Any of the 33,000 free ebooks in the Project Gutenberg's library can be downloaded to be read on a PC, iPad, Kindle, Sony Reader, iPhone, or other portable device. Project Gutenberg also provides links to other affiliates and resources to access an additional 100,000 free ebooks.

National Federation of the Blind Company Website and Software

After 30 years as an innovator in the field of print technologies, Ray Kurzweil has partnered with the National Federation of the Blind to form a company called K-NFB, and together they have created a much-awaited text-to-speech software called Blio, which can be downloaded for free at www.blio.com. Blio is not only a screen reader; it also provides a catalog for both free and paid e-books. Blio provides a very unique book-like reading experience, with print appearing on screen in its original book layout, complete with images and full color. Text can be resized, highlighted as it is read, and synchronized with lifelike voices using the Nuance Vocalizer. Users can select text and references and look them up through integrated Internet search engines. Blios' electronic books can even be annotated with notes (the eBook equivalent of writing in the margins). The downside is that, for now, Blio requires Windows and uses Microsoft's XPS format that can only be read by Blio software. (http://blog.the-ebook-reader.com/2010/10/06/blio-ereader-review-and-toshiba-book-place-too/#more-2796) Blio currently supports English, French and Spanish, and is slated to add Italian, German and Asian-language options.

Create-Your-Own

There are now a variety of ways to access free DAISY creation and reading tools. The DAISY plug-in for Microsoft Word will convert a correctly structured Microsoft Word document into either an XML file for further refinement or a complete DAISY book. It can be used with Word XP, Word 2003 and Word 2007, and can be downloaded from www.daisy.org/projects/save-as-daisy-microsoft. A second example is the Adaptive Multimedia Information System (AMIS), a free DAISY player that provides access to several DAISY book versions in a wide variety of languages. AMIS can be downloaded from http://daisy.org/projects/amis/.

Text-To-Speech Applications

Most people are unaware of all the accessibility options that come standard on computers. All Macintosh computers come with a text-reading feature built-in, and an application called VoiceOver that produces synthetic speech in 21 languages. Users can designate a "speech key" that can be pressed to read any highlighted text. A good way to hear the difference in voice quality capabilities is to compare Mac's newest voice for Leopard, "Alex," with other synthesized voices. Alex's voice is so human-like, you can hear dramatic pauses and what sounds like an inhalation before the start of a new paragraph. Non Visual Desktop Access (NVDA) is a free screen reader for Windows. The synthesizer is eSpeak. It reads Word, Excel, and even emails in Outlook (in HTML format). NVDA offers a variety of speech speeds and quality, as well as a dictionary for mispronounced words. The synthetic speech sound is mechanical, but the pronunciation is accurate. Their site is www.nvda-project.org/.

Free Downloads

With increasing frequency, students can access text-to-speech technology through either free trials, which many assistive technology products offer, or through freeware. Googling "Free text to speech" or some variation thereof will produce a multitude of samples, but some are better than others. It is best to download software that has already been tried out by others and rated in several places. Here are some examples of free text-to-speech options: *DSpeech, Natural Reader 9.0, Panopreter, Read Aloud, TTS Reader, Text-2Speech*, Adobe Reader 9, and too many others to list. Students can also send any document or text to www.iSpeech.org to have it converted to speech.

With free downloads, students will get very basic services and functionality, with lots of limitations. For those who would like to purchase text-to-speech technology, there are an almost overwhelming number of options to choose from in a variety of formats with many diverse features. There are text-to-speech (TTS) scanners with magnification to multilingual plug-ins, software contained in a 2GB flash drive, and hand-held devices that allow individuals to store up to 10,000 digital books in their pocket.

There are well over a thousand text reading assistive technology products on the market, and accessible through the Internet. From software to hardware, and from fully equipped computer/scanners to hand-held devices, it would take a large book to present them all. The following, therefore, is a relatively small sampling of well-known products that have either been touted by reputable assistive technology websites or blogs, or that numerous post secondary disability services offices have reported using. Table 2 represents a sampling of "reading by listening" products of all that is available.

Accommodation for Standardized Testing

Can a student receive modifications and use assistive technology during standardized and national tests, such as the college admissions test, the Scholastic Aptitude Test (SAT)? Yes, depending on the time available and the testers' determined necessity of the accommodation. Educational Testing Services (ETS), the publisher of the SAT, offers many options for its test-takers, but the process for getting approval takes at least seven weeks. In most cases, the evaluation and diagnostic testing documentation needs to have been completed within five years of the request for modifications. There are no fees for any testing modifications.

STUDENT DOCUMENTATION FOR DISABILITY SERVICES OFFICES

When disability services personnel receive documentation from a psychologist (in the case of a

Table 2. Sample assistive technology for college students with print disabilities

Free	**Blio** eReader by K-NFB. http://blioreader.com	Interactive screen reader Highlights words as it reads and also enables users to highlight and look up words and phrases and to input/save personal notes. Over 1 million free downloadable eBooks—others can be purchased.
Under $100	**EasyReader** Offered by Dophin. 30-day free trial available www.yourdolphin.com	Digital talking book player. Read while listening to highlighted words, navigate to any section of a book, change the reading voice, customize text and colors, search for words and phrases, and place digital bookmarks. Reads DAISY, NIMAS, HTML, and TXT.
	EasyOffice Premium http://easyofficepremium.com	An alternative to (and compatible with) Microsoft Office--at about 1/8 the price, it comes with a variety of accessibility features, including EasySpeaker (which converts text to speech), as well as EasyVoice (which converts speech to text).
	GhostReader, by Convenience Ware. 15-day free trial www.convenienceware.com	An easy-to-use multilingual reader for Mac with a wide choice of languages and highly life-like voices that can convert text from, HTML, PDF, and RTF documents, as well as news sites and emails, into a playable iTunes file. Can control how text is spoken.
$100 - $499	**Book Port Plus**, by the American Printing House for the Blind, Inc. http://tech.aph.org/	A compact, portable digital talking book player/recorder with enhanced navigation for large audio files. Has book playing capability for books obtained through NLS (National Library Service), Learning Ally, NFB (National Federation for the Blind), Newsline, and Bookshare. Lets the user take notes.
	BookSense, by GW Micro. www.gwmicro.com	The size of a cell phone, this screen reader plays audio files, reads multiple file formats (including DAISY), and has a built-in digital recorder. Enables access to digital talking books from providers such as the NLS, Bookshare, Audible, and Learning Ally.
	ClaroRead by Claro Software. www.clarosoftware.com	Multi-sensory software solution designed for users of any level of ability. Create read, view, scan, and check text using all the standard Microsoft Office applications and up to 20 additional languages. Includes scanning and Dragon (speech-to-text) echo features.
	gh Player, by *gh.* www.gh-accessibility.com	Feature-rich playback application that reads most file formats, as well as MathML-embedded books with enhanced navigation. Users can zoom up to 16x, pan the document, adjust color settings, set bookmarks, take notes, and select from six synthesized voices.
	Key to Access, by Premier AT. www.readingmadeez.com	As small as a pack of gum, this 2GB flash drive/MP3 player device renders any computer accessible. Includes e-text and pdf reader, talking dictionary, scanning software, and a voice recorder that allows users to dictate notes or record lectures and listen to them later.
	Read: OutLoud by Don Johnson. www.donjohnson.com Free tutorials and webinars.	The focus of 5 research studies, Read: OutLoud is the chosen text reader for every school in Indiana and Virginia. It reads nearly any text format, has an accessible Web browser, and has built-in study tools designed to enhance reading comprehension.
	Scan N Talk, by Turning Point Technology. www.TurningTechnologies.com	Documents are placed on the scanner, and the printed text appears on the user's computer monitor in large type, highlighting each word as it reads it uses AT&T Natural Voices.

continued on following page

Table 2. continued

	Victor Reader Wave, by Humanware. www.humanware.com	A compact CD, DAISY, and talking book player. Navigability to go to chapter, section, page, paragraph, or custom bookmarks. Audio feedback for controls and visual progress bar for reading position. Variable-speed playback with auto-pitch compensation.
$500-$1500 or more	**Intel Reader,** by Intel www.reader.intel.com	A book-sized device that uses digital camera technology to read any text you capture. Point, shoot and listen to printed text. Easy-to-locate buttons, audio and visual navigation, and straightforward menus. Will also play most content, including DAISY books, and MP3 or WAV music files.
	JAWS, by Freedom Scientific. www.freedomscientific.com Free demo and online training.	Distributed in more than 50 countries and in 23 languages, JAWS reads aloud what's on the PC screen, and is compatible with nearly all software and Internet applications. Human-like voices, Braille support, and 15 years experience working with Windows.
	K-NFB Reader Mobile by K-NFB Reading Technology, Inc. www.knfbreader.com	A collaboration of Ray Kurzweil and the National Federation of the Blind, this is a cell phone capable of taking a picture of any text (even currency), displaying a printed version on the screen, and reading it aloud, highlighting each word. Transfers text files to and from both computers and Braille note takers; and can store thousands of pages.
	Kurzweil 3000, by Kurzweil Educational Systems. www.kurzweil.edu	This well-known "reading machine" scans and reads any text with word-by-word highlights. Compatible with NIMAS, DAISY, MathML, Internet Explorer, Bookshare. Adjustable speed of human-like voices. Bilingual dictionary and thesaurus, plus note-taking and writing functionality.
	Read & Write GOLD by TextHELP. www.texthelp.com	Award-winning literacy support software that can scan, read text aloud and assist the student with writing using features such as: a phonetic spell checker, pronunciation tutor, word prediction, dictionary, homophone finder, voice recognition, and an Internet fact finder.
	ZoomText Magnifier/Reader, by AI Squared. www.aiaquared.com/zoomtext	Ideal for individuals with visual impairments, this popular magnification and screen reader software allows for numerous screen enhancements and enables users to magnify up to 36x with no distortion. It also highlights while reading aloud in humanlike voices. Free trail is available.

learning disability) or physician (for a student who is blind or has a visual impairment), that documentation will typically identify the diagnosis of the student's disability, show the results of any testing done, and propose recommendations for accommodations. This is most often the section of documentation that disabilities specialists pay attention to, as it is presents the kinds of assistance the student will likely be looking for. Sometimes accommodation recommendations for students with a print disability will suggest the need for "access to books in alternative format" or "use of screen reader technology" or another variation that indicates having printed material available in an audio format. If the evaluator is less familiar with advances in assistive technology, it is not uncommon to see an accommodation recommending the utilization of "books on tape."

Recommendations for students to have access to material in an audio format would typically be expected for students who are blind or who have severe visual impairments. But for students with a reading disability or a learning disability NOS (not otherwise specified), recommendations for accommodations are rather unpredictable. Some are extensive, while others are brief. Some evaluators call for every kind of assistance imaginable, while others make vague references to "any kind of support that would be helpful" for the student. What evaluators recommend may depend on how well they know the student, as well as how familiar they are with the types of assistive technology options available for students with a print disability.

There is no standardized checklist for evaluators' recommendations of accommodations. There are no guidelines mandating, for example, that "If the student scores a 79 or below in reading fluency on the Woodcock Johnson Battery III, you should recommend that the student have access to books in audio format." Without any required consistency in recommendations, it is therefore possible that two students with the same diagnosis and identical IQ test scores may have dramatically different recommendations for accommodations. Occasionally, the need for assistive technology in the area of reading is made evident by the documentation, even though there is no recommendation for such an accommodation.

We contend that, whenever possible, disabilities specialists should read all documentation thoroughly and provide necessary academic accommodations to students with print disabilities documented by their neuropsychological or psycho-educational evaluations; even if those accommodations are not specifically recommended.

ILLITERATE COMPUTERS: SYNTHESIZERS

Although speech synthesizers sound as if they are "reading words," they are actually not identifying words, but rather phonics and sounds. If their focus were on whole words, the software driving the synthetic speech would have to search a vast dictionary to find each word and then determine how that word should be pronounced. This would become highly problematic for words like cough, through, and dough. Instead, speech synthesizers follow a complex set of rules for phonetics. Practically speaking, the better the quality of the synthesizer, the more rules dictating patterns of speech, and thus the more correct and human-sounding the pronunciation (Cunningham & Combs, 1997).

Nonetheless, regardless of how advanced the synthesizer, listeners will always hear a somewhat mechanical-sounding voice. Yet most people who use screen readers regularly become accustomed to the synthetic sound and find that the flat voice better enables them to speed up the audio and listen at an extremely fast past.

Speech synthesis technology is one of the most powerful computer applications being used to assist individuals who are blind or visually impaired. It has also long been among the least expensive computer adaptations available, which has made it a widely used and invaluable tool for individuals with print disabilities (Lazzaro, 1993).

CASES

Case 1: Student with a Visual Impairment

Dan, a twelfth grader, has a visual impairment as a result of a head injury that occurred when he was in eighth grade. His formal diagnosis is cortical visual impairment with very little residual sight. Due to his becoming blind as a teenager, he has not really mastered Braille and relies on recorded material to read books.

His high school, in conjunction with high schools in other districts, bought the use of books through Learning Ally. Dan's books are ordered several months in advance and he also uses the speech synthesizer program on his computer to read assignments from his teachers. He has relearned how to type and uses programs such as Microsoft Word to turn in assignments, using his speech synthesizer to make corrections as he types. Dan plans on going to college, but wants to start at the local community college because he still needs some help with orientation and mobility issues in his town, and feels learning a new town and starting a new school would be too overwhelming at this time.

The local community college can access materials from Learning Ally, and also has access to recorded material from the American Printing House for the Blind (among many other places), and the disabilities specialist thinks he should start using the *Book Port Plus*, a portable audio player. Like other players, the *Book Port Plus* can play text at regular speed, but also can play text at 250-270 words a minute. This player can also read Microsoft Word and Powerpoint files from a flash drive.

At the Individualized Education Program (IEP) meeting--mandated by the U.S. Individuals with Disabilities Education Act of 2004--at the end of his eleventh grade year, Dan's parents requested that training related to the *Book Port Plus* be included for him as he prepares for college. His parents said they would purchase the *Book Port Plus* so he could keep it and be able to take it with him to college. The district agreed to provide him instruction on how to use the device, but would have to get training for the specialists and the teachers on how to add files to the device. Most likely they will hire a consultant who has been trained by the American Printing House for the Blind to come in and train Dan, his parents, and a few teachers in how to best use the device.

Dan is used to listening to material and not reading, and only really has a problem with notes. He records all his lectures, but in order to review them, he basically has to listen to each whole lecture again instead of just reviewing notes or sections of notes from the lecture. Dan has learned that, along with the search and navigation tools that come with the *Book Port Plus* is the ability to skim through the audible texts, just as a sighted person would.

Dan is excited about moving forward with a portable device, but also anxious about going to college. Luckily, the disabilities specialist has met with him already and discussed the services that will be provided. Dan and his parents realize there is a difference between the services provided in high school and those in college, but want to make the transition as smooth as possible and work to assist Dan in becoming as independent as possible.

Case 2: Student with a Learning Disability

Kate, who just finished her freshman year in college, has a specific learning disability in reading, and is starting to really feel the pressures of the unstructured time of life in college. In high school, the teachers were constantly talking about the need for good grades, the need to be a participant in high school activities, and the need to try and do well in either a sport or a musical instrument. She felt pressure then, but did not really participate in those activities because of a lack of time.

She was able to disguise her reading problems throughout high school, but now she runs out of time to complete her reading each day. Kate needs anywhere from three to four times the amount of time to read and comprehend an assignment as other students. As the work has increased, along with all of her other commitments, she often finds herself going to bed well after midnight. Her friends in the dorm come home after their various activities, quickly do their homework, and then spend time playing on Facebook and texting each other. Then they usually go out for a few hours. Kate does not have time to do those activities, and was on the verge of giving up in school. However, she really wants to do well in college to become a social studies teacher and show others that a student with a learning disability can be successful and be a model for others.

Kate's parents really did not have any idea how late she was staying up doing homework until she came home for spring break and just slept the majority of the week. Kate told them she was so tired because of her lack of sleep. Her parents thought she might be spending too much time going out to parties since her grades were only fair. Kate's parents sat down to talk with her about the lack of sleep she had been getting, and that is when she shared her struggles with how long it takes her to do the work. Her parents knew she had a learning disability, but saw that her grades in high school were pretty good and did not see the need to seek accommodations.

After spring break, Kate met with the disabilities specialist at the college she attends to find out about the disability services provided. She had tried to "not have a learning disability" in college but was starting to realize it was too much work for her and that she needed more time for tests and maybe even a note taker. She expressed that she just could not stay on top of all that was expected of her in the amount of time that she had.

The disabilities specialist suggested that Kate consider accessing her books in an audio format, and that the school had a *Kurzweil 3000* in the library. He also let her know that she could buy a portable device that she could keep. The two of them went on the Internet and researched all the various options for recorders and players. Like most teenagers, Kate already knew how to work an MP3 player and wanted something small and easy to use. Her parents wanted something that would not cost too much money. Kate has not decided yet what she intends to use. She was worried that she would be embarrassed if people see her using the *Kurzweil* in the library. But she also fears that listening to the audio recording might actually take longer than reading—though she did learn that it can be sped up. Still, she wonders if she would get used to the computerized voice. Kate knows she needs help, and dreads laboring over each word she reads, but wants to find out more and weigh all the options before she makes her decision.

CONCLUSION

Clearly, the area of Assistive Technology (AT) for students with print disabilities is evolving rapidly. We have attempted to identify issues that are currently critical, but we recognize that the information in this chapter will be outdated in the near future, as the size of the instruments decreases and the computer chip capability increases. Similarly, what is intended for students with print disabilities may become widely available to and used by the general public.

There are drawbacks and points to consider regarding reading by listening. First, not all books assigned by professors to be read are available through the publisher as a PDF, e-text, or MP3 file, and not all schools have the means to create their own alternate formats of printed books. Even when books can be obtained through the publisher, students have been encumbered by having to wait weeks for publishers to send copies of textbooks in alternate formats.

Second, scanning, using a NIMAS or DAISY converter, or recording another student reading a text, can be cumbersome and time consuming. With rapid changes in the adoption of college textbooks, there is an endless supply of new books to convert.

Third, Phillips and Zhoe (2003) found that 29% of students with disabilities abandoned the use of assistive technology for one of the following reasons: their needs changed, the devices did not meet their expectations, or they did not take part in selecting the device.

Finally, the diverse individual needs and personal preferences of students with print disabilities may make it difficult for colleges to find a "one size fits all" solution.

This chapter was designed to answer questions relative to the use of assistive technology for students with print disabilities, and we believe that we have offered some useful information, but the fact remains that there is a genuine paucity of research in the area. It is thus an area that is rich for future research, with the following questions as suggested options for possible research:

1. What resources exist for reviewing, validating, and reporting on new technologies for students with print disabilities?
2. What is known about the benefits/challenges of technology for college students with print disabilities?
3. How many students with print disabilities on college campuses access technology, and what are their preferences?
4. Can assistive technology for college students with print disabilities improve reading fluency, decoding, or comprehension?
5. What experimental research supports the use of technology for college students with print disabilities?

EPILOGUE

There are a multitude of options for students with a print disability in need of assistive technology in the area of reading. Yet students' needs and options will vary dramatically depending on a number of factors, such as what type of computer they may have, how easy it is for them to access the technology on campus, and the nature of their disability. In order to insure that students persist in using the device or software presented to them, it is critical that students play a role in selecting the technology that is right for them. The ideal is for colleges to offer a variety of assistive technology options that are not difficult for students to access.

Occasionally there are students with disabilities, particularly those with a reading disability, whose documentation (including psycho-educational testing results) reveal that they are eligible for an assistive technology accommodation, but who are not provided with any recommendations for their use. This technology should nonetheless be made available to them based on need.

Alternatively, there are also students who may be eligible for access to assistive technology, but who are not interested in availing themselves of it. Perhaps they do not feel it is necessary, they are embarrassed to use it, or they have found it to be too cumbersome. Or maybe they have merely grown accustomed to reading without listening, and don't want to try something new; and that is their prerogative. College offices of disability services need to recognize that it is not so much whether or not college students who are in need of this assistive technology use it, so much as whether they have access to it, are made aware of the options available (and their purported pros and cons), and provided the necessary training to use the technology.

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ADDITIONAL READING

Websites

Accessible Educational Technology. www.resna.org The website for the Rehabilitation Engineering and Assistive Technology Society of North America, it provides guidance regarding how to improve the potential of people with disabilities to achieve their goals via technology.

Alliance for Technology Access. www.ataccess.org A network of community-based resource centers dedicated to providing information on technology and support services to individuals with disabilities.

Association on Higher Education and Disability (AHEAD)'s E-Text Solutions Group: www.ahead.org/resources/e-text AHEAD is the leading professional association for postsecondary disability services offices. This section of their website provides information, trainings, resource links and networking opportunities to address assistive technology needs.

Axistive Assistive Technology. www.axistive.com The AAT News Portal offers free news, articles, product reviews and product and vendor information of over 1600 assistive technology devices.

Bookshare: www.bookshare.org In addition to providing free books, newspapers, and magazines in alternate format for individuals with print disabilities, it offers a useful list of reading tool products.

Center for Applied Special Technology (CAST). www.cast.org A not-for-profit organization whose mission is to expand opportunities for individuals with disabilities through innovative computer technology. Provides a wealth of information on Universal Design for Learning and NIMAS.

Closing the Gap. www.closingthegap.com This organization promotes computer technology in special education and rehabilitation. It offers a comprehensive list of assistive technology products (for a membership fee) and sponsors a popular annual conference in Minnesota.

Equal Access to Software and Information (EASI). www.easi.cc/clinic.htm Online training on accessible information technology for people with disabilities, as well as links to webinar archives.

Learning Ally. www.learningally.org A non-profit organization founded in 1948 and known, until 2011, as Reading for the Blind and Dyslexic (RFB&D), serving over 300,000 individuals with learning differences through a comprehensive volunteer-recorded library of over 65,000 books and textbooks. They also provide resources and training.

NCAM. (The Carl and Ruth Shapiro Family National Center for Accessible Media): http://ncam.wgbh.org Known for creating guidelines for STEM (Science, Technology, Engineering, and Math) images. Shares the media access findings of WGBH's research and development facility dedicated to addressing barriers to media and emerging technologies for people with disabilities in their homes, schools, workplaces, and communities.

NCTI (National Center for Technology Innovation). www.nationaltechcenter.org Along with providing information on products, services, and events, this website presents case studies depicting successful partnerships in technology research and development.

Blogs

Considering the rapid growth of assistive technology for students with print disabilities, as well as the bountiful number of access options, one of the best ways to identify what is current, available, a good investment, or even free, is by going to one of the many blogs devoted to assistive technology. Here are a few of them:

Accessibility at the Center for Learning Innovation (CLI). http://accessiblecli.wordpress.com/ With the slogan, "Adaptive technologies to improve accessibility," this blog's aim is to provide educators with up-to-date information regarding adaptive technology.

Assistive Technology. http://assistivetek.blogspot.com/ Blog by Professor of Education, Dr. Brian Friedlander on the topic of assistive technology, eLearning, mind mapping, project management, visual learning, collaborative tools, and educational technology.

Assistive Technology Blog. www.nfb.org/nfb/Assistive_Technology_Blog.asp This blog of the US National Federation of the Blind (NFB) primarily reviews AT products and relevant technology, like the iPad, as well as providing information on software being offered for free.

Note: Websites do change their urls, so you may need to use a search engine to find the sites.

KEY TERMS AND DEFINITIONS

Assistive Technology:: Broadly defined, any technology that persons with disabilities use in order to engage in tasks that might otherwise be difficult or impossible is an assistive technology. The formal, legal definition of assistive technology cited in the Assistive Technology Act of 1998 includes "any product, device, or equipment, whether acquired commercially off-the-shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities."

Speech Synthesis: The ability of a computer of other device to change text into spoken words using a "synthetic" male or female voice. It works by recognizing individual phonemes and identifying the pronunciation of them when combined with other phonemes.

Text-to-Speech (TTS): Software that uses speech synthesizers to receive information in the form of letters, numbers, and punctuation marks, and then "speak" it out loud in a computerized voice. Words are often highlighted as they are read.

Optical Character Recognition (OCR): Software that converts a scanned document into an editable text file. When this is integrated with speech synthesizing TTS technology, in enables any printed document to be read. One well-known example of this technology is a Kurzweil reader.

Screen Readers: Devices or software that that enhances TTS technology in its capacity to synthetically verbalize everything that appears on a screen, including text, graphics, control buttons, and menus; or to send the information to a Braille output device. In essence, a screen reader transforms a graphic user interface into an audio interface. Screen readers are essential for computer users who are blind, and a valuable tool for individuals with a print disability. Sample screen reader features to consider: 1) Multiple voice options; 2) Human quality voices; 3) Multiple voice languages; 4) Adjustable speed; 5) Numbers spoken as words or digits; 6) Navigability/Item finders; 7) Bookmarking and "Read from here" features.

Electronic Text (e-Text): Files that have been saved in a plain text format that can be opened on any computer (i.e. no formatting, or no html markup). They can be downloaded and opened using TTS-featured software programs. A Word document is not an e-text unless it is saved in plain text format.

eBook: A downloadable book presented electronically on a computer or mobile device such as an iPod, iPad, or Kindle Reader.

Audio Book: A book presented in analog or digital format on tape, CD, DVD, or in digital file format.

Talking Book: A book in analog or digital form with narration provided by paid or volunteers readers. This is the primary format of National Library Service for the Blind and Physically Handicapped (NLS) and Learning Ally (formerly RFB&D).

Digital Talking Book (DTB): A multimedia representation of a print publication created by a collection of digital files that may contain digital audio recordings of human or synthetic speech, marked up text, and a range of machine-readable files. DTBs adhere to the standard developed by the National Information Standards Organization (NISO), the American National Standards Institute (ANSI), and are compatible with DAISY 3, the version which meets the ANSI/NISO standard.

DAISY: Acronym for the Digital Audio-based Information SYstem developed by the International DAISY Consortium, founded in 1996. DAISY is a globally recognized technical standard or specification for producing accessible and navigable multimedia documents, such as Digital Talking Books, digital textbooks, or a combination of synchronized audio and textbooks. Books produced using the DAISY standard and reading software and devices equipped with DAISY technology provide the option of "eyes free" reading, enabling users to "audio-skim," and to navigate to pages, chapters, headings, keywords, and images.

NIMAS: The National Instructional Materials Accessibility Standard was published in 2006. With the endorsement of the US Department of Education, NIMAS guides the production and electronic distribution of digital versions of textbooks and other instructional materials so they can be more easily converted to accessible formats such as Braille and text-to-speech.

DISCUSSION QUESTIONS

1. **What is assistive technology?** Any product, device, or equipment, whether acquired commercially off-the-shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities. *Quandry:* With so many types of assistive technology available, what might be some reasons why students with a print disability would not use the most advanced options identified? (For example, why might a blind student use a book converted to Braille, rather than one in audio format?)
2. **What are some examples of assistive technology?** Assistive technology ranges on a continuum from low-tech to high-tech devices or equipment. Low-tech examples can include eyeglasses, a tape recorder, a cushion for better positioning, handheld magnifiers, large print text, using paper and pen to communicate, or specialized pen grips. Mid-tech examples can include talking spell checkers, electronic organizers, larger computer monitors, alternate keyboards, and books on tape or CD. High-tech examples can include prosthetic devices, digital hearing aids, augmentative communication device, voice activated telephones, and digital books. *Quandry*: Consider a scenario whereby an assistive technology solution is either too high or too low tech for an individual's need. What might be the disadvantages of such a scenario?
3. **What are some reasons why an individual might need assistive technology (and what technology might they use)?** Some examples are shown in Table 3. *Quandry*: What other examples can you come up with?

Table 3. Sample circumstances and possible solutions

Circumstance	Assistive Technology
mobility impairment	cane, walker, basic wheelchair, motorized scooter
limited hand function	a keyboard with large keys and a special mouse and/or speech to text (dictation) technology
speech impairment	computer or device that speaks aloud what is entered into a keyboard

4. **Why is it important to be aware of assistive technology options with regard to individuals with print disabilities?** Assistive technology has the potential of significantly improving the lives of individuals with print disabilities by providing them with access or augmented access to information, and by contributing to their ability to learn and acquire information, to obtain a job, to be independent, and to improve their quality of life. *Quandry*: Do you or do you know anyone who uses assistive technology? What would be the consequences if this technology were taken away?

Chapter 21
Integrating Accessible Multiplication Games into Inclusive Classrooms

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ABSTRACT

Two accessible games were the focus of a study involving inclusive fourth grade classrooms in a suburban Chicago elementary school district. The games were created using software with universal design capability and were designed to teach multiplication facts. Data were collected that compared the classes using the software with classes that did not use the software. The statistical analysis used in the design of the study was analysis of covariance using a pretest assessment of multiplication facts as the covariate. Students used the games twice a week for four weeks during a period of 40 minutes a day. Results indicated a gain in accuracy of multiplication facts on the part of the groups using the games, but not enough to demonstrate significance. In addition to the analysis of covariance analysis, selected classes filled out surveys designed to measure the students' opinions of the games and their effectiveness. Results of the surveys indicated that the students were somewhat unsure about their effectiveness as a tool to learn multiplication facts but found them enjoyable to play. Interpretation of both of these results is provided.

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INTRODUCTION

Several recent educational initiatives have resulted in the inclusion of students with disabilities in standards-based instruction and standardized assessments (Anderson & Anderson, 2005). Standards-based instruction developed primarily during the 1990s when national teacher organizations developed academic standards. Students with disabilities became increasingly involved with standards-based instruction and assessment, culminating in the passage of the Individuals with Disabilities in Education Act of 1997 that required students with disabilities be included in standardized assessments (Bottsford-Miller, Thurlow, Stout, & Quenemoen, 2006). The passage of No Child Left Behind (2001) further required that not only must students with disabilities be included in standardized assessment, but the law also demanded successful results by these students. This movement has made it necessary for the field of education to develop a system for making curriculum universally accessible for all students, including those with disabilities. Indeed, the most recent iteration of the Individuals with Disabilities in Education Act (H.R. 1350, 2004) advocates that instructional materials be developed using principles of universal design.

Technology is a useful tool in assisting in the development of universally designed curriculum. Several software tools have been developed with the intent of promoting an accessible curriculum. This study took advantage of the accessible authoring capabilities of one of these tools, Intellimathics (2003), to create and study the effectiveness of two multiplication games that were developed and used in four inclusive fourth grade classrooms.

BACKGROUND

In 1983, the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983) led to a national push for accountability in teaching. In 1989, President George H.W. Bush and the governors of the 50 states developed a set of national educational goals that would become the Goals 2000: Educate America Act (H.R. 1804). This act required greater accountability based on higher academic standards. Professional teacher organizations in each content area set out to develop their own lists of standards, designed to be the backbone of standardized assessment development and the foci of each field in its attempt to develop future problem-solving workers. Individual states, in the meantime, adapted and adopted these lists of academic standards into their own under the direction of the Goals 2000 initiative and with the assistance of the initiative's funding (Anderson & Anderson, 2005).

At the same time, the field of special education began to question its effectiveness and its parallel programming as being too separate from general education (Wang, Reynolds, & Walberg, 1988, Behrman, 1992). The resulting self-questioning led to a movement towards inclusion of students in the regular classroom (Fuchs & Fuchs, 1994), requiring that the education of students with disabilities become a joint responsibility between general education and special education. As inclusion progressed, students with disabilities were also increasingly included in standardized assessments, culminating in the passage of Individuals with Disabilities in Education Act of 1997, requiring that all students with disabilities be included in all standardized assessments with the exception of the bottom two percent of those identified as disabled who were required to be assessed in an alternate capacity using the states' academic standards. No Child Left Behind (2001) finalized the process, declaring that special education is a subgroup of those students taking standardized assessment who are also required to be achieving acceptable levels in reading and writing by 2013-14 (Anderson & Anderson, 2005).

A recent development that benefits both the inclusion movement and the high stakes assessment movement for students with disabilities is the initiative called universal design for learning. This movement, named after the architectural initiative called universal design, involves changing teaching methods and materials to make them accessible for all students including those with disabilities (Rose & Meyer, 2002). Universal design for learning may or may not take advantage of technology. However, many software developers and researchers are taking advantage of the characteristics offered by technology to help make teaching accessible for all, including standardized assessments. Examples of universal design for learning include: enabling text to speech synthesis so that materials can be read by the computer (Lance, McPhillips, Mulhern, & Wylie, 2006), including links in documents to graphic organizers that can further describe the reading selection (Boone & Higgins, 1993), and making software accessible to alternate input devices (Burgstahler, 2010). Incorporating these techniques is designed to make the general education curriculum and its use of standards-based, high-stakes assessments accessible to all students. Since the passage of No Child Left Behind (2001), students with disabilities must achieve a successful score on state assessments. Thus, finding accessible curriculum to be used by all students for these assessments becomes the goal of all education professionals.

This chapter outlines the results of a study that was funded by a university summer research grant. The research incorporated games that were designed to address one of the academic standards, multiplication facts, and were developed using an authoring software that was designed to be accessible to all students called Intellimathics (2003). Developed by Intellitools, Intellimathics is part of a suite of programs with built in features that comply with many of the Universal Design for Learning principles for accessible instruction (CAST, 2010). The program features text-to-speech synthesis and is designed to interact with an alternative input keyboard such as Intellikeys. The software includes a series of math tools that are computer versions of manipulatives that some students with disabilities are not able to use when presented off the computer. The program includes dice, spinners, flipping coins and several other math tools such as counting boxes and sorting boxes. Developers can build their own menus so that users can use the menus to respond to activities, navigate, or do other activities that the designer creates. These tools were used to build the games that were the focus of the research in this study. Thus, two multiplication games were created using this universally-designed software and its manipulative tools and were used with inclusive fourth grade classrooms. This study relates the results of the research.

REVIEW OF LITERATURE

Effectiveness of Technology on Mathematics Achievement

The National Council of Teachers of Mathematics has encouraged the use of technology when teaching, including it in their six principles of learning mathematics (NCTM, 2000). Several studies have examined and documented the effectiveness of using technology when teaching mathematics. Several other studies specifically looked at the effectiveness of the use of technology with students who experience difficulty in learning. This review of literature will describe relevant studies in each of these areas.

Math Instruction Using Computer-Based Tools

Several studies have researched the effects of technology integration into mathematics instruction in the classroom. Most demonstrated improvements in achievement. Several of these studies looked at specific instructional software programs while others looked at instructional systems that include mathematics. Some studies focus on researching mathematics software games. Overall, most demonstrate the effectiveness with significant results.

Sedig (2008) studied the effectiveness of a game called *Super Tangrams* (1998). *Super Tangrams* permits students to affect transformations on tangram pieces to make them fit correctly into a suggested pattern. Three levels of increasingly independent play are provided with scoring based on the number of moves needed to match the figure. Assessment measures involved a pretest-posttest of tangram matching, as well as a survey about this method of learning mathematics. The students were divided into three groups receiving varying levels of scaffolding by teachers. All groups achieved significant changes in their scores and knowledge of transformational geometry, with some score variance caused by teacher intervention. Survey results on the games suggested that students found the learning process engaging.

Dynarksi Godini, Heaviside, Novak, Carey, Campuzano, Means, Murphy, Penuel, Javitz, Emery, and Sussex (2007) studied the effectiveness of several learning systems, including PLATO Achieve Now, and iLearn Math, on sixth and ninth graders. The students were placed in nonrandom groups, with technology or without technology. Researchers used multiple measurements including classroom observations, teacher surveys, interviews, and student achievement scores as measured by a standardized test. A mixed method of quantitative measures and interviews were used with multivariate analysis of covariance to analyze the data.

The mathematics instruction portion of the software consisted primarily of tutorial, drill-and-practice computer activities. The study found that the classes that used the learning systems showed no significantly higher test scores than those not using the software. No significant improvement was found in the motivation of either group. Prior knowledge, computer and English language skill was not found to have significant roles in achievement and motivation of the experimental group.

Schoppek and Tulis (2010) hypothesized that the computer could be an effective tool for increasing the fluency of basic arithmetical operations as a precondition for increasing mathematical problem solving. To achieve individualization of practice as a means to increase problem-solving efficiency, the researchers developed adaptive software that was used with third-grade classes. The software, *Merlin's Math Mill*, selected problems, provided feedback, and adapted instruction to the needs of the students. The authors evaluated the application of the software in two studies with nine third-grade classes, using typical classroom situations, as the researchers were interested in studying the effectiveness of their software as a tool exhibiting minimal disruption in an ordinary classroom. In two separate experiments, elementary students using the software showed significant gains over control groups through all ability levels. Results demonstrated that computer-based, individualized practice was associated with large improvements of arithmetic and problem solving skills, even after a follow-up period of three months.

Miller and Robertson (2010) investigated the effects of an off-the-shelf computer game designed to reflect Kawashima's theory of mental mathematics based on Kawashima's theory on children's mathematics skills (Kawashima, 2005). A second measurement of change in this study was a measure of the students' perceptions of their math skills. A pre–post design was employed with three groups. One group used a Nintendo DS™ program, *Dr. Kawashima's Brain Training Game*, for 20 minutes a day. The second group used *Brain Gym,* another program based on Kawashima's theory for 20 minutes a day. The third group was a control group. The participants were 71 primary school children (10–11 years old) from three classes. The treatment period lasted 10 weeks. Significant pre–posttest gains were found in the *Brain Training Game* group for both accuracy and speed of calculations. Results for the two comparison groups were mixed, with the *Brain Gym* demonstrating nonsignificant gains and the control group demonstrating significant gains. Both comparison groups increased their ability for mental calculations. The *Brain Training* group also showed significant gains in global self-esteem, but not in other aspects of self-concept.

In Chang, Lin, Ching, Cheng, Chang, Chen, Wu, and Chan (2010), an effort to measure the potential of a one-to-one wireless classroom used mathematics software as a practice tool. Using *EduBingo* (2010), a drill and practice program for a variety of mathematics problems including fractions, multiplication, and division, the researchers found that the game increased mathematics fluency and students' attitudes towards mathematics in elementary classrooms.

Kebritschi, Hirumi, and Bai (2010) studied the effects of a mathematics computer game, DimensionM, on algebra and pre-algebra students' achievement and their motivation for mathematics. They also investigated the role of students' prior mathematics knowledge, computer skills, and English language skills on their achievement and motivation as they played the game. Using a multivariate analysis of co-variance to analyze motivation and achievement and follow-up interviews, researchers randomly assigned 193 students and 10 teachers to experimental and control groups. Significant achievement improvement was found for the experimental group. However no significant improvement was found in motivation for algebra for this group when compared to the control group. Researchers found that prior knowledge, computer skills, and knowledge of the English language skill did not appear to play significant roles in achievement and motivation of the experimental group.

Mathematics software has been found to be successful when used to increase students' mathematics skills. Success has been achieved with off-the-shelf software, researcher-designed software, and instructional systems. Mathematics games have been found to increase achievement scores as well as improving engagement of students. Thus computer software has been shown to be effective as a tool in the instruction of children.

Math Instruction Using Computer-Based Tools for At-Risk Students

Several studies have looked at the effectiveness of using computers to teach students who are at-risk of learning difficulties in mathematics. Results have been mixed with most studies demonstrating a successful effect on mathematics achievement. Research studies in this section included computer-assisted instruction, specially designed software, and digital games.

Studies generally support the success of using computer-assisted instruction with students with disabilities in mathematics. Bahr and Reith (1991) measured the effects on achievement scores of students with mild disabilities on single-digit subtraction and multiplication facts while using computer games. They looked at students using these games in different goal structures: cooperative, competitive, individualistic and no goal structures. Results indicated that while the goal structures did not significantly affect score differences, all groups improved their achievement scores significantly with the use of computer-assisted instruction. Gleason, Carnine, and Boriero (1990) studied the effects of computer-based tutorials to train students in story problems. In this study, researchers compared the computer-supported instruction to teacher-supported instruction. Achievement levels increased for both groups of this computer-assisted instruction study.

Seo and Woo (2010) investigated user interface design features and implementation guidelines of computer programs in mathematics for students with learning disabilities. Identifying several recommended features and guidelines, a computer-assisted instruction program called *Math Explorer* (2007) was developed. *Math Explorer* provided instruction in addition and subtraction for students with learning disabilities at the early elementary level. Results of the usability study supported the assumption that the user interface design features and guidelines in mathematics software programs do impact and improve the mathematical learning of students with learning disabilities.

Shirvani (2010) evaluated the assumption that lower-achieving students would benefit from the use of computers in their classrooms. The researcher divided six introductory algebra classes into three experimental and three control groups. Results of the study found that the lower-performing students who used computer software in their classrooms significantly outperformed other students who had no access to computer-assisted instruction. On a measure of attitudes towards mathematics, this study found that students with computer-assisted technology had better attitudes towards mathematics.

Mautone, DuPaul, and Jitendra (2005) used a controlled case study to investigate the effects of computer-assisted instruction on the mathematics performance and classroom behavior of three elementary students with attention deficit hyperactivity disorder (ADHD). During the study, results demonstrated that use of computer assisted instruction increased participants' mathematics achievement and reduced their off-task behavior. In addition, students as well as teachers indicated that they felt that computer-assisted instruction was an acceptable intervention for students with attention deficit hyperactivity disorder who have problems learning mathematics.

Fuchs, Fuchs, Hamlet, Powell, Capizzi, and Seethaler (2006) investigated computer-assisted instruction as a tool to build number combination skills among at-risk first graders with mathematics and reading problems. Using computer-assisted instruction that flashed number problems on the screen with the timing adapting to accuracy rates of the students, students filled out pretest and posttest measures appropriate to first grade number sense goals. Using spelling software with a similar instructional design, a second group examined the effects of computer-assisted instruction on this subject area. The spelling group was selected to serve as a control group, assessing the effects of the computer-assisted design in a different area. The results indicated that mathematics computer-assisted instruction was effective in promoting addition but not subtraction skills and that transfer to arithmetic story problems did not occur. The spelling computer-assisted instruction found similar gains.

Irish (2002) designed a computer-assisted instruction program that trained students to use mnemonics to solve multiplication problems. She looked at the effects of the implementation of the software combined with regular classroom instruction on multiplication facts with students with learning disabilities and cognitive disabilities. Irish also measured how the effects of computer-assisted instruction transferred to pencil and paper tasks. Using a single subject design with computer sessions lasting 20 minutes with a classroom review of five to 10 minutes, mnemonic devices were taught one at a time. During the baseline period, students would complete an evaluation event called a *Real Quiz* two or three times per week but received no computer-assisted instruction intervention during that time. During the intervention period, when students interacted with the software, students took a *Real Quiz* at the end of each software use. Following the intervention period of two weeks, students returned to the baseline, taking a quiz two or three times per week but not using the software. Electronic quizzes and paper and pencil probes were used to measure accuracy. Results indicated that five of the six students demonstrated improved accuracy on the electronic quizzes, while all six students demonstrated increased accuracy on the paper and pencil probes.

Ota and DuPaul (2002) investigated the effects that computer games have on the mathematics performance of children diagnosed as having attention deficit hyperactivity disorder. In the study Ota and DuPaul found that computer games allowed the students with attention deficit hyperactivity disorder to focus more closely on mathematics. All students in the study decreased their off task behaviors during computer-based mathematics instruction. The subjects also increased the number of digits correct per minute as a result of using computers. Ota and DuPaul credited the improvement in the students' achievement and increased on-task behavior to the computer games, because the games covered the content, was stimulating, and provided immediate feedback.

As with heterogeneous-ability classrooms, mathematics software use has been successful for students at-risk for learning mathematics. Researchers demonstrated that tutorials were successful with students with learning disabilities. Other researchers demonstrated that computer-assisted instruction was successful for a variety of exceptionalities. Games were found to be both engaging and beneficial for students at-risk for learning problems in mathematics.

Research Questions

The study that is the focus of this chapter researched two games that were designed for all students including those at-risk for mathematics disabilities. These games were developed with universally accessible software, so they were usable by students with a variety of disabilities. The specific research questions that were the focus of this study are as follows:

1. Did the computer software improve the students' ability to solve multiplication fact problems when compared to peers who did not use the software?
2. Did the students feel that the software was effective for them?
3. Did the students who used the games find them engaging?

METHOD

Participants

Students involved in the study were fourth graders in a suburban Midwest school district. Four classes served as the four treatment groups while three served as the control groups. These classrooms were part of a district that is diverse and inclusive, with a special education population of 18 percent. Students with disabilities were not excluded from the study. The study included 30 boys and 39 girls in the experimental group and 26 boys and 32 girls in the control group. The experimental group included nine African American girls and eight African-American boys, twenty-eight Caucasian girls, twenty Caucasian boys, and two girls and two boys making up other minority groups for a total of sixty-nine students. The control group had seven African-American girls and six African-American boys, nineteen Caucasian boys, twenty-one Caucasian girls, and three boys and two girls making up other minority groups for a total of 58 students.

Materials

This study was designed to study the effectiveness of two accessible multiplication games developed by the researcher. These games were developed with an authoring software, Intellimathics, a program that is part of Classroom Suite by Intellitools (2003) that has built-in universal design features. One game was a baseball game while the other game was a Bingo game. Because each game was developed using Classroom Suite, the games were accessible to students needing alternative inputs other than the computer keyboard, such as an Intellikeys (Intellitools, 2010) or a single switch. Classroom Suite allows the development of menus and buttons that can be accessed using these alternative inputs. Classroom Suite also utilizes text-to-speech, a feature that assists students who cannot read (Boone & Higgins, 1993). For students who have reading difficulties, the text of the games, such as the directions and the numerals on the Bingo game, would be read, providing a scaffold for the students.

The Bingo game was designed to reinforce multiplication facts from zero to 12. The game provided a menu designed by the developers that permitted the user to access a page with the game's directions, a page with a multiplication fact chart for assistance, and buttons that added playing pieces and clear the board of playing pieces (Figure 1). A second menu bar at the bottom of the game placed the answers to multiplication facts randomly on the two Bingo cards of the two players (Figure 1). Programming in the game was designed to place these numbers randomly from lists of the products (Figure 1).

To play the game, two opponents first pressed their respective buttons that were designed to build their playing cards. These buttons filled each player's Bingo card with random multiplication products (Figure 2). Next, each player repeatedly pressed their respective buttons designed to add playing chips. These buttons dropped small circles into a square assigned to each player. These small circles acted as the chips that were dragged over the numbers on the Bingo card.

To begin the game, each player spun a spinner to determine who went first. The winning player then pressed a button labeled "Draw Cards." This button dropped two playing cards into a square at the center of the playing screen. These two numbers were the numbers that the player multiplied in order to find the product. If the player's response was correct, both players covered that answer on their respective BINGO cards. If the player's response was incorrect, the opponent had a chance to state the answer. If correct, that player covered the number on his or her BINGO card. The incorrect player did not get to use his/her BINGO card on that turn. Play then progressed to the opponent. The conclusion was the same as the standard BINGO game with the winner declared as the person with chips extending across or diagonally. The multiplication chart would be used to settle disputes about correct responses.

The multiplication baseball game followed the rules of baseball as much as possible. Each student had nine ball players represented by baseballs that could be added by the student using a button on

Figure 1. Multiplication bingo game board

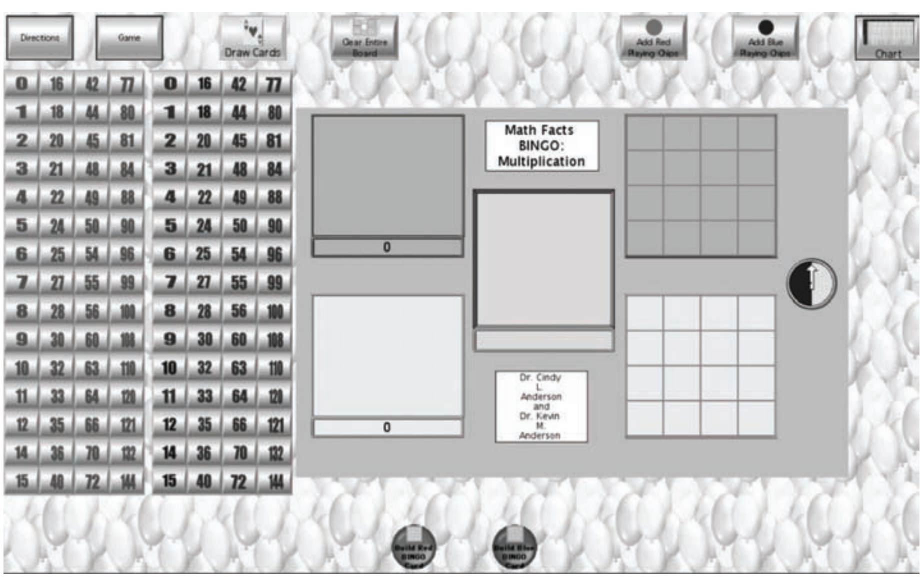
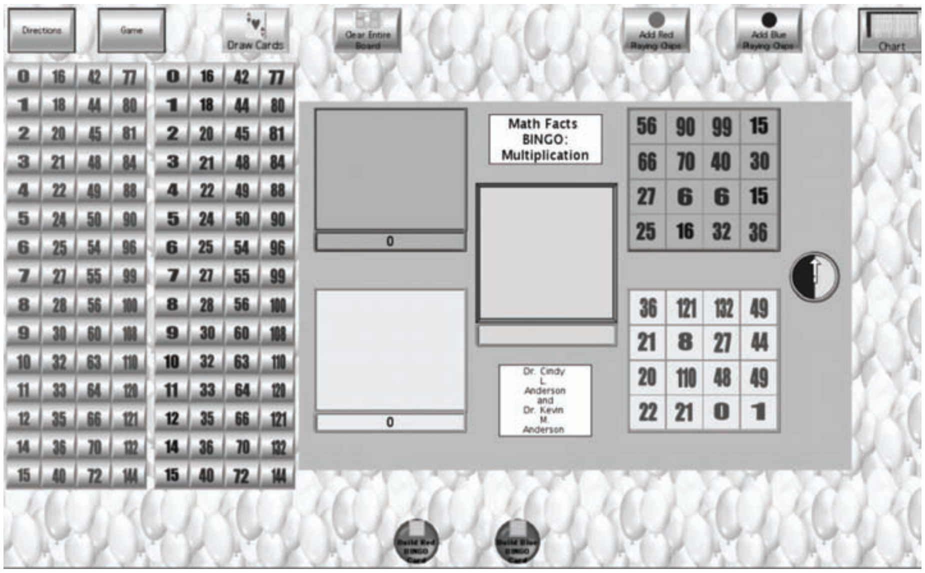


Figure 2. Multiplication bingo with playing cards filled



the menu (Figure 3). A quarter, which is an accessible tool of Classroom Suite designed to be flipped on a mouse or alternative input click, was activated to determine who was the first player at bat. When a player was at bat, he or she pressed a button on the menu to release playing cards that would be multiplied to determine how far or if his player was able to advance. An incorrect response was an automatic out. For a correct response, the answer would determine how far the player would advance. However, before the player could advance, the opponent had the opportunity to

Figure 3. Multiplication baseball game board

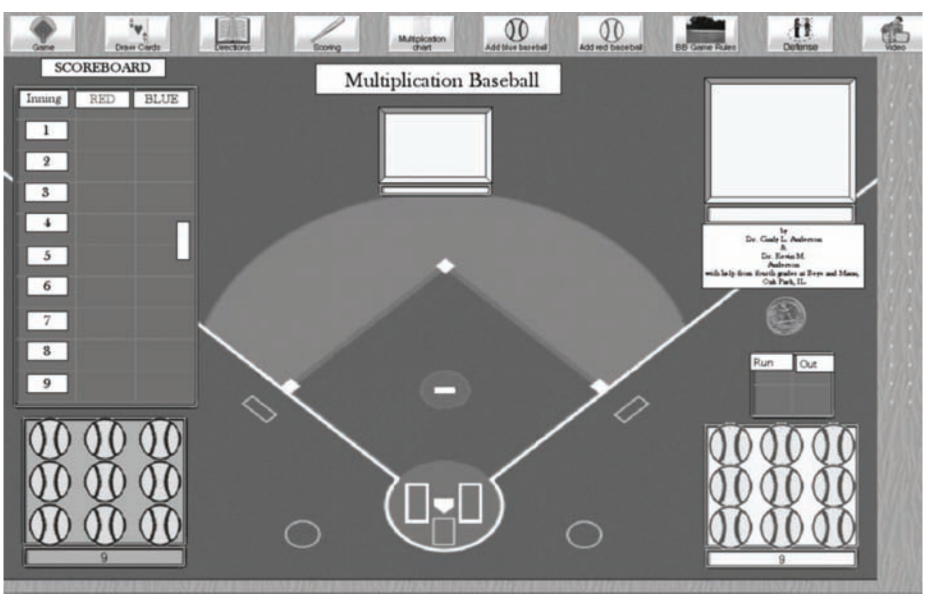


Figure 4. Multiplication baseball with players on base

press the "Defense" button (Figure 4). This button randomly placed a happy figure or sad face on the playing field. The happy figure meant that player could advance. The sad face was accompanied by an explanation of an out situation in baseball, and the batter was declared out (Figure 4). The latter feature kept the second player involved in each play and allowed the game to more closely resemble a true baseball game, both in play and score. However, in case the random elements in the game failed to allow each player a reasonable length of time at bat, as in t-ball, the game had a run limit per inning built in.

The multiplication baseball game had a few additional features. The game included on the menu bar many buttons to both play the game and to assist the person playing the game. The buttons were as follows:

- Directions of the game;
- Scoring directions;
- Standard baseball game rules for those players not familiar with baseball;
- Multiplication chart;
- "Defense" button;
- "Drop cards" with the numbers to be multiplied;
- Place players on the field;
- Access a video explaining how to play the game; and
- Return the player to the game screen (Figure 4).

The game screen had several other features. There was a small scoreboard for keeping score during an inning, with a larger scoreboard for the game. The game had a background that was an image of a baseball diamond. There were squares allotted for storing the players who were represented by baseballs, a box for the cards to be multiplied, and a box for the "Defense" button to drop its selection into (Figure 4).

The two multiplication games were used as the instructional materials for practicing multiplication problems with the experimental group during the study with the pre and posttest used as measures of assessment. The control group simply received the pre and posttest with normal classroom instruction in math during the test period.

Procedure

This study took place during one four week period in spring of 2009. During this time, the experimental classes met with the researcher twice a week for 50 minutes. Students first took a one minute timed pretest of 50 random multiplication facts. Next, the students were instructed in the directions of the game. Then researchers met with the experimental classes twice a week for 40 minutes to use the multiplication games for a period of four weeks. First the Bingo game was used for two weeks and then the baseball game was used for the following two weeks. At the conclusion of each of the individual games, students were asked to fill out a survey indicating how they felt about the games. At the end of the experiment, the students were given a posttest of 50 randomly selected multiplication facts. The control groups were given the same pretest and posttest of multiplication facts.

Statistical analysis used in the study was analysis of covariance, with the pretest acting as the covariate for the groups. Students' opinions of the games were measured using a Likert survey with results transformed to numerical data and reported as means.

RESULTS

To answer the first research question "Did the computer software improve inclusive students' ability to solve multiplication fact problems when compared to peers who did not use the software," the researcher used a one-way analysis of covariance comparing the experimental group with the control group. The dependent variable was the score on the multiplication fact posttest, while the covariate was the score on the multiplication pretest. Descriptive statistics can be found in Table 1. Conditions for the analysis were met with the homogeneity of the regression effect being nonsignificant for the covariate, and the covariate was linearly related to the dependent measure (see Table 2). Analysis of covariance statistical analysis results are reflected in Table 3.

The analysis of covariance was not significant, $F(1, 123) = .02, p = .89$. While not significant, the evidence shows the trend toward significance. The respective mean differences between pretest and posttests were larger in the experimental group; 1.91 for the experimental group and 1.69 for the control group. Both groups demonstrated gains during the period of the study, resulting in nonsignificant results on the analysis of covariance. The experimental group and control groups had similar adjusted means. The experimental

Table 1. Descriptive statistics

Groups	N	Pretest Means	Posttest Means	Adjusted Means
Experimental Group	69	16.25	18.16	16.20
Control Group	58	12.40	14.09	16.36

Table 2. Test for homogeneity of regression

Source	SS	df	MS	F	p
Between regressions	48.9	1	48.9	1.5	.223
remainder	3996.26	123	32.49		
adjusted error	4045.15	124			

Table 3. Analysis of Covariance for Experimental Groups vs. Control Groups

Source	SS	df	MS	F	p
Adjusted means	.69	1	.69	.02	.89
Adjusted error	4045.15	123	32.62		
Adjusted total	4045.85	124			

group (M = 16.2) was slightly lower than that of the control group (M=16.36). These results demonstrated that the games were not statistically significantly useful tools, when compared to normal classroom interaction.

To answer the second and third research questions, "Did the students feel that the software was effective," and "Did the students who used the games find them engaging," Likert survey results were changed to numeric values and reported as means with the accompanying standard deviations. For this study, a response of "Not Sure" was evaluated as a middle response with the students who participated in the study being instructed to think of the scores as a continuous range from 1 to 5. A copy of the survey form is provided in the appendix. Survey results for the two multiplication games are reflected in Table 4.

Comparing the results for the two games in Table 4, mean scores for Bingo were lower than baseball in students' opinions of the games' use as a tool for practicing multiplication facts (M=2.842, M=3.000). Bingo was also seen as lower than baseball when rating the games as good practice for fourth graders (M= 2.763, M=2.829). Yet, the students reported that Bingo was better than baseball for helping them to remember facts (M=2.684, M=2.543). They also rated Bingo higher than baseball when asked if they would recommend the game to their friends (M=2.974, M=2.914). These seemingly conflicting results might be explained in their ratings for how fun the games were and their opinions of the difficulty that they had with the games. The students reported that the baseball game was more fun than the Bingo game (M=3.053, M=3.171). In addition, their opinion about playing baseball everyday was higher than that of Bingo (M=2.800, M=2.553). In contrast, their opinion about the games working with their partners was slightly higher for Bingo than baseball (M=3.026, M=3.029). They also reported that the Bingo game

Table 4. Survey Results for Classroom Suite Multiplication Games: Bingo and Baseball

Survey Results for Games – Based on 1 to 5 Scale with Five as Highest	Bingo Means	Bingo SD	Baseball Means	Baseball SD
1. Classroom Suite [Game] is a good way to practice multiplication facts.	2.842	0.9733	3.000	1.1882
2. Classroom Suite [Game] is fun	3.053	0.8683	3.171	1.1242
3. Classroom Suite [Game] worked well with your partners.	3.026	0.8216	3.029	1.0977
4. Classroom Suite [Game] was easy to learn.	3.158	0.9733	2.829	1.0977
5. Classroom Suite [Game] could be played without asking the teacher for help.	2.737	1.2233	2.514	1.1725
6. Classroom Suite [Game] was good practice for fourth graders.	2.763	0.9708	2.829	1.0142
7. Classroom Suite [Game] was fun to play every day.	2.553	1.1554	2.800	1.2078
8. Classroom Suite [Game] helped me to remember multiplication facts faster.	2.684	0.9893	2.543	1.0100
9. I would recommend Classroom Suite [Game] to other fourth graders.	2.974	0.9722	2.914	0.9194
10. Classroom Suite [Game] works without problems.	2.395	1.0537	2.286	0.8250

took less teacher assistance than baseball (M=2.763, M=2.829). In addition, they rated Bingo as working with fewer operational problems than baseball (M=2.395, M=2.286). Since they viewed Bingo as needing less teacher intervention and working better, it might be that they thought Bingo was the better game to recommend to their friends (M=2.974, M=2.914). Likewise, since Bingo took less teacher intervention and had fewer technical issues, they may have thought that Bingo was a more efficient tool to remember their facts. Their higher ratings for baseball over Bingo as a tool for practicing multiplication facts and good practice for fourth graders compared to their opinion that Bingo required less teacher intervention and worked better may also explain why they enjoyed baseball more but would recommend Bingo to their friends.

In summary, the students found the games to be fun, thought that they worked well with partners, but were somewhat ambivalent about their ability to help them learn multiplication. These latter results may have been impacted by their opinions of how much teacher assistance was needed and their perceptions of how well the games worked.

Results from this study failed to demonstrate a statistically significant difference between the universally-designed multiplication games and standard classroom interventions. However, descriptive statistics demonstrated their potential usefulness as instructional tools, with the experimental class making greater gains than the control class when comparing mean values of both groups. Student opinions about the usefulness of the games were ambivalent for both learning and remembering multiplication facts, possibly impacted by their somewhat negative opinions about the problems that they may have had with the games. Their opinions about ease of use were favorable for Bingo but less so for baseball possibly because it was a more complicated game requiring additional teacher intervention. Their enjoyment in playing the games was reported although this opinion did not carry over as a recommendation for the games to classmates. Thus, while failing to demonstrate statistically significant differences between control groups and experimental groups when measuring acquisition of multiplication facts, the software trended toward statistical significance and was reported to be engaging and easy to use with partners.

DISCUSSION

This study compared four classes of inclusive fourth graders who used universally- designed multiplication Bingo and baseball games for four weeks to classes not using the software. The analysis of pre- and post-test scores of multiplication facts did not yield statistically significant results when comparing the effects of using these accessible multiplication games to a control situation. Both experimental and control groups improved their assessment scores during the time of the study, leading to statistical nonsignificance. Like the study by Miller and Robertson (2010), the students in the experimental group did not show significantly more improvement when compared to the improvement of the control group to result in a statistical significance. However, unlike the Miller and Robertson study whose students in the experimental group failed to show gains, the scores of the experimental classes in this study improved more than those of the scores for the control classes.

The multiplication games of this study were developed to match Universal Design standards for all students and to provide an alternative method of multiplication facts instruction. Even though the results were statistically non-significant, these games hold promise as useful alternative instructional tools for the inclusive classroom.

Students were also surveyed as to their opinions of the games concerning both application to improve math skills and as enjoyable alternative ways of practicing math facts. Students in the experimental groups responded that they enjoyed playing the games but were unsure about their ability to help them learn their multiplication facts. For survey questions about the ability of the games to help them with multiplication, the students' responses approached average. However, they scored above average when asked to rate their enjoyment. Similar to the study by Ota and DuPaul (2002) who studied students with attention deficit hyperactivity disorder, the students in this study in an inclusive classroom reported that computer-based multiplication games were engaging. However, in the Ota and DuPaul study, the games were reported to be a good tool for learning. In this study, the students were ambivalent about the games' ability to help them learn multiplication facts, perhaps because they also reported some technical issues.

The possibility exists that the results of this study were impacted by the timeline of the project in relation to the school calendar. Both the experimental and control groups consisted of fourth grade students who had just finished final preparations for the annual state mathematics assessment. This may have impacted their opinions of the games as tools for learning. If the students felt that they already knew the facts, they may have been reflecting an attitude that playing the games was not that useful. However, even with this additional practice prior to the study, both groups showed improvement after the study period, with the experimental group who used the computer-based multiplication games showing slightly more improvement than the control group. Even without a statistical significance from the results, it appears that the use of these accessible computer-based multiplication games is a potentially viable method for improving the learning of multiplication facts in an inclusive fourth grade classroom.

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KEY TERMS AND DEFINITIONS

Accessible: The ability of the classroom and instruction to benefit all, because methods are made to allow all students to learn.

Analysis of Covariance: A statistical analysis where experimental results are studies for their effect though use of a covariate that is related to the variable.

Attention Deficit Hyperactivity Disorder (ADHD): A developmental disability characterized by lack of attention accompanied by excessive physical activity.

Computer Assisted Instruction: Instruction that is supplemented by the use of instructional software.

GeneralEducation: The classroom for most of the students who are taught by general education certified teachers.

Inclusion: The maintenance of students with disabilities in the general education classroom with special education services coming to the general education classroom.

Special Education: Education for students with exceptionalities, which is designed to support a student's different learning needs.

Text-to-Speech Synthesis: The ability of a computer to speak text as it is typed on the screen.

Universal Design: The educational philosophy that all instruction should be made accessible to all students regardless of the disability. Access can be gained through instructional change, technology, and attitude.

APPENDIX

Epilogue and Lessons Learned

The students who used this software were fourth graders in the latter part of their school year. The students used a Bingo game and a baseball game to practice multiplication facts, a key focus of the games. This study demonstrated that students using these games showed a larger improvement in average test scores for acquisition of multiplication facts than for those who were not part of the study, but did not show a statistically significant difference. Since the students enjoyed using the games, the games offer an effective alternative to traditional instruction.

This research was followed by a study using three different games in a summer school remedial program for mathematics. In this study, summer school at-risk students played three different games that were derived from games from different countries and modified to teach multiplication facts. During this research, the authors found that these three other multiplication games yielded statistically significantly results when used with the summer school at-risk students (Anderson and Anderson, 2010). These two research studies corroborate the success of using games to teach multiplication facts in inclusive settings. Survey analysis of the students' opinions of the games during this study supported the positive results of the spring study using Baseball and Bingo.

Given the results of the two studies, the research offers evidence that using computer games is not only instructionally beneficial for students but also a fun activity.

Student Code	__ __ __ __	
This will be the initials of the teacher and an alphabetical number system using the last name of the student, i.e. Anderson will be 01, Baker will be 02, Cooley will be 03, etc. Teacher will not score this form and researchers will not know the names of the students. Circle if you are male or female:		
Gender	M	F

Student Survey Form

Please circle the answer that describes how you feel about the math game in with each sentence below. Circle the appropriate letters to the right of each sentence. (SA = Strongly agree; A = Agree; NS = Not sure; D = Disagree; SD = Strongly disagree)					
1. Classroom Suite BASEBALL is a good way to practice multiplication facts.	SA	A	NS	D	SD
2. Classroom Suite BASEBALL is fun	SA	A	NS	D	SD
3. Classroom Suite BASEBALL worked well with your partners.	SA	A	NS	D	SD
4. Classroom Suite BASEBALL was easy to learn.	SA	A	NS	D	SD
5. Classroom Suite BASEBALL could be played without asking the teacher for help.	SA	A	NS	D	SD
6. Classroom Suite BASEBALL was good practice for fourth graders.	SA	A	NS	D	SD
7. Classroom Suite BASEBALL was fun to play every day.	SA	A	NS	D	SD
8. Classroom Suite BASEBALL helped me to remember multiplication facts faster.	SA	A	NS	D	SD
9. I would recommend Classroom Suite BASEBALL to other fourth graders.	SA	A	NS	D	SD
10. Classroom Suite BASEBALL works without problems.	SA	A	NS	D	SD

Student Code	__ __ __ __	
This will be the initials of the teacher and an alphabetical number system using the last name of the student, i.e. Anderson will be 01, Baker will be 02, Cooley will be 03, etc. Teacher will not score this form and researchers will not know the names of the students. Circle if you are male or female:		
Gender	M	F

Student Survey Form

Please circle the answer that describes how you feel about the math game in with each sentence below. Circle the appropriate letters to the right of each sentence. (SA = Strongly agree; A = Agree; NS = Not sure; D = Disagree; SD = Strongly disagree)					
1. Classroom Suite BINGO is a good way to practice multiplication facts.	SA	A	NS	D	SD
2. Classroom Suite BINGO is fun	SA	A	NS	D	SD
3. Classroom Suite BINGO worked well with your partners.	SA	A	NS	D	SD
4. Classroom Suite BINGO was easy to learn.	SA	A	NS	D	SD
5. Classroom Suite BINGO could be played without asking the teacher for help.	SA	A	NS	D	SD
6. Classroom Suite BINGO was good practice for fourth graders.	SA	A	NS	D	SD
7. Classroom Suite BINGO was fun to play every day.	SA	A	NS	D	SD
8. Classroom Suite BINGO helped me to remember multiplication facts faster.	SA	A	NS	D	SD
9. I would recommend Classroom Suite BINGO to other fourth graders.	SA	A	NS	D	SD
10. Classroom Suite BINGO works without problems.	SA	A	NS	D	SD

Challenges Facing Professionals

The cost of the software and hardware to generate these kinds of activities is significant. Each license for the software is approximately $300.00. If purchasing the alternate input device called Intellikeys made by Intellitools to accompany their software, Classroom Suite, the additional cost is $350.00. If Intellikeys is not used, an adaptor for alternative input devices as well as the input switch used by the student is also quite expensive.

Few teachers are trained to use the development capability of Classroom Suite. This lack of training will need to be solved through teacher inservices.

In addition to needing training for developing mathematics games on Classroom Suite, lack of time to develop these activities is a problem. Few teachers have the time to devote to developing and testing games. This issue was addressed in the district where the research was held by asking district technology employees to develop instructional materials using the Classroom Suite for the teachers who did not have the time to develop their own programs.

Many teachers in public schools lack knowledge about the existence and availability of accessible software for their students. Standards for instruction in special education technology for preservice teachers are not currently addressed in detail (CEC, 2010) nor listed as separate technology standards from those required by the International Society for Technology in Education (ISTE, 2010) for beginning teachers.

DISCUSSION QUESTIONS

1. **What studies have been done recently showing the efficacy of using games to teach mathematics skills?** See Kebritchi, Hirumi, and Bai, 2010; Miller and Robertson, 2010; and Sedig, 2008.
2. **If given free time to use computers, do you think that these children would have chosen to continue to use the games for free computer time?** No. Upon observation, they chose alternate activities. However, informal observation also showed that the students were interacting by themselves with the computer. Perhaps we need to do more to encourage social use of the computer.
3. **What might have been a different statistical assessment that could have been used to assess the efficacy of the games?** ANOVA might have demonstrated a gain by comparing the students at the beginning of the study to the same students at the end of the study.

Chapter 22
Do You See What I'm Saying?
Ultrasound Technology as a Tool for Pronunciation Instruction

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ABSTRACT

Ultrasound technology aids pronunciation training because it makes visible what ordinarily is not. Ultrasound technology produces a real-time visual image of speech articulations that take place inside of the mouth; thus, it contributes visual input to an instructional context. This chapter first reports on investigatory applications of ultrasound within the context of second language instruction. Two pilot studies have been conducted which, although they did not return statistically significant results, pointed to high potentials for pedagogical efficacy in instructional settings. Ongoing use of the ultrasound in language classrooms at the University of Arizona underscores the ultrasound's applicability to pronunciation training settings. In light of the positive results in the language classroom, the implications for ultrasound applications to speech language pathology are considered. Two broad areas of potential application are diagnosis and treatment practices. Challenges facing ultrasound-enhanced pronunciation instruction are subsequently discussed, and future directions are suggested for continued research into ultrasound technology as an instructional aide.

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INTRODUCTION

One central difficulty to pronunciation training is the issue of visibility. In short, we cannot see much of what is going inside of the mouth during speech. And this is a seemingly insurmountable difficulty since the problem is a physiological one. The complex set of articulations that take place in the mouth region are not visible due to the lips, teeth, and skin that hide the inner mouth from external view. What this means is that evaluators of pronunciation (e.g., teachers and speech-language pathologists) are largely restricted to auditory information alone and to what they are able to observe externally.

BACKGROUND: ULTRASOUND

At the University of Arizona, the Arizona Phonological Imaging Lab (APIL)[1] has been experimenting with the utilization of ultrasound technology for pronunciation instruction in the context of second language learning. In two pilot studies and ongoing application to language classrooms, APIL has touched on a practical place for ultrasound technology in language learning contexts. Before discussing the benefits that Arizona Phonological Imaging Lab (APIL) has demonstrated thus far, it will be useful to first consider how the ultrasound works.

When one places the ultrasound transducer (i.e., the ultrasound's "eye") underneath one's chin, a black-white image of the tongue appears on the ultrasound monitor. The image is a video image of the tongue in real-time, and the frame rate is fast enough to produce fluid images of tongue movements. The clarity of the tongue image depends on the distance between the tongue and the ultrasound transducer. As such, the tongue image is more opaque when it is positioned close to the palate.

In the two ultrasound screenshots above, Figure 1 is what one sees on the ultrasound monitor in real-time. Figure 2 features a superimposed profile frame which is not visible during ultrasound use, but is provided here to give the reader a means for better situating the tongue image that they are seeing in Figure 1.

The transducer functions as the ultrasound's eye. The transducer is a thin, plastic probe with a rounded edge that is held in the hand and attached to the ultrasound monitor via a cable. When one places the transducer against the body[2], the ultrasound monitor makes visible what is beneath the skin. More specifically, the ultrasound "works

Figure 1. Typical image of ultrasound. (© 2005, Diana Archangeli and Jeff Mielke. Used with permission.)

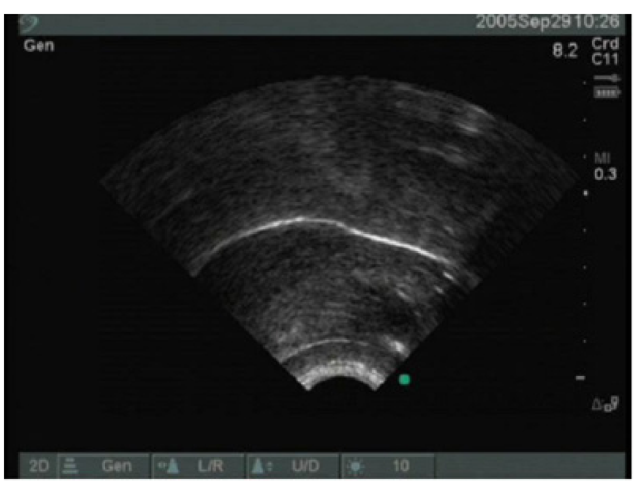
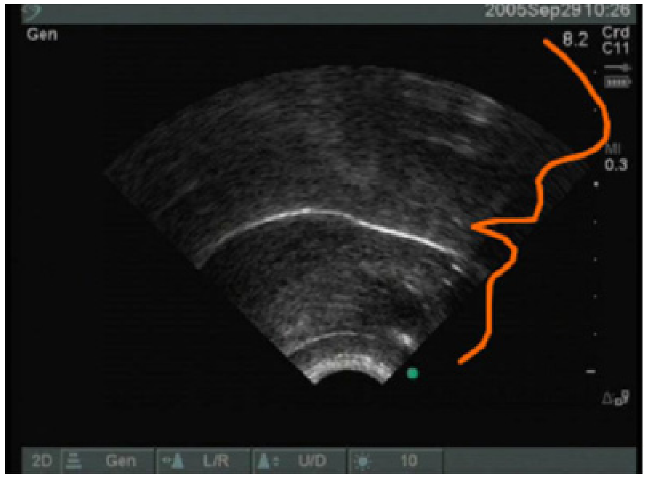


Figure 2. Same image with profile overlay to situate the tongue (© 2005, Diana Archangeli and Jeff Mielke. Used with permission.)



by emitting high-frequency sound waves which are reflected back to the transducer by surfaces with sharp changes in density" (Archangeli & Mielke, 2005, slide 18). The ultrasound responds to sharp contrasts in density such as between a tongue and the empty air that lies between it and the palate. The contrast between air and tongue makes the tongue's upper surface highly reflective, or echogenic of ultrasound waves.

While the tongue's surface is highly visible in the ultrasound image, the palate is not. It is possible to image the palate on the ultrasound if one holds water or gelatin in their mouth while placing the transducer under their chin. This works because the fluids fill up the empty space between the tongue surface and the palate, thus reducing the density contrast that would normally exist (Archangeli & Mielke, 2005). However, since we cannot generally articulate well with liquids in our mouths, we are limited to either projecting the palate or the tongue, but not both at once. In practice, students readily comprehend the ultrasound images even without seeing the palate (D. Archangeli, personal communication).

Ultrasound technology visualizes many articulations common to American English, but not all. Vowels (i, ɪ, eɪ, ɛ, æ, ə, ʌ, aɪ, aʊ, u, ʊ, oʊ, ɔɪ, ɔ, ɑ) image well on the ultrasound because their articulations involve primarily the body of the tongue, which is highly echogenic on the ultrasound. However, high vowels do not image as well as low vowels for two reasons (J. Mielke, personal communication). First, high vowels (e.g., i, u) establish a greater distance between the tongue surface and the transducer compared to the situation for low vowels (e.g., æ, aɪ, ɑ). Furthermore, less of the tongue surface is perpendicular to the ultrasound waves resulting in lower image quality relative to low vowels.

Consonants that involve places of articulation from the alveolar ridge to the pharyngeal wall image well: alveolar consonants (t, d, s, z, n), alveopalatal consonants (tʃ, dʒ, ʃ, ʒ), palatal consonants (j), velar consonants (k, g, ŋ, w), liquids (r, l), and glottal fricatives (h). On the other hand, bilabial consonants (p, b, m), labio-dental consonants (f, v), and inter-dental consonants (θ, ð) do not image well because of the proximity of the lips and teeth, which disrupts the correspondence of the ultrasound waves with the transducer.

There are other limitations to mention. The ultrasound cannot image "passive articulators" (e.g., alveolar ridge and velum; Archangeli & Mielke, 2005). Lip rounding, nasalization, and

Table 1. Sound segments of American English, arranged according to ease of ultrasound imaging

Sound segments easy to image	Sound segments challenging to image
vowels: i as in "beet" ɪ as in "bit" eɪ as in "bait" ɛ as in "bet" æ as in "bat" ə as in "sofa" ʌ as in "bus" aɪ as in "site" aʊ as in "cow" u as in "food" ʊ as in "good" oʊ as in "boat" ɔɪ as in "boy" ɔ as in "author" ɑ as in "father" (Note: low vowels image better than high vowels)	bilabial: p as in "pam" b as in "bam" m as in "ham"
alveolar: t as in "tab" d as in "dab" s as in "sip" z as in "zip"	labio-dental: f as in "foot" v as in "vase"
alveo-palatal: tʃ as in "chip" dʒ as in "job" ʃ as in "ship" ʒ as in "measure"	inter-dental: θ as in "thought" ð as in "though"
palatal: j as in "yes"	
velar: k as in "cap" g as in "gap" ŋ as in "ring" w as in "wing"	
liquids: r as in "right" l as in "light"	
glottal: h as in "hat"	

voicing are also not within the imaging range of the ultrasound, nor is the palate for reasons discussed previously. In response to the palate imaging problem, linguists have designed a software program called Palatoglossatron which integrates palate and tongue images, but unfortunately does not do so in real-time (Baker, 2006; Mielke, Baker, Archangeli, & Racy, 2005).

The ultrasound makes tongue articulations visible in real-time. What does this mean for pronunciation instruction in the context of language teaching? First, the ultrasound can make visible both teacher and student articulations. A teacher can model target articulations visually to augment auditory input to the student. In return, the student can visualize their own articulations for self-correction and teacher-correction. Second, the ultrasound produces moving visual images which can give rich, visual representation of complex articulatory series taking place inside the mouth (e.g., glides, diphthongs, co-articulatory effects). Third, since ultrasound imagery is delivered in real-time, there is no lag between recording and image projection. Fourth, ultrasound equipment is highly portable: equipment is now available that is around the size of the average laptop. This portable design allows for a teacher/student to use it collaboratively in a shared setting (e.g., working at a desk or table). Speaking broadly, through application of the ultrasound, language teachers and their students are able to make visible what normally is not.

ULTRASOUND APPLICATIONS

Under the direction of Arizona Phonological Imaging Lab (APIL), I took part in two pilot studies investigating the applications of ultrasound to second language pronunciation training. The first study explored the effectiveness of ultrasound to facilitate in Korean learners of English an ability to identify the English tense/lax distinction (e.g., compare "meet" to "mitt") and to demonstrate that ability in their own English pronunciation. Students worked through web-based lessons that featured still and video ultrasound images. Students also had the option of viewing their own pronunciation via the ultrasound. These lessons were self-directed without teacher intervention. According to post-lesson testing, we found that there was some increase in student perception and production of this vowel contrast but the results were below statistical significance (Meadows, Yun, Archangeli, Mielke, & Lukes, 2005). As any pilot study should, it fostered further questions for investigation: (a.) What would a language classroom look like if the ultrasound were an available pedagogical tool? (b.) What if students could receive direct evaluative feedback on their pronunciation both verbally and visually via the ultrasound? (c.) What if students had a substantial amount of time to work directly with the ultrasound in the form of consecutive pronunciation lessons?

A follow up study addressed these three questions by incorporating the ultrasound directly into language classroom instruction. Four English speakers who were studying Japanese participated in a series of Japanese language lessons each centered around four articulations that are commonly challenging for English speakers: (a.) long vowels (compare [u] to [u:]), (b.) flaps ([ri] as in the Japanese word [ɾiŋgo], or "apple" in English), (c.) palatalized flaps ([r^j] as in the Japanese word [r^ju:], or "dragon" in English), and (d.) uvular nasals ([ɴ] as in the Japanese word [paɴ], or "bread" in English). A volunteer Japanese instructor taught the four class meetings which each consisted of (a.) choral reading, (b.) teacher modeling via the ultrasound thus giving students auditory and visual input, (c.) time for students to practice with ultrasound, (d.) opportunity for students to receive teacher feedback on pronunciation according to combined auditory and visual output. Using a computer laptop projector we projected ultrasound images to a large screen for all class participants to view at the same time. According to pre-post test comparisons, student pronunciation of target Japanese items moved towards native-like attainment according to the judgments of native speaker evaluators but did not reach statistical significance (Meadows, 2007).

We conducted exit surveys after each class meeting which afforded us some insights into student reactions to the ultrasound technology. Student reaction was extremely positive. They noted the contributions of the ultrasound in the following aspects: (a.) teacher modeling, (b.) the opportunity to practice directly with the teacher, and (c.) the projection of their articulations to the projector screen.

Since these pilot studies, Arizona Phonological Imaging Lab (APIL) has been able to introduce ultrasound technology to Arabic language classes at the University of Arizona. During these classes, the language instructor projects her articulations onto a large screen in the classroom in order to help students see the articulatory distinction between guttural and regular consonants, a distinction that English speakers are able to perceive but find difficult to reproduce (D. Archangeli, personal communication).

FURTHER ULTRASOUND POTENTIALS: SPEECH LANGUAGE PATHOLOGY

Given the practical contributions of the ultrasound demonstrated by Arizona Phonological Imaging Lab (APIL) in the domain of second language instruction, what might be the implications for other contexts such as the diagnosis and treatment of speech disorders? It is intuitive to suggest that ultrasound technology offers similar benefits to the field of speech language pathology for the same reason that it benefits language instruction: The ultrasound makes visible what normally is hidden from view. In what follows, I will consider the potential contributions in light of the APIL findings thus far.

The ultrasound has potential to improve diagnostic procedures because it can provide a video image in real-time of articulatory practices taking place inside the mouth. For the average diagnosis situation, this provides a speech language pathologist (SLP) with an additional channel of information that then contributes to their ability to ascertain range of movement of the tongue muscle. A limited range of movement can be an indicator of an articulatory disorder, childhood apraxia, dysarthria, or Orofacial Myofunctional Disorder (OMD) (ASHA, 2010; Haynes & Pindzola, 2008). The ultrasound can also aid a speech language pathologist in evaluating the strength of muscles involved in articulation. Limited muscle strength can be a sign of Orofacial Myofunctional Disorder (ASHA, 2010). A third potential contribution is found in the fact that the ultrasound can be attached to a video recording device, thus making it possible to make a video account of an individual's phonetic inventory, for example. Additionally, a speech language pathologist can treat a video recording as an additional form of baseline data prior to treatment.

The introduction of the ultrasound to diagnostic procedure does not entail additional logistical difficulties. The ultrasound is easily transportable due to its small size. Setup and subsequent breakdown are simple and fast. Speech language pathologists working in school settings can easily move between school sites with the ultrasound machine.

Following diagnosis, the ultrasound offers potential in the area of treatment of speech language disorders. Essentially, the therapy client and the speech language pathologist can both utilize ultrasound visual images in the interest of facilitating the client's mastery of their pronunciation practices. Common therapy treatments for articulatory disorders and childhood apraxia feature one-on-one interaction between the client and the speech language pathologist where the client receives multi-sensory feedback (e.g., tactile, auditory, and visual) on their pronunciation performance (ASHA, 2010; Haynes & Pindzola, 2008). Other aspects of treatment involve muscle exercises intended to strengthen articulators, in the case of dysarthria, and exercises to increase self-awareness of one's articulatory apparatus, in the case of Orofacial Myofunctional Disorder (ASHA, 2010; Haynes & Pindzola, 2008). If the client and speech language pathologists were to have access to a real-time video images of both client and speech language pathologist pronunciations, this could be a valuable resource for all forms of treatment mentioned here.

Potential applications extend to language-related disorders such as stuttering (i.e., disfluency). The visuals of the ultrasound can help a therapist more accurately pinpoint phonological triggers (i.e., sound contexts that appear to initiate a disfluency) and perhaps better understand them once identified.

STANDING CHALLENGES

There are standing challenges to the application of ultrasound that apply to both domains discussed here. First, there are limitations to the articulations that the ultrasound can visualize. The tongue surface images very well on the ultrasound because of the sharp contrast in density between the tongue and the air pocket above it. On the other hand, the ultrasound does not image areas around the teeth and lips; nor are the palate and tongue visible simultaneously.

Ultrasound technology in its present form is expensive and can present serious problems for organizational budgets. The ultrasound machines currently being used for research purposes are reported to cost around $30,000 USD. Even where it is financially feasible, the expensive price can constrain the number of machines that can be purchased at an instructional site. However, if the ultrasound follows the general trend in technology--which is to reduce price while increasing performance over time--the current price may reduce to levels that can make purchasing multiple machines at a single site more reasonable.

FUTURE DIRECTIONS

The agenda for ultrasound pedagogy should first include the continued experimental application of ultrasound technology to a variety of settings where pronunciation is a central focus. The promising results found in the second language teaching domain and the speculations for speech language pathology must be tested empirically. This calls for experimental and case studies across disciplinary boundaries, both supported by a mixture of quantitative and qualitative data analysis. Another issue to address is how to circumvent financial constraints so that the ultrasound can be used in a cost-effective way. One avenue of active exploration is the use of projection systems to make the ultrasound image visible to a group of students at once in the context of language instruction. A third issue is to explore the types of software interfaces that best facilitate the application of the ultrasound to pronunciation training. One possibility could be a software program that superimposes a palate in real-time on the ultrasound image (D. Archangeli, personal communication).

Also what lies ahead are training and certification programs for instructors and therapists in how to apply the ultrasound to their professional practices. Currently no such programs exist. Such programs would have to be designed through an interdisciplinary coordination among departments of curriculum and instruction, linguistics, and speech pathology.

CONCLUSION

Ultrasound technology offers important benefits to pronunciation training that are worthy of academic attention. Through the ultrasound, teachers/students and SLPs/clients can make visible what normally is not, thus introducing an additional channel of input/output to pronunciation instruction. This can only lead to more effective pronunciation training in both contexts.

ACKNOWLEDGMENT

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KEY TERMS AND DEFINITIONS

Childhood Apraxia: A motor speech disorder characterized by a disconnect between signals from the brain and the muscles involved in speech. Individuals with childhood apraxia experience difficulty in coordinating articulators in order to say what they want to say.

Co-Articulation: This refers to the phenomenon where individual sound segments (or pronunciations) come to resemble one another when placed in linear sequencing with each other. For example, the exact articulation that makes up a [k] will be slightly different according to what vowel follows it. One easy illustration of co-articulatory effects is the difference between "about you" and "abouchu" [əbaʊtʃu] in rapid speech. The [t] and the [j] co-articulate, that is they compromise halfway between the alveolar ridge and the palate, thus generating an alveo-palatal affricate [tʃ].

Dysarthria: A motor speech disorder wherein an individual experiences difficulty in moving the muscles involved with speech. This weakness of muscle can occur after a stroke or brain trauma. The speech of an individual with dysarthria may be slower than normal or sound mumbled or slurred due to a restricted range of muscle movement. Dysarthria is more likely to affect adults than children.

Echogenic: This refers to an object that borders a sharp change in density and thus images brightly on ultrasound technology. The tongue surface is generally echogenic.

Orofacial Myofunctional Disorder (OMD): This speech disorder is characterized by a protruding tongue during rest, speech, or swallowing. An individual with OMD may have difficulty with consonants pronounced towards the front of the mouth (e.g., alveolar, interdental, labio-dental, and bilabial). The muscles of the tongue tip may also exhibit weakness.

Palate: The area of the mouth region commonly referred to as the "roof" of the mouth. It is characterized by a hard bone-like density towards the front and a softer density towards the rear. Generally, the palate is not visible on the ultrasound during regular speech.

Passive Articulators: These are the parts of the mouth that play a contributive role in articulatory processes but are not part of the tongue—the primary articulatory device. They are the stationary parts of the articulatory equation such as the alveolar ridge, palate, and velum.

Phonemic: This refers to the saliency of a particular sound contrast to a speaker of a language. While the human speech apparatus can produce countless sounds, each language narrows down to a select range of contrasts. These are called phonemic contrasts. One primary task for second language learners is to both perceive and reproduce such phonemic contrasts which may or may not correspond to their first language.

Tense/Lax Distinction: This refers to the vowel distinction heard by English speakers in the words "beet" and "bit." This distinction is salient to most English speakers because the difference between the two articulations generate a change in meaning in English (e.g., a "beet" is not the same thing as a "bit"). This is one example of a "phonemic distinction" (see above). Non-English languages may or may not give attention to this distinction.

Transducer: This is the plastic probe that projects ultrasound waves. The style of transducer that has been used for linguistic research thus far is oblong in shape and is easily grasped in the palm of one's hand.

Ultrasound Technology: A technology that utilizes ultrasound waves to visually represent structures beneath the skin surface. The ultrasound waves construct images by reflecting off of sharp changes in density. Surfaces that border a sharp change in density are termed "echogenic" (see above).

ENDNOTES

1. The APIL website is located at: http://dingo.sbs.arizona.edu/~apilab/.
2. To facilitate the flow of ultrasound waves between the body and the transducer, one applies a thick gel (e.g., aloe vera) to the skin.

DISCUSSION QUESTIONS

1. **What are some of the assumptions embedded in this chapter about how pronunciation training should work?** In other words, what are the theories of pedagogy and of language learning that the author brings to this text? One theoretical assumption is that "noticing" leads to a change in pronunciation (i.e., learning). There is also the assumption that pronunciation instruction is always conducted in a dialogue-fashion wherein an instructor evaluates a person's pronunciation practice in the interest of affecting some sort of change. Readers may identify further theoretical assumptions regarding pronunciation instruction that are embedded in the chapter text.
2. **In what ways would visual imagery aid pronunciation training in your setting?** Reader answers will vary according to their particular instructional context. It is hypothesized that readers may see uses for the ultrasound congruent with the manner discussed in the chapter. They may also specify particular challenges that they face in the current instructional context and the specific contributions that ultrasound could make to overcome those pedagogical challenges.
3. **What other limitations are there that are not mentioned in this chapter?** In what conditions might visual imagery NOT aid pronunciation training? It is difficult for the author to predict what further limitations there may be to ultrasound-enhanced pedagogy that are not mentioned in the chapter text. It is conceivable that in certain situations visual imagery may become distracting for some students and possibly over-complicate their pronunciation advancement. Another conceivable issue could be that some learners are uncomfortable with using the ultrasound as a pedagogical device and may refuse incorporating it into their training. Readers will undoubtedly see further limitations than these.
4. **Can there ever be software that will allow ultrasound technology to conduct pronunciation instruction independent of human intervention?** Or, will the ultrasound remain a secondary tool to augment human-led training? Support your answer with examples from your context. This item is asking for speculation on the part of the reader so it is difficult to predict how readers will respond. The author conceives of the ultrasound as a pedagogical tool tied to human-led instruction. However, reader knowledge of technology and other fields may give credence to the possibility of human-less ultrasound pedagogy.

Chapter 23
What Do You Do With a Digital Pen?

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ABSTRACT

This chapter describes an assistive technology device called a digital pen. Digital pens allow notes written to be uploaded to a computer and translated into word processing documents. The new LiveScribe Echo™ provides this feature and also digitally records an audio track to accompany the notes. This technology can be used by students with disabilities for note taking, writing, reading, mathematics, and virtually any content area. Using the pen for augmentative communication, as well as in-class assessment is discussed. Teachers can use a recording digital pen to create a "pencast" of a lecture. The pencast could then be available for repeated viewings by students who require repetition for learning or those not available when the content was covered. The chapter concludes that the recording digital pen's applications and usage will expand as knowledge of the device increases.

INTRODUCTION

What if your student could upload his or her notes into a computer document without using a digital board? What if the notes were remembered by the pen that wrote it? What if your student could re-listen to a lecture while viewing main header notes? Welcome to the world of the new digital pens. How would that benefit the communication between you and your student?

A digital pen is a handheld electronic device that has its own memory. Most digital pens such as LogiPen™, Pegasus™, and Sony™ can write on any paper surface. Another version such as LiveScribe Echo™ that allows the recording and playback of an audio track does require specially coded paper. The pen does not need to be connected to a computer to work. If you upload the

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pen's memory to a computer, you can view, store and edit your written ink notes. Some digital pens are even compatible with Microsoft Word. Most digital pens range in cost from $100-$180 per pen and include the pen, a computer connector cable, and software that enable handwritten material to be translated into text.

So what can you do with this wunderkind? Your imagination is the limit. The remainder of this chapter will focus on pens that allow concurrent audio recordings.

A PENCAST LECTURE

Who needs an interactive whiteboard, overhead projector or slide projector? You can create your own "pencast" using the specially coded paper and a pen. Then you use your pen and a document camera to teach the content. You can upload everything to a classroom computer or website for students to reference at a later time. Every student will have access to the exact same lesson at any time you allow.

From the student's point of view, instead of scrambling to copy down everything from the board or trying to remember later what some cryptic note means, the student can take down key points, drawings, or dates from the pencast. The lecture will be available on a class computer to fill in any missing information later.

USING DIGITAL PENS FOR STUDENTS WITH DISABILITIES

Disabilities will not magically go away with the use of any technological device. Hard work on the part of the student and imaginative application of technology on the part of the teacher will still be required to help students compensate for disabilities. However, digital pen technology can be used in many ways to assist the learning process.

Note-Taking

Note-taking requires the student to simultaneously listen, remember and write down information. This is a challenge for most students and particularly for students with an attention deficit. Although computers and PDAs have been used to facilitate note-taking, research has shown that note-taking actually takes longer on these devices than with paper and pencil, requires familiarity with the equipment and does not lend itself to drawings or diagrams (Davis et al., 1999; Van Schaack, 2009; Ward & Tatsukawa, 2003). For students with learning disabilities, a digital pen would allow them to use their cognitive abilities to focus on the material being presented rather than on the multi-tasks of note-taking. The pen would allow him or her to take big idea notes and record the audio simultaneously. The lecture could be played back when reviewing the notes to fill-in gaps, possibly to restructure notes and to reinforce ideas. Kiewra (1989) found that lower-achieving students who could rehearse a lecture were able to bring their notes up to the level of the highest achieving students. Although video and audio tapes could provide this feature, they are not linked to the note-taking page as the recording would be with a digital pen. Research has also noted that multiple hearings of lecture material creates a higher level of recall and synthesis. For days when a student is absent, the pencast would become another way of making sure the student has the material available in the same way that the other students received it. This is particularly beneficial for students with higher absenteeism due to physical and other health impairments.

Writing

For students with difficulty in writing, a digital pen would enable the student to see their work on the computer. The computer's spell-checking capability could assist with highlighting misspelled words. This could be used to create a personalized spelling list. The student could use the specialized paper with whatever line width and spacing assisted him or her in writing while the computer would put their words and lines together. This process of writing and uploading the information to see errors would help the student correct his or her own work.

Reading

Van Schaack (2009) noted that digital pens allow for bimodal experiences and that this can enhance reading comprehension. By seeing his or her own words typed on a screen, the student has the opportunity to read what he or she has written. Teachers can also audio record personalized lessons on the pen and the student could follow along on the screen while listening to the recorded lesson. Students with difficulties due to font size, font type or line spacing could easily be accommodated through the link into word processing software. Students can also create personal auditory flash cards that will read the correct answers with a touch of the pen.

Mathematics and Science

Students doing mathematics or science problems with the pen in recording mode can talk through a problem and record their approach. By uploading this information through the web or classroom computer, teachers have the opportunity to get into the student's mindset and discover where incorrectly worked problems went astray. This could lead to supplementary lessons to cover content missed by several students or targeted instruction for a single student without the necessity of sitting with each student one-on-one.

Reports

The digital pen allows the student to produce reports that can be uploaded to the web with or without audio. The student can also rehearse an oral report while reading it and then play it back for personal critique. With teacher feedback, this can become a confidence-building exercise.

Augmented Communication

Many teachers for students with autism spectrum disorders are familiar with the use of picture boards as a means for students with these and other disorders that limit speech and language. However, a research study has found that attitudes of teachers and peers towards a non-speaking student increase with the sophistication of the augmentative communication technique (Van Schaack, 2009). The audio-capable digital pen can be used as an augmentative communication device using only the pen and a piece of coded paper. The teacher or parent writes a page with common words, pictures and even an alphabet and says the word while writing it. The student can then tap the word or picture hitting replay on the pen. The pen then speaks for the student. Custom pages could be created for school arrival, lunch or at-home activities at a greatly reduced cost over other text-to-speech devices.

ENGLISH LANGUAGE LEARNERS

For students who are learning English, simultaneously learning English and a subject can be a daunting task. Using a recording digital pen enables the student to replay a lesson's audio, speeding it up or slowing it down as necessary. This way a student can develop both oral and written skills.

COMBINING MULTIPLE MODALITIES

The digital pen contains the promise of tapping into true multi-modality instruction. The paper visibly has the student's work on it. The recording reproduces lectures or oral reports for aural review. The pen and paper are kinesthetic by nature. Working with the pen, the paper and the computer combine to form a powerful reinforcement of the original lesson while allowing the student to experience the lesson in a variety of ways.

IN-CLASS ASSESSMENT

A particular challenge faced by teachers is knowing when the class understands a concept while simultaneously lecturing, engaging in discussion and managing behavior. It is also necessary to monitor learning difficulties to know when interventions may be necessary. Documenting these items provides the teacher with concrete evidence that learning has taken place, that a student has grown silent or that an undesirable behavior might be increasing. By creating a seating chart on a piece of coded paper and making digital pen notations to indicate the frequency or duration of an observed behavior or types of questions asked, a complete record of a class discussion or work period can be obtained.

CONCLUSION

The recording digital pen is relatively new item in the mainstream marketplace. Application programs are and have been written for many facets of education, entertainment, travel and business. From travel phrases to guitar chords to Hangman to U.S. state facts, the application packages and ideas on how to expand the pen's usage will continue to grow. Even without the applications, the ability to link speech with written notes provides a potent tool for the creative teacher. Although note-taking may form the cornerstone of advanced classes, using the digital pen for note-taking is just a first, logical step for students with disabilities. Even students in lower grade levels can use the pen to individually study sight words, to learn a foreign language and to create their own imaginative pencasts.

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ADDITIONAL READING

Echo Smartpen. www.Livescribe.com

IRISpen. www.irislink.com

LogiPen. www.logipen.com

Pegasus, www.pegatech.com

KEY TERMS AND DEFINITIONS

Digital Pen: A handheld assistive technology device that remembers handwriting for later uploading onto a computer.

Recording Digital Pen: A handheld assistive technology device that remembers handwriting and makes a simultaneous audio recording for later playback or uploading onto a computer platform.

Pencast: An audio recording on a recording digital pen with accompanying written text.

DISCUSSION QUESTIONS

1. **How can a digital pen assist teachers?** Teachers can use a recording digital pen to create pencasts that students may view repetitively. Teachers can also create customized lectures, complete in-class assessments, produce differentiated instruction and generate multi-modal presentations.
2. **How can digital pens help teachers and students communicate in the classroom?** Students can use a digital pen to take notes, create reports, complete homework and communicate independently.

Chapter 24
Communication Technologies for Instructional Use:
Linear and Nonlinear Tools Contributing to Student Learning

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ABSTRACT

This chapter explores educational tools that adopt the interactive nature of communication technologies. The effectiveness of communication technologies for teaching varies depending on what and how the tools are used. Further, learner characteristics and/or available facilities determine the effect of communication technologies as instructional tools on student learning. In this chapter, the most up-to-date communication technologies for classroom use are introduced and evaluated. Linear technologies such as Screenr® and Ispring® are assessed from an educator perspective. Nonlinear communication technologies include Wimba,® Turning Technologies,® or Second Life.® Possible advantages and disadvantages are discussed as implications that instructors can reference for their own needs and objectives in teaching. This chapter concludes that instructors find the best-fit tools for their course objectives, materials, student backgrounds, and difficulty levels.

INTRODUCTION

Educators increasingly rely on communication technologies, defined as the systems used for connecting communicators through electronic multimedia devices including computers, video, audio, and phones, for pedagogical development. Seismic changes in instructional technologies with the advent of the digital age offer instructors new opportunities of effective teaching in and out of the classroom and interactions with learners. Today, harnessing the utility of communication technologies for instructional use is a top priority to edu-

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cators teaching the tech savvy social networking Net (*N*)-generation. Communication technologies from email to interactive virtual classroom enable educators to communicate with students in both a synchronous and asynchronous way expecting intended positive educational results.

Research on the effectiveness of communication technologies for instructional use report many different results encompassing positive and negative learning experiences. The outcomes of technology use also depend on the characteristics of learners and educators, facility settings, and instructional tool customization. There would need to be different pedagogical methods for students in varying age groups, cultures, and course subjects. Interfaces used for educational materials, such as video, audio, images, texts in the network environment fit learning development dependent on learners' needs and educators' instructional plans (e.g., Jones, Dean, & Hui-Chan, 2010; Wang, & Hsu, 2008).

In this chapter, the most up-to-date communication technologies for classroom use are introduced and evaluated. Possible benefits and downfalls are discussed as implications that educators can reference for their own teaching needs. Prior to the explanations of the technologies, empirical assessments about communication technologies for instructional use are explicated.

EFFECTIVENESS OF COMMUNICATION TECHNOLOGIES AS INSTRUCTIONAL TOOLS

The *N*-generation (social networking generation) today is more familiar with digital gadgets than any other generation. From first graders in elementary school to graduate students in college using Facebook,® Twitter,® iPad,® and cell phones apps for communication on a daily basis, they tend to be used to technology-oriented learning environments. In addition to the *N*-generation's fluency in communication technologies, many other factors have propelled the transformation of pedagogical methods from the traditional classroom setting to interactive learning. For example, communication technologies for interaction and instructions are commonplace in educational sectors because the use of them saves time and offers flexibility (Shea, Motiwalla, & Lewis, 2001; Sullivan, 2001). Further, digital interactivity has become a norm in communicating between educators and learners (Benbunan-Fich et al., 2001; Phillips, 1998).

Overall research on communication technologies as instructional tools suggests that the effectiveness of technologies is threefold. First, many studies tout the functionality of communication technologies used for education. A second group of research reports the opposite of the functionality, which addresses counterproductive pedagogical effectiveness as a result of communication technology use for teaching and learning. Another body of research emphasizes customized effects of technologies as they fit in specific pedagogy.

According to positive effects, communication technologies with the interactive nature enhance learner participation in class discussion, recall and understanding of class materials, teamwork skills, and overall enjoyment of class (Uektschy, 2001). Segmented categories of pedagogy are useful in applying communication technologies to teaching. Research found that subject knowledge, course management, and student management skills combined with interactive communication technologies for a course produced promising outcomes of the adoption (Madhavaram & Laverie, 2010). A computer-aided tutor system positively influenced students' level of learning and classroom functioning (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003; Schofield, Eurich-Fulcer, & Britt, 1994). Use of communication technologies for class also facilitates student interest in and understanding of subjects (Miller, 2009).

On the other hand, some researchers address that communication technologies generate counterproductive results in some instructional settings. In a study of high school students' use of wireless laptops for English, students used the device quite less than face-to-face classroom settings since they realized the device was less effective for functional exchange of ideas and interaction with the teacher (Towndrow & Vaish, 2009). Students used the real classroom setting for legitimate knowledge and meaning-making practices implicating that the instructor needs to develop and apply the relevant course materials for online and offline course settings separately (e.g., Burch & Kuo, 2010; Martin & Treves, 2007). Some researchers point out that communication technologies distract learners' attention when they are excessively used, suggesting that a hybrid of technologies and face-to-face interaction in the classroom is a better option (Helford & Lei, 1999).

As a third group of research in communication technologies for instructional use, a body of studies on multimedia instructional technologies shows that learners advocate technologies in their learning experience only under the condition of proper use (Cox, 2009; Pearlman, 2009). For example, Blackboard,® a course management system, was more frequently used by the professional academic unit than the liberal arts academic unit. The results suggested that practical course instructors experienced more effective functions of the system than theory or philosophy teachers as the system provided controllable video instructions (Lin & Ha, 2009).

Learners prefer straightforward to complex interactive technologies in the learning process (Lewin & Luckin, 2010). If the communication technology is too intricate to use, it may diminish the effectiveness of the tool. Overall research on teacher participation in interactive technologies, such as course management systems, blogs, and learning gadgets (e.g., writing pad), reports a positive evaluation as a result of their use, only when they are used for customized pedagogical purposes (Shoffner, 2009; Wieling & Hofman, 2010).

The quality of teaching materials is enhanced if the materials cater to individuals' different learning styles such as fast learner, slow learner, visual communication advocates, or verbal communication advocates (Riding & Grimley, 1999). An instructional Web site provides an audio email tool, which enables the instructor to communicate with the student in a personal conversation setting. Besides, video lecture files available can help students with any impairment learn efficiently. Guthrie (2010) affirmed this notion of customized pedagogy using communication technologies in a study by revealing that students' reaction to online class materials varied from skeptical to promising. These results suggest that a hybrid of online and offline instructional settings would offer a better learning outcome to satisfy differential needs of learners.

In summary, these different results suggest that new communication technologies are a good fit when they are used properly. The factors such as characteristics of educators and learners, instructional environments, available facilities, learners' interests and experience with communication technologies, and/or class materials fitting the use of communication technologies, come into play in understanding the effectiveness of technologies for instructional purposes. The Web sites and tools introduced in the following section also offer educators opportunities to use them with the expectation of intended results. The tools are categorized into either linear or nonlinear technologies based on interactivity. The tools requiring students' direct participation are called nonlinear technologies whereas the tools used for teacher lectures are introduced as linear technologies.

LINEAR TECHNOLOGIES FOR CLASSROOM USE

Ispring®

- **Site:** http://www.ispringsolutions.com/

- **Tool Management Logic:** Basic program downloading for free and premium service with a software package for a charge.
- **Tool Information:** Ispring® is a software program for an integrative use of multimedia components for teaching and learning enhancement.
- **How It Works:** Ispring® allows a user to download the basic packet from the Web site. Once downloaded, the program is added as a new menu tab in PowerPoint. The user clicks the new icon of Ispring® on desktop and can find the new tab in PowerPoint.® By clicking the tab, it shows several options from YouTube® video conversion to Flash® movie insertion. The user simply clicks the YouTube® icon on top to paste the movie clip URL from the YouTube site in the box.
- **Educational Use:** This tool is useful for utilizing YouTube® videos as class materials. Currently, it is not technically simple to convert a YouTube® video to another video file format and use it in a PowerPoint® presentation. The program allows the placement of the video in PowerPoint®, which can provide an organized class lecture without visiting the YouTube site to play the video.
- **Advantage:** The classroom can be more dynamic with animated graphics and movies. Students can watch a Flash® animation movie or a YouTube® clip in PowerPoint. This instructional tool fosters an active learning environment and draws a higher level of student attention.
- **Disadvantage:** Possible disadvantage is the knowledge needed for Flash® animation movie creation. The instructor needs prior knowledge of the Flash® software to use this component. The computer for the PowerPoint® presentation with a YouTube® video should be Internet connected. The computer should also be installed with a Flash player.

Screenr®

- **Site:** http://screenr.com/
- **Site Management Logic:** Basic service for free and premium service for a charge.
- **Site Information:** The site allows a user to video record the computer screen for many purposes. The user can create an instructional video using this site.
- **How It Works:** A user gets ready with content to video record on the computer screen. The computer should be equipped with a microphone and speaker. For example, if a user wants to video record a Photoshop® instruction, open Photoshop and be ready to record the instruction. Once the user clicks the “record your screen” button, a record screen guideline appears. The user can adjust the size of the line, which is the size of the video recording portion of the screen. After recording the screen, the user can save it as a video file (e.g.,.mp4). The site requires a user to have a Twitter account to publish the recorded clip. Once it is published, it provides the URL of the video or enables the user to publish it on YouTube.
- **Educational Use:** Teachers can video record class materials using the computer. By opening class materials on the computer (e.g., online book, article, software program), the teacher records the portion and makes it available in archives for students on the Web.
- **Advantage:** The access to the site and use is straightforward for users. Students can enjoy teachers’ short videos about class materials that were not covered in class. This is another way of using communication technologies for both students and

teachers to get involved in enhanced learning experiences.
- **Disadvantage:** The user needs to have an external or built-in microphone and speaker equipped on the computer.

NONLINEAR TECHNOLOGIES FOR CLASSROOM USE

Poll Everywhere®

- **Site:** http://www.polleverywhere.com
- **Site Management Logic:** Basic service for free and premium service for a charge.
- **Site Information:** This site offers an interactive poll data collection interface using the cell phone.
- **How It Works:** As a user, first register to be a member of the site. A registered member can create poll questions. Each poll question is assigned a cell phone text messaging number for a respondent to access and answer. A respondent calls the text message number and chooses an answer by sending the designated number of the answering option. As respondents send their answers, a bar graph in real time shows the status of responses.
- **Educational Use:** An instructor can post review questions about the day's class materials at the end of class. Have students use their cell phones to answer the questions.
- **Advantage:** This method fosters an impressive learning atmosphere that the instructor uses a topnotch digital technology to facilitate student learning. Students are likely to pay attention to the responding process during the use of their cell phones to answer questions. Students are impressed as they see the bar graph change in real time as they respond.
- **Disadvantage:** Students without a cell phone or text-messaging service in the phone cannot participate. Phone companies charge for text-messaging service.

Second Life®

- **Site:** http://secondlife.com
- **Site Management Logic:** Basic service for free and Linden money purchase for a charge.
- **Site Information:** This site offers an interactive virtual reality interface for users to live another life as an avatar online.
- **How It Works:** First download the Second Life® software on the computer. Register as a user and create an avatar. Run the downloaded software to log in. Using the transport tool, the avatar can visit any place created in the Second Life® on the Web.
- **Educational Use:** An instructor can ask students to download the software and become a member. During the class or at any other designated time, the instructor and students can meet at a virtual place by teleporting together. The instructor with students can visit educational places, such as NASA,® historic sites, or museums. The instructor can create an assignment for students to visit a site and write a report about the visit. The instructor can also create PowerPoint® slides in a virtual place for a virtual class. Instructions for slide creation can be obtained in Google® search.
- **Advantage:** Both teachers and students experience the virtual world for learning. Students can get involved in learning about a subject as they visit and explore a place online for their academic inquiries.
- **Disadvantage:** In some cases, students may be distracted from their learning when the instructor focuses on the technical aspects of Second Life.® The class may lose focus if the instructor too heavily depends on the virtual reality for class.

Wimba®

- **Site:** http://www.wimba.com/
- **Tool Management Logic:** The Wimba® voice tools work in affiliation with course management systems, such as Blackboard.
- **Tool Information:** Wimba® provides several voice tools that can be used for podcasting, voice recording, voice email, and asynchronous voice discussion.
- **How It Works:** Once the tools are installed and activated in a course management system, the tools are available as plug-ins. The instructor first plugs-in each tool in the course interface where students log in to obtain course materials and communicate with the instructor. The instructor records a voice email and sends it to either all or individual students. Students can check the voice email in their email account. Students can reply by clicking a link provided in the voice email. The instructor can record a voice lecture using podcast or voice recorder. Students play the audio file in the course management site. The instructor is able to post a discussion topic as an audio file. Students participate in the discussion by recording their opinions.
- **Educational Use:** The first voice email to all students before the first day of semester is a nice start to communicate with students. There are many lectures that are not fully covered or discussed in face-to-face classes. The instructor can record any missing materials in podcast or voice recorder for students' access. A review of study guides for tests can be recorded and posted on the site as well. Students can listen to clarified explanations of the study guide on the site.
- **Advantage:** The voice tools offer the personal communication interface between teachers and students. Students prefer to hear their teacher's voice in emails and discussion boards. These tools enhance students' learning by giving an opportunity of involvement, concentration, and retention in course subjects and issues through listening.
- **Disadvantage:** Currently, the tools are provided in affiliation with course management systems only. The teachers intending to use the tools need to work with the school for its adoption of an online course management system (if the school doesn't have one) first and connection with the Wimba® tools.

Turningpoint Technologies®

- **Site:** http://www.turningtechnologies.com/
- **Tool Management Logic:** Turningpoint® technologies require the use of a keypad and receiver when users interact with each other. The keypad can be purchased in bulk by schools or organizations. The receiver captures the signal the keypad sends in a room for communication.
- **Tool Information:** The keypad enables the user to respond to questions in a classroom setting. The tool is used for quizzes or tests.
- **How It Works:** A teacher needs a receiver and the Turningpoint® software program downloaded from the Web site. Students are given keypads that are used for question responses. With the receiver ready, the teacher downloads the software program on the computer. A new icon is placed on the desktop screen. Once clicked, PowerPoint is open and a new Turningpoint® tab is added to the program. The teacher creates questions using several question display types (e.g., bar graph, pie chart). In the classroom, the teacher first plugs in the receiver to the USB slot to activate the signal reception. The teacher runs the question slideshow for students to answer. Students press a button on the keypad to answer the

question. The answers are received in the receiver and the bar graph shows the answer status. More detailed instructions are provided on the Web site.

- **Educational Use:** Teachers can conduct quizzes throughout the semester using this tool. Students' answers are recorded in a file and used as a grading item for the final grade. If the teacher is not using the responses for grading, using it for review questions of each chapter or class can be effective. Students can be given a discussion time with partners after they see that the answer bar graph is widespread with no unified answer. This technology nicely integrates classroom learning with communication technologies.
- **Advantage:** Students get involved in the quiz in an entertaining manner. They directly see the results of their responses in a graphical figure. They have a chance to discuss the question and understand the concept.
- **Disadvantage:** The tool requires the user to purchase receivers and keypads. Some students forget to bring keypads in class or lose them. An instructor's careful management of keypads is necessary.

CONCLUSION

The Web sites and tools offer educators various opportunities of pedagogical development. As reviewed in the first section of this chapter, it is important that educators find the best spot from the sites, gadgets, and tools in the classroom for use. For lecture courses, Ispring® offers the employment of multimedia into the classroom as it enables an instructor to play YouTube® videos and Flash® animation movies in PowerPoint® presentations. Second Life® provides a new way of teaching and learning in virtual reality. Students are expected to get more involved with class materials as the instructor reviews course materials with quiz questions in Poll Everywhere® or Turningpoint® Technologies. To make the class more personal than one-way lectures for the purpose of test preparation, Wimba® voice tools connect educators and students personally as they exchange voice emails or narrative explanations of concepts and class materials. Teachers for practical courses can video record some segments of class instructions using Screenr® for students' convenient access on the computer.

The term "hybrid" represents the use of communication technologies as instructional tools. Educators need to design a course with a combination of technologies and traditional lectures to facilitate learning by choosing the proper delivery mode for class sections and materials (Sautter, 2007; Smith, 2005).

Eventually, communication technologies as instructional tools are unable to replace the current classroom completely and entirely. The technologies are supplements supporting teaching effectiveness in student learning. Customized use of the technologies adequate to the right pedagogy, student level, and the classroom setting can yield the planned results maximizing the utility of the gadgets.

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KEY TERMS AND DEFINITIONS

Blackboard®: Online course management system supporting instructors' teaching and student management.

Facebook®: Network Web site for interpersonal connection, sharing, and exchange of personal attributes, identity, and social involvement.

Communication Gadget: Mechanical device used for facilitating communication needs.

Hybrid: New form derived from a mixture of multiple elements. Online and offline communications are redeveloped as a communication hybrid to take advantages from each communication method.

Instructional Technology: Technological devices used for teaching needs. Computer programs, Web sites, or keypads for questions and answers are examples of instructional technology.

iPad®: Apple company's tablet computer. It enables users to tap the screen of the pad to run a program, visit a site, or use multimedia components such as movies and newspapers.

Ispring®: Software program that converts multimedia components into a presentable format. Movie files and animations are reproduced in a presentation file in Ispring®.

Linear Technology: One-way mode of technology operation. A presenter controls a presentation a projector but the technology does not enable it to interact with the audience. The projector is an example of linear technology.

Net (*N*)-Generation: Young generation that is familiar with technology. Most people in the US, ages between 14-35 are used to the Internet, social network sites, and computer technologies in their everyday lives.

Nonlinear Technology: Two-way mode of technology operation. Students use a keypad for questions and answers in the classroom to interact with the teacher. The keypad is an example of nonlinear technology.

Pedagogy: It encompasses methods of teaching and instruction. It is also a term for the art or science of teaching. A relevant pedagogy indicates correct use of the teaching method.

Poll Everywhere®: Web site that offers text messaging-based polls. Users answer questions by sending text message codes and the Web site displays the results.

Screenr®: Web site that enables a user to video record the computer screen. The user records the computer screen with voice over and exports it to a social networking site or saves on the computer.

Second Life®: Virtual reality space where avatars live and interact as real life humans. Avatars can teleport to another virtual place to experience cyber-reality.

Turningpoint® Technologies: Keypad and receiver system for class interaction. An instructor connects a receiver to the computer for the reception of students' signals sent from their keypads. Learning occurs as they use these devices for asking and answering questions on the computer.

Twitter®: Web site for short message exchange. The user can follow other users and be followed by others as well.

Wimba®: Voice recording tool consisting of voice email, voice discussion, voice recorder for instructional needs, and online virtual classroom.

DISCUSSION QUESTIONS

1. **Discuss the effectiveness of communication technologies for classroom use in groups. Draw an opinion grid for advantages and disadvantages of technology use. Share the discussion results with other groups.** (see Table 1)

Table 1. Effectiveness of communication technologies as instructional tools

Advantages	Disadvantages
Communication technologies… 1. facilitate learner participation in class discussion. 2. help recall and understand class materials. 3. enhance teamwork skills and overall enjoyment of class. 4. help course and student management. 5. Induce student interest in the subject.	Communication Technologies…. 1. limit face-to-face interactions between instructors and students when the course largely depends on online teaching. 2. Distract student attention and engagement when they are used excessively.

2. **Visit the Ispring® Web site (**http://www.ispringsolutions.com/**), download the software, and install on the computer. Use the program in PowerPoint® to embed a YouTube video and make a presentation file.** Once downloading the software, open PowerPoint; Visit YouTube.com and find a video clip for the class subject; Copy the URL of the video clip. In PowerPoint, click the YouTube button on the top menu bar; Insert the URL in the video link box.
3. **Visit Poll Everywhere® (**http://www.polleverywhere.com**) to register as a member. Create questions on the site and use them as a quiz in class.** Once the questions are displayed on the projector, students are expected to use their cell phones to text message by calling the number provided on top of the screen for the question. Students can post their own questions there and have classmates answer the question.

Chapter 25
Teaching What We Don't Know:
Failing to Adequately Prepare Teachers to Use Technology for the Benefit of Students with Special Needs

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ABSTRACT

When newly graduated teachers enter the classroom, they are expected to possess the knowledge to adequately teach students with a wide variety of needs including students with special needs, whether these students perform far above the majority of their peers or lag significantly behind. A disconnect exists, however, between the expectation and the reality. The truth is that most teacher education programs do not provide adequate training to teacher candidates in the area of special needs, and in terms of teaching pre-service educators what technological tools are available to enhance the educational opportunities of students with special needs, there is virtually no training whatsoever. The conclusions from this study come from a random sample (n=60) of National Council for Accreditation of Teacher Education accredited schools and colleges of education in the United States and its territories.

INTRODUCTION

Schools of education in the United States make lofty claims about how well they prepare their graduates for teaching diverse student populations. One university web site claims to "prepare socially responsible critical thinkers who are collaborative and reflective educators committed to the moral endeavor of schooling in a democracy" (Maryville University, St. Louis, 2010); another claims to "promote extraordinary educators and learners" (Oswego State University of New York, 2010). While these kinds of claims are broad and could

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be defended based on qualifying words such as *prepare* and *promote*, the quality of their graduates is implied as generally high quality, but what makes a high quality teacher?

One skill set needed for high quality teachers in the digital age is the ability to infuse technology effectively and seamlessly into practice. Another is the knowledge of how to adapt technologies for the benefit of a diverse student body including students with exceptionalities. Yet in a random sample of the teacher education programs of U.S. schools and colleges of education that are accredited by the National Council for Accreditation of Teacher Education (NCATE), the findings demonstrate that teacher education programs in the U.S. do not adequately prepare their graduates to use current technologies in sound pedagogical ways to enhance student learning in general, and more specifically, they almost completely ignore the needs of students with exceptionalities.

This research examines to what extent teacher education programs accredited by NCATE in 2010 are preparing teachers to effectively use technology in teaching students with exceptional needs. The suggestion is made that perhaps more time should be spent revamping teacher education programs to meet the needs of all 21st century learners rather than continuing to invest time in jumping through the hoops held up by accrediting bodies.

BACKGROUND

In 1995 only three states recommended a technology proficiency component for teacher education programs (Zhou, Kendall, & Tan, 2003). By 2007, 45 states had incorporated technology standards into their programs to assess teacher competency (Bausell & Klemick, 2007). Despite a 14-fold growth rate over a 12-year period, teacher education programs have been extremely slow to respond to the mandate of preparing more technologically competent teachers.

The problem of ill preparation is not limited to the education of pre-service teachers. In-service teachers are also slow to respond to the call to become more technologically savvy. In a 2006 survey, only 18 percent of teachers rated themselves as having an advanced level of technological proficiency (CDW-G, 2006).

Many tools designed to help students with exceptionalities reach their potential exist, including the following:

- Text to speech and speech to text
- Touch screens
- Sticky key functions that allow sequential keystrokes to be recorded as simultaneous keystrokes (e.g. CTRL+ALT+DEL)
- Head and mouth controls
- Wacom Tablets (drawing pads)
- Closed Circuit Televisions
- Alternative assessment tools, such as portfolios
- Writing tablets that recognize even poorly formed letters

The problem is that most pre-service teachers never learn about the aforementioned tools. If teacher education candidates are even required to take a course in educational technology, adaptive technologies are usually addressed as a single chapter in their textbook (see Tomei, 2003), as an afterthought at the end of each chapter (see O'Bannon & Puckett, 2009), or not all (see Naidu, 2003).

If the so-called experts fail to address the needs of students with exceptionalities in their technology texts, it is unlikely that the professor who assigned the text will spend much additional time addressing the needs of this demographic. It is even more unlikely that pre-service teachers who plan to teach in the mainstream classroom will take the initiative to learn about technologies for students with exceptionalities.

METHODS

This research was a random sample of 60 of the 655 National Council for Accreditation of Teacher Education (NCATE) accredited schools and colleges of education in the U.S. and its territories. (The research originally called for a sample size of 100, but the variance was small enough that it was concluded that 60 was an appropriate sample size.) All of the 655 institutions were entered into an Excel spreadsheet and the analyzed institutions were selected through the use of the RAND function. The numbers were then sorted in ascending order and the first 60 were analyzed.

For each institution in the sample, the course of study analyzed was elementary education or early childhood education if no elementary education program was offered. Special education programs were not analyzed because the focus of the study was to examine how well schools and colleges of education prepare teachers who work with students with exceptionalities in mainstream classrooms.

The analysis was conducted using the current course catalog and class descriptions for each institution. Institutions were then sorted by the number of required technology courses and credit hours. Finally, a qualitative analysis was performed by examining the content of the required courses as detailed in the course descriptions or syllabi where available.

RESULTS

Both quantitative and qualitative data were analyzed. The purpose of the quantitative analysis was to determine a) what percent of the sampled schools required educational technology courses for their undergraduate teacher education candidates, and b) how many credit hours were devoted to learning how to use educational technology for teaching.

The qualitative analysis was performed in order to learn what specific topics were being taught to pre-service teachers in an effort to gain a clearer understanding of whether or not issues related to teaching students with exceptionalities were explored and if so, to what extent.

Quantitative Results

Of the 60 sampled National Council for Accreditation of Teacher Education (NCATE) accredited institutions, 21 (35%) required zero technology courses for their undergraduate teacher education candidates, 32 (53.3%) required one technology course, 5 (8.3%) required two technology courses, and 2 (3.3%) of the institutions did not offer undergraduate degrees in education. The results are shown in Figure 1.

In terms of credit hours devoted to learning about educational technology, 21 (35%) NCATE accredited teacher education programs required zero credit hours in technology courses, 3 (5%) required one credit hour, 7 (11.6%) required two credit hours, 23 (38.3%) required three credit hours, 1 (1.6%) required four credit hours, and 3 (5%) required six credit hours. Two additional universities (3.3%) in the sample did not offer undergraduate degrees in education. See figure 2.

While the numbers of required technology courses and credit hours offer some insight into how teacher education programs are preparing their candidates, it is only part of the story. In order to get a more accurate view of how well teacher education candidates learn to use technology for the benefit of students with exceptionalities, a qualitative approach is required.

QUALITATIVE RESULTS

Of the 37 institutions that required a technology component for teacher candidates, only two placed any emphasis on students with exceptionalities. According to its course descriptions, Northwest Missouri State University offered the opportunity for teacher education students to learn how to use technology in teaching students with exceptionalities:

Figure 1. Number of Required Educational Technology Courses for Teacher Candidates

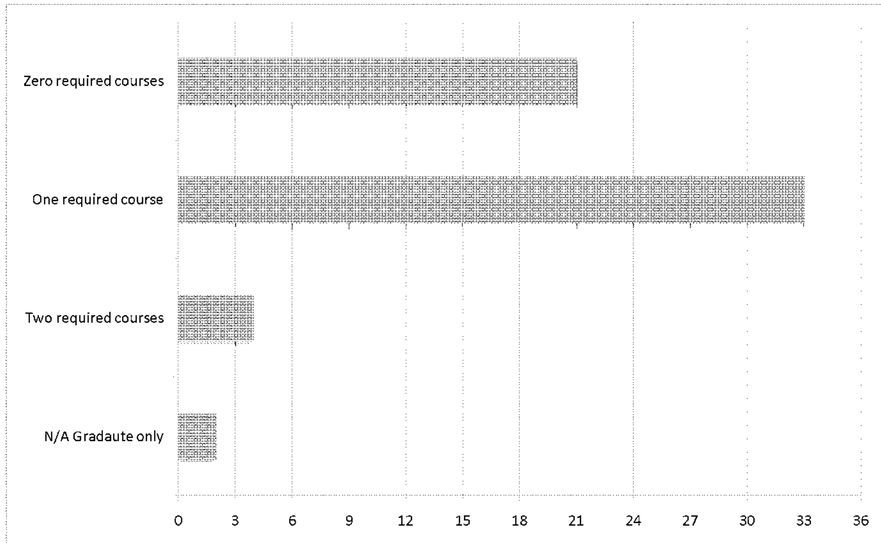
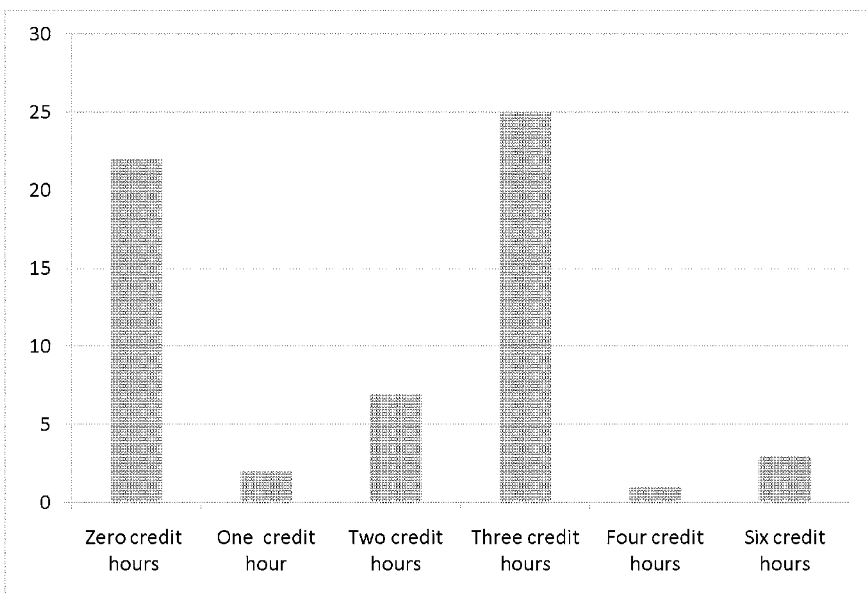


Figure 2. Number of Educational Technology Courses Required



Students will learn about various technologies, applications, procedures and assessment to facilitate the learning of students with disabilities. Topics include assessment, levels of assistive technology services and, use of word processing, spreadsheet, and database software in the classroom, student and teacher productivity applications, legal, ethical issues regarding technology in the classroom and instructional software. (Northwest Missouri State, 2010, p. 7)

Buffalo State College (2010) offered a similar course to its preservice teachers in an effort to expose them to technologies for learners with exceptionalities:

Provides preservice teachers with an awareness of the current range of instructional and adaptive technologies. Emphasis is placed on factors relating to curricular integration of technology within the general and special education classroom. Students receive hands-on experience with the use of instructional software, web sites, and adaptive/assistive technologies. (n.p.)

One other institution, made reference to "addressing the needs of individual learners" (St. Augustine's College, 2010, n.p.). None of the remaining 34 institutions that required technology courses for their teacher candidates made any reference to utilizing educational technologies to meet the needs of students with exceptionalities.

DISCUSSION

Pre-service teachers are not just failing to learn the technology skills necessary to serve the needs of students with exceptionalities, they are also failing to learn how to use technology to facilitate higher order thinking in their mainstream students. Not one of the 37 institutions that required a technology component for teacher candidates made any mention of using technology to develop critical thinking skills and none of the institutions addressed pedagogically sound practices of integrating technology. Only one institution, Marshall University, even mentioned technology and its "application to teaching and learning" (2010, n.p.). The remainder of the institutions appears to be teaching skills in isolation from practice.

In *Training Teachers who are Terrorized by Technology!*, Kathy Campbell (as cited in Hopkins, 2005), teacher facilitator of technology for the St. Charles Parish (Louisiana) Schools, cautions against teaching technology in isolation:

As a teacher, your primary goal is to use technology to supplement learning—rather than teaching technology in isolation... The use of computers should be so infused that the students think that technology is part of the natural learning process. (n.p.)

Despite the recognition that technology should not be taught in isolation, that is precisely what most teacher education programs do. Pre-service teachers, if they spend any time at all learning technology skills, spend it learning how to use Word, Excel, PowerPoint, and e-mail programs but few teacher education programs teach teachers how to use technology in sound pedagogical ways. Such practices might come as no surprise from non-accredited teacher education programs or online diploma mills, but when colleges and universities that allegedly have the highest oversight and claim to be of the utmost quality perpetuate unsound pedagogical practices, it is truly reprehensible. Such an utter lack of preparation would never be tolerated in other fields.

Imagine that during the course of medical school, a physician received only one 16-week class in diagnostics, of which one or two sessions were devoted to diagnosing patients of a particular age bracket. Now imagine that you fall into that age bracket and you have been experiencing symptoms that worry you. If you knew that your physician, who graduated from a prestigious program, had spent only a few class hours of a single course learning to diagnose people of your age bracket, how comfortable would you be in letting that physician diagnose your ailment? Yet, this is exactly the scenario that is playing out every year in schools and colleges of education in the United States and its territories. Graduates with zero to only a few class hours utilizing digital technologies aimed at helping students with exceptional needs reach their full potential are entering classrooms allegedly well prepared to teach these students. In an age where technology is ubiquitous, turning out teachers who lack technological literacy is almost unthinkable.

CONCLUSION

What this research demonstrates is that schools and colleges of education that are accredited by the National Council for Accreditation of Teacher Education (NCATE), which is touted as "the standard of excellence in teacher preparation" (National Council for Accreditation of Teacher Education, 2010, n.p.), are not living up to the accrediting body's claims. It makes one wonder what exactly NCATE is assessing when deeming that a particular teacher education program meets its standards of excellence. Whatever NCATE is measuring, it is clearly not a teacher education program's ability to produce teachers with a high level of digital literacy and it is not the program's ability to produce teachers who have knowledge of how to utilize technology to meet the needs of students with exceptionalities.

Far too much emphasis is being placed on NCATE accreditation, which as this research indicates falls far short of its proclamation that it is "the standard of excellence in teacher preparation" (National Council for Accreditation of Teacher Education, 2010, n.p.). Suzanne M. Wilson (2006), University Distinguished Professor at Michigan State University, Chair and Professor in the Department of Teacher Education asks, "What are the implications for accreditation? Do we really need it? And if so, to what ends?" (p. 42). Perhaps the time has come to stop jumping through the hoops put in place by an accrediting body that claims to be the standard of excellence and instead focus on creating courses that better serve all students, students with exceptional needs included.

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KEY TERMS AND DEFINITIONS

Students with Exceptionalities: Any student who has been determined eligible for a special program in accordance with rules of the Florida State Board of Education. The term includes students who are gifted and students with disabilities who have an intellectual disability; autism spectrum disorder; a speech impairment; a language impairment; an orthopedic impairment; an other health impairment; traumatic brain injury; a visual impairment; an emotional or behavioral disability; or a specific learning disability, including, but not limited to, dyslexia, dyscalculia, or developmental aphasia; students who are deaf or hard of hearing or dual sensory impaired; students who are hospitalized or homebound; children with developmental delays (Laws of Florida, 2008–204, 1003.01, 3a).

Technology: Electronic machines or components and wireless devices used for personal, educational, and professional productivity as well as those used for entertainment and the infrastructures behind those machines.

DISCUSSION QUESTIONS

1. **What evidence exists that accredited teacher education programs produce teachers who are more highly prepared to teach students with exceptional needs in mainstream classrooms than non-accredited programs?** Research the web site for the National Council for Accreditation of Teacher Education at http://ncate.org/ and the Teacher Education Accreditation Council website at http://www.teac.org/. There is no empirical evidence provided that demonstrates teachers who graduate from accredited programs are more prepared to teach students with exceptional needs in mainstream classrooms than those who attend non-accredited programs.
2. **What implications are there for students growing up in a digital world when their teachers are not utilizing technology in pedagogically sound ways?** One must model the behavior that one hopes to foster. This belief is widely held by educational researchers, ministers, parents, and others. Teachers, then, have an obligation to model technology usage in pedagogically sound ways so that students learn how to harness the power of technology to answer their own questions and solve their own problems throughout life.
3. **How might teacher education programs be restructured so that the needs of students with exceptionalities are more effectively being met?** The needs of students with exceptionalities must be thought about, discussed, and addressed throughout teacher education programs. To treat any population of students as an afterthought devalues them as both persons and learners.
4. **What advantages might there be in infusing technology throughout teacher education programs as opposed to requiring one or two courses that focus on how to use technology in isolation?** Teaching any skill in isolation from its practice setting makes no sense. The advantages of infusing technology throughout teacher education programs are many and include producing more competent teachers, promoting autodidactic behavior, demonstrating seamless technological integration, modeling more interactive teaching methods, and encouraging a pragmatic approach.
5. **How many credit hours should be required in the area of (a.) educational technology in general? (b.) educational technology for students with exceptionalities?** There is not a magic number of credit hours that if completed will consistently produce teachers who can use technology for the benefit of all their students; however, college administrators need to constantly examine and reexamine the use of technology in their teacher education programs and be able to effectively demonstrate that preservice teachers are graduating with the requisite knowledge to use technology as an effective teaching and learning tool.

Chapter 26
Ten Hot Assistive Tech Websites That You Won't Want to Miss

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ABSTRACT

This chapter introduces ten websites that can be used to access and reference information on assistive technology. Assistive technology is defined as technology used by individuals with disabilities in order to perform functions that might otherwise be difficult or impossible. With the advent of more advanced technology comes the need to understand what is available, how to get it, and how to use it. The Internet provides easy access to this information; however, search engines can make it difficult to screen the vast number of websites available. The authors have screened websites to facilitate those interested in assistive technology more than simply company products and advertising. The criteria for determining which websites to include were applicability for teachers and availability of additional resources. Each website has a listing of the website's sponsor, the full Web address, and a description of what information, products, and tools can be found on the website. Website authors include companies, teachers, individuals with disabilities, and government organizations. The websites chosen range from those offering products and resources for entire classrooms to those customizing computer controlled devices for individual students.

INTRODUCTION

Type in "assistive technology" into a search engine on the Internet and pages of websites will appear. Many websites are from companies selling their devices or approaches. Some are from teachers, government organizations and even from individuals with disabilities. Rather than chase randomly around the Internet to find information on assistive technology, you can read through this article and check out the ten websites extracted from those pages the search engine provides. These websites were selected based on the information available in them. The websites reviewed below include

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everything from free materials to lists of computer vendors who specialize in high tech solutions for individuals with disabilities. Make these your starting place to fruitful web searching. Each of the ten includes the web address, the name of the website sponsor and a brief description of what information can be gained from the website.

THE TOP 10

1. **Equal Access to Software and Information (EASI):** http://people.rit.edu/easi/resource/input.htm. A computer does a student no good if he or she cannot access it. This website from the Rochester Institute of Technology is a great place to start if you need a list of companies specializing in alternative input hardware and software and do not want to weed through what your search engine may include. These companies produce alternative keyboards, on-screen keyboards, trackballs, joysticks, various switches, and voice recognition.
2. **SMART Technologies:** http://smarttech.com/us/Solutions/Education+Solutions. This is the website for those SMART boards, other SMART products and programs. If you click on the *Resources* tab and select *Programs and funding* from the drop down list, there is help in getting a grant and ideas for fundraising. In the same drop down is *Research and data*. The last item is *Explore our research library*. Clicking on that will take you to a list of topics that includes *Special Education*. There you will find research on what works for students with various disabilities. Holding the best part until last, also under the *Resources* drop down is *SMART Exchange*. This allows teachers to download free programs that other teachers have created for use with SMART products.
3. **Captioned Media Program (CMP):** http://www.dcmp.org. Provides free-loan, open-captioned videos to students who are deaf or hard of hearing and described video for students who are blind or have visual impairments. These include classic movies, educational videos, and special-interest videos. In addition the organization acts as a clearinghouse for articles on accessible media utilization [click on the *Clearinghouse* tab and then on one of the last items, *Accessible Media Utilization... For Educators*.].
4. **The U.S. Department of Labor's job accommodations network:** http://askjan.org/soar/disbilities.html. This website allows you to search by disability and provides lists of accommodations. At the bottom of the page are four listings that display products useful for cognitive/neurological, deaf/hard of hearing/motor and vision impairments. It is a super compendium of products and ideas that can be adapted to the classroom. These also make a great basis for a transition plan.
5. **Alliance for Technology Access (ATA):** http://ataccess.org. Selecting the *ResourceHUB* tab takes you to a page with excellent definitions of assistive technology and a left hand list of resources. Under *Publications*, you can find free, downloadable publications including a "Guide to Low-Cost/No-Cost Online Tools for People with Disabilities" and "Making a Switch Adapted Toy." Clicking on *ATA Centers* takes you to a state-by-state list of assistive technology centers. *ATA Partners* provides yet another list of assistive technology vendors. The strangely named *Ning* opens up a new Internet window called the *ATA Disability Access Community*. This is a question/answer forum where you can join in the assistive technology community.
6. **Empower Technology:** http://empowertech.org/Technology.html. Although this is a California organization, the website contains great information under the *Technology* tab. This tab sends you to a super list of assis-

tive technology terms and components that describe the variety of what is available and what it does. It will make speaking and understanding techno easy.

7. **Able Net:** http://www.ablenetinc.com. AbleNet is an international manufacturer of adaptive technology for use in teaching students with disabilities. Their website also has a great resource library of ideas that teachers and parents have implemented using their technology. To get there, just click on *Remarkable Ideas* in the upper right corner. At that point you have boxes where you can select disability or content area.
8. **Super Duper Inc.:** http://www.superduperinc.com/handouts/handout.aspx. The SuperDuper company offers many low tech solutions for reading. The website also incorporates a great list of free handout materials and most have a version in Spanish. Titles include *Fun Ways to Teach Children How to Write the Letters of the Alphabet* and *Can Pictures Help Children with Autism*?
9. **Slater Software:** http://slatersoftware.com. Slater is a manufacturer of communication boards primarily for use with children with autism. Their website has free, color communication games that can be downloaded for use in the classroom. To get to them, you just have to click on the tab marked *Free Stuff*. At the bottom of the page there are two free computer games, *PixMatch Animals* and *PixMatch Shapes*. Under *Literacy Support Pictures*, you can type in a word and the program produces a picture that you can freely use for non-commercial applications.
10. **Web Accessibility in Mind:** *http://www.webaim.org*. And let us not forget that the Web itself can be a challenge for students with disabilities. **Web Accessibility in Mind** (www.webaim.org) has the mission to help inform web developers and others who use html content on how to make the web accessible for all people with disabilities. It provides great checklists of what to look for when evaluating web content for use by students with disabilities. It includes a free software tool called WAVE that can score the accessibility of web/html documents under development.

CONCLUSION

These websites should propel anyone interested in a certain aspect of assistive technology to a wealth of information on their topic. The websites are not intended to be exhaustive. However, they will provide a foundation for in-depth analysis of a facet of assistive technology. Many of these websites offer links to other websites offering complementary products, services and resources. These hot top 10 websites on assistive technology provide a great starting place for a look into this world.

ADDITIONALREADING

http://www.makoa.org//computers.htm

DISCUSSION QUESTIONS

1. **Since search engines are freely available, why is it beneficial to have a list of websites for assistive technology?** Responses should mention the volume of data a search engine provides with paid advertisers generally appearing at the top of the search list.
2. **Identify three websites with assistive technology information. Why you feel they are important?** Responses could include any of the ten listed in the chapter or others from the Internet.

List of Abbreviations

The fields of education, technology, and special education use jargon extensively. Because this book takes an interdisciplinary approach, which is designed for use by students and professional from around the world, we sought to minimize the use of abbreviations in each chapter. Still, you will find many abbreviations. To help reader understanding and to help readers who need to look up a term in the index, we have provided this list of abbreviations.

- **2e:** Child who has double exceptionalities
- **AAC:** Argumentative and alternative communication
- **AAIDD:** American Association on Intellectual and Developmental Disabilities
- **AAMD:** American Association of Mental Deficiency
- **AAMR:** American Association of Mental Retardation http://www.aamr.org/
- **AAMT:** American Association for Music Therapy
- **ABA:** Applied behavior analysis
- **ABC:** Antecedent-behavior-consequence
- **ABS:** Adaptive Behavior Scales
- **ACARA:** Australian Curriculum, Assessment, and Reporting Authority
- **ACLD/LDA:** Adults and Children with Learning and Developmental Disabilities, Inc. http://www.acldd.org/
- **ADA:** Americans with Disabilities Act of 1990
- **ADD:** Attention deficit disorder
- **ADHD:** Attention-deficit/hyperactivity disorder
- **ADHD-C:** Combined type
- **ADHD-HI:** Predominantly hyperactive/impulsive type
- **ADHD-I:** Predominantly inattentive type
- **AIMS:** Assessment for Integration into Mainstream Settings
- **AMX:** Alternate Media eXchange Database
- **ANSI:** American National Standards Institute
- **APA:** American Psychological Association
- **APIL:** Arizona Phonological Imaging Lab
- **ARC:** Association for Retarded Citizens
- **ASD:** Autism Spectrum Disorders
- **AT:** Assistive technology
- **ATC:** Assistive Technology Collaboration, often used regarding a student's plan

- **ATP:** Assistive Technology Professional
- **ATS:** Assistive Technology Services
- **CAMT:** Canadian Association for Music Therapy
- **CAPD:** central auditory processing disorder
- **CAST:** Center for Applied Special Technology
- **CBM:** Curriculum-based measurement
- **CC:** Closed captioned
- **CC:** Cross Categorical
- **CCBD:** Council for Children with Behavioral Disorders
- **CD:** Compact disc
- **CD:** Conduct disorder
- **CEC:** Council for Exceptional Children
- **CMC:** Computer-mediated communication
- **CMO:** Conditioned motivation operation
- **CNS:** Central nervous system
- **CPMT:** Communication Privacy Management Theory
- **CWC:** Class-within-a-class model (special educator works in classroom with general educator)
- **DAISY:** Digital Audio-based Information System
- **DD:** Designated driver
- **DD:** Developmental Disabilities
- **DRA:** Differential reinforcement of alternate behavior
- **DRI:** Differential reinforcement of incompatible behaviors
- **DRL:** Differential reinforcement of low rates of behavior
- **DRO:** Differential reinforcement of other behavior
- **DS:** Disability services
- **DSM-IV:** Diagnostic and Statistical Manual of Mental Disorders, 4th Edition
- **DTB:** Digital talking book
- **DVD:** Digital video disc
- **EAHCA:** Education for All Handicapped Children Act
- **EBD:** Emotional/behavioral disorder
- **EBP:** Evidence-based practice
- **ELL:** English language learners
- **ELPA:** English Language Proficiency Assessment
- **EO:** Establishing operations
- **Eval:** Evaluation
- **FAPE:** Free and Appropriate Public Education
- **FAS:** Fetal alcohol syndrome
- **FBA:** Functional Behavior Assessment
- **GE:** General Education (Gen. Ed.)
- **GI:** Government issue
- **GUI:** Graphical user interface
- **HIPAA:** Health Insurance Portability and Accountability Act of 1996
- **ICLD:** Interagency Committee on Learning Disabilities
- **IDEA:** U.S. Individuals with Disabilities Education Act of 2004

- **IDEIA:** Individuals with Disabilities Education Improvement Act
- **IEP:** Individualized Education Program or plan
- **IEP Team:** Individualized Education Program Team
- **IFSP:** Individualized family service program required for services from birth to age five
- **IHCP:** Individualized health care plans
- **IPlans (IEP, IFSP, ITP):** Individual education plan
- **IQ:** Intelligence Quotient. 100 is average
- **IRC:** Internet Relay Chat
- **IT:** Information technology
- **IT:** Instructional technology
- **ITP:** Individualized transition program by time child is 14
- **JABA:** Journal of Applied Behavior Analysis
- **K-12:** Kindergarten through 12th grade education
- **K-ABC:** An intelligence test
- **LD:** Learning disability
- **LEA:** Local educational agency or local educational association
- **LEP:** Limited English proficiency
- **LIFT:** Linking the Interests of Families and Teachers
- **LLD:** Language learning disabled
- **LRE:** Least restrictive environment
- **Mac:** Macintosh computer
- **MAS:** Motivation assessment scale
- **MDT:** Multidisciplinary team.
- **MID:** Mild intellectual disability
- **MM/CC:** Mild to Moderate Disabilities Cross Categorical
- **MMD:** Mild-to-moderate disabilities
- **MO:** Motivative operations
- **MP3:** MPEG-1 Audio Layer III
- **MR:** Mental Retardation
- **NAPCSE:** National Association of Parents with Children in Special Education
- **NCA:** National Communication Association
- **NCATE:** National Council for Accreditation of Teacher Education, USA
- **NCLB:** No Child Left Behind Act
- **NCR:** Noncontingent reinforcement
- **NEA:** National Education Association
- **NHMRC:** Australia National Health and Medical Research Council
- **NICHCY:** Connections...to Behavior Assessment, Plans, and Positive Supports
- **NIDA:** National Institute on Drug Abuse
- **NIMAS:** National Instructional Materials Accessibility Standard
- **NISO:** National Information Standards Organization
- **NJCLD:** National Joint Committee on Learning Disabilities
- **NLD:** Nonverbal learning disorder
- **NOS:** Not otherwise specified disability
- **NVDA:** Non Visual Desktop Access

- **OCD:** Obsessive-compulsive disorder
- **ODD:** Operational Defiant Disorder
- **ODR:** Office discipline referral
- **OMD:** Orofacial Myofunctional Disorder
- **OUL:** Optimal Utterance Length
- **PATHWAYS:** Promoting Alternative Thinking Strategies
- **PBS:** Positive behavior support
- **PCBs:** Polychlorinated Biphenyls
- **PDD-NOS:** Refers to pervasive developmental disorder - not otherwise specified (Autism subcategory)
- **PDF:** Portable Document Format
- **PHS:** Public Health Service
- **PIAT:** Peabody Individual Achievement Test
- **PKU:** Phenylketonuria
- **RC:** Response Cost
- **RE Menu:** Reinforcing event menu
- **REI:** Regular Education Initiative
- **RFB&D:** Recording for the Blind and Dyslexic
- **RtI:** Response to Intervention
- **SAP:** Student Assistance Program
- **SD:** Standard Deviation
- **SEA:** State educational association
- **SES:** Socioeconomic status
- **SIB:** Self-injurious behaviors
- **SIB-C:** Self-injury and self-restraint
- **SLD:** Specific learning disability
- **SLI:** Speech and language impairment
- **SLP:** Speech language pathologist
- **SPED:** Special Education
- **SSB:** Self-stimulatory behavior
- **STEM:** Science, technology, engineering, and math
- **STT:** Speech-to-test technology
- **STY-C:** Stereotypy Checklist
- **TBI:** Traumatic Brain Injury
- **TTS:** Text-to-speech technology
- **UD:** Universal design
- **UDL:** Universal Design for Learning
- **UMO:** Unconditioned motivative operation
- **URL:** Universal resource locator
- **USB:** Universal Serial Bus
- **WIAT:** Weschler Individual Achievement Test
- **WMA:** Windows Media Audio
- **WPPSI, WISC III, WAIS:** Wechsler family of intelligence tests

Glossary

Access: The ability, right, or permission to approach, enter, or use.

Accessible: The ability of the classroom and instruction to benefit all, because methods are made to allow all students to learn.

Accommodation: A change to an activity that alters how content is taught or learning is measured without changing the difficulty of the content.

Accommodations: Adaptations provided to increase student success.

Americans with Disabilities Act of 1990 ADA: The Americans with Disabilities Act of 1990 provides nondiscriminatory protections to individuals with disabilities, in particular adults with disabilities. ADA applies to all segments of society including education, employment, public accommodation, telecommunications, and services operated by public and private entities, only excludes private schools and religious organizations.

Analysis of Covariance: A statistical analysis where experimental results are studied for their effect though use of a covariate that is related to the variable.

Anchored Instruction (AI): Teaching and learning activities situated or anchored in complex meaningful macro contexts presented via video multimedia formats (CTGV, 1990).

Annotation: The addition of explanatory or critical comments to a text, website or other artifact.

Assistive Technology (AT): 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 the functional capabilities of a child with a disability. The formal, legal definition of assistive technology cited in the Assistive Technology Act of 1998 includes "any product, device, or equipment, whether acquired commercially off-the-shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities."

Attention Deficit Hyperactivity Disorder (ADHD): A developmental disability characterized by lack of attention accompanied by excessive physical activity.

Audio Book: A book presented in analog or digital format on tape, CD, DVD, or in digital file format.

Autism: A developmental delay characterized by delays in communication, social skills, and repetitive movements or restricted interests.

Banana Keyboard: The "banana keyboard" is a unique system designed to allow people with disabilities access to the wonderful world of music and sound. The keyboard has 16 keys configured like an oversized piano, but curved to suit the radial movement of an arm. It may be placed on a wheelchair tray or bench.

Blackboard®: Online course management system supporting instructors' teaching and student management.

Bloom's Revised Taxonomy: It is a six level pyramid structure of complexities for classifying thinking (remembering, understanding, applying, analyzing, evaluating and creating).

Charter of Rights and Freedoms: Section 15.1: Canadian federal law that students with special needs have the right to assistive technology in their classrooms and cannot be denied that right.

Chat Rooms: Similar to Internet relay chat. These are virtual rooms where communication can occur.

Childhood Apraxia: A motor speech disorder characterized by a disconnect between signals from the brain and the muscles involved in speech. Individuals with childhood apraxia experience difficulty in coordinating articulators in order to say what they want to say.

Cleft Palate: An opening in either the hard palate (towards the front of the mouth) or the soft palate (towards the rear of the mouth). A cleft palate can result in nasalized speech.

Closed Captioning: An accommodation that provides access to the audio portion of a video file for viewers who are deaf or hard of hearing. Closed captions are written transcripts of dialogue and other significant sounds that are synchronized to display on the screen as the sounds occur. Captions are either closed or open. Closed captions can be turned on or off. On TV in the U.S., closed captions are delivered through line 21 of the video data area. On the Web, closed captions are delivered in a separate text file and activated when the user selects the caption function/button on the video interface. Open captions cannot be turned off. They are burned into the video itself. Captions are live or pre-recorded. Live captions are transcribed by a human stenocaptioner and delivered to viewers with a slight delay of 2-3 seconds usually. Captions are usually either one of two types: scroll-up or pop-on.

Cloud Computing: Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand, like the electricity grid.

Cloze-Text Activity: A reading assessment tool that is used to assess a student's reading comprehension. Teachers typically choose a grade appropriate reading passage and delete words systematically (for example, every fifth or seventh word), then ask students to predict words that belong in the blanks of the passage. The missing words are usually provided in a word bank.

Co-Articulation: This refers to the phenomenon where individual sound segments (or pronunciations) come to resemble one another when placed in linear sequencing with each other. For example, the exact articulation that makes up a [k] will be slightly differently according to what vowel follows it. One easy illustration of co-articulatory effects is the difference between "about you" and "abouchu" [əbaʊtʃu] in rapid speech. The [t] and the [j] co-articulate, that is they compromise halfway between the alveolar ridge and the palate, thus generating an alveo-palatal affricate [tʃ].

Cognition-Related Disability: A disability that has negative effects on one's ability to memorize, comprehend, plan or to perform other intellectual functions.

Communication Gadget: Mechanical device used for facilitating communication needs.

Communication Privacy Management Theory: A theory that explains what we disclose and to whom do we disclose or what we chose to keep private and what we chose to reveal to others.

Compic Pictographs: There are a variety of augmentative and alternative communication (AAC) systems and strategies that assist to address the communication needs of those with developmental, acquired and progressive disabilities. Compic pictographs are a library of easily understood computer generated visual representations of approximately 1800 words and concepts to convey information on a CD ROM.

Component: A part of a mechanical system such as a wheelchair.

Computer Assisted Instruction: Instruction that is supplemented by the use of instructional software.

Computer-Mediated Communication (CMC): Also called digital communication. Any interactive communication conducted solely through digital means (e.g., smartphone, computer, Smartboard) or where technology is used to enhance or supplement face-to-face communication. Examples include videoblogs, YouTube, Web blogs, online course environments, listservs, discussion boards, instructional software, and games.

Constructivist Teaching: A teaching approach that makes effective use of students' prior knowledge and cognitive structures based on those experiences to enhance learning.

DAISY: Acronym for the Digital Audio-based Information SYstem developed by the International DAISY Consortium, founded in 1996. DAISY is a globally recognized technical standard or specification for producing accessible and navigable multimedia documents, such as Digital Talking Books, digital textbooks, or a combination of synchronized audio and textbooks. Books produced using the DAISY standard and reading software and devices equipped with DAISY technology provide the option of "eyes free" reading, enabling users to "audio-skim," and to navigate to pages, chapters, headings, keywords, and images.

Descriptive Norms: People's perceptions of what is commonly done in specific situations.

Differentiated Instruction: A differentiated curriculum is a program of activities that offers a variety of entry points for students who differ in abilities, knowledge and skills. In a differentiated curriculum, teachers offer different approaches to *what students learn* (content), *how students learn* (process) and *how students demonstrate what they have learned* (product).

Digital Divide: A contrast between most US Americans (high access to computers and the Internet) and those of lower socio-economic status (low access to computers and the Internet).

Digital Talking Book (DTB): A multimedia representation of a print publication created by a collection of digital files that may contain digital audio recordings of human or synthetic speech, marked up text, and a range of machine-readable files. DTBs adhere to the standard developed by the National Information Standards Organization (NISO), the American National Standards Institute (ANSI), and are compatible with DAISY 3, the version which meets the ANSI/NISO standard.

Diverse Learners: Students with multiple learning styles, different levels of cognitive abilities, and social skills. It also includes students from different socio-economic and cultural backgrounds.

Double Exceptionalities (2e): A person who qualifies as having more than one special need or exceptionality. Often one exceptionality is classified as a disability, while another is giftedness.

Dysarthria: A motor speech disorder wherein an individual experiences difficulty in moving the muscles involved with speech. This weakness of muscle can occur after a stroke or brain trauma. The speech of an individual with dysarthria may be slower than normal or sound mumbled or slurred due to a restricted range of muscle movement. Dysarthria is more likely to affect adults than children.

eBook: A downloadable book presented electronically on a computer or mobile device such as an iPod, iPad, or Kindle Reader.

Echogenic: This refers to an object that borders a sharp change in density and thus images brightly on ultrasound technology. The tongue surface is generally echogenic.

Education for All Handicapped Children Act of 1975 (EAHCA): The Education for All Handicapped Children Act of 1975 made special education mandatory in the U.S. It was the first protection of American students with disabilities against discriminatory treatment by public education agencies.

Electronic Pens and Markers: Tools which can accompany IWBs to be used to interact with the IWBs for navigation and writing purposes.

Electronic Text (e-Text): Files that have been saved in a plain text format that can be opened on any computer (i.e. no formatting, or no html markup). They can be downloaded and opened using TTS-featured software programs. A Word document is not an e-text unless it is saved in plain text format.

Emotional/Behavioral Disorders (EBD): Challenging behaviors characterized by excesses and/or deficits in behaviors that deviate from expectations of others and may put them at risk for failure in school and/or home (www.cec.sped.org).

Eye Contact: Looking at someone else's eyes.

Facebook®: Network Web site for interpersonal connection, sharing, and exchange of personal attributes, identity, and social involvement.

Facial Expressions: Movements of the face expressing emotion, such as happy, upset, and bored.

Formative Assessment: An activity designed to measure progress toward a specific learning objective.

Functional Distances: The distance typically traveled in the course of the individual's daily routines.

Functional Essay Elements: Essential parts of an expository or persuasive essay, which include a *premise* or statement of belief, *reasons* to support the premise, a *conclusion*, and *elaborations* which elaborate on a premise, reason, or conclusion through examples, explanations, or experiences. Nonfunctional elements are not counted and include irrelevant material, which does not contribute to the overall topic.

Gallery: A database of images, interactive media, backgrounds, games, and/or videos.

General Education: The classroom for most of the students who are taught by general education certified teachers.

High-Tech Tools: Complex or specialized technologies such as computers and software programs (King-Sears & Evmenova, 2007).

Hybrid Communication: New form derived from a mixture of multiple elements. Online and offline communications are redeveloped as a communication hybrid to take advantages from each communication method.

Inclusion: Inclusion is a philosophy of education that integrates children with disabilities into educational settings in which meaningful learning occurs. Inclusion is not just a place or a classroom setting either; rather it means that all students, regardless of disability are included in the school community as valued members of the school.

Individualized Education Program (IEP): Also called Individualized Education Plan. The educational plan created by the educational team to assist a student with an exceptionality.

Individuals with Disabilities Act (IDEA): US American federal law that students with special needs have the right to assistive technology in their classrooms and cannot be denied that right. Stands for the Individuals with Disabilities Education Act of 1997 and its amendment in 2004 ensures students with disabilities have access to the regular classroom, and will be successful with the regular education curriculum. Under IDEA, children with disabilities, from age 3 to 21, are entitled to receive free and appropriate public educational services and support through their local school district.

Injunctive Norms: People's perceptions of what is commonly approved or disapproved of within a particular culture.

Instructional Design: A systematic process of planning, designing, implementing, and evaluation instructional materials and activities.

Instructional Technology: Technological devices used for teaching needs. Computer programs, Web sites, or keypads for questions and answers are examples of instructional technology.

Interactive Transcripts: Written transcripts of the audio portion of a video file. The transcripts are searchable and clickable, so users can interact with the transcript. By clicking on a word or sentence in the transcript, the user is transported to that moment in the video where that word is spoken. Vendors include 3Play Media and ProTranscript. YouTube also supports interactive transcripts.

Interactive Whiteboard (IWB): An electronic, interactive board which is either mounted or mobile.

Internet Relay Chat (IRC): Virtual synchronous communication in an unregulated, general, multi-user environment.

Internet: A technology used for various communications, such as information and relationship development.

iPad®: Apple company's tablet computer. It enables users to tap the screen of the pad to run a program, visit a site, or use multimedia components such as movies and newspapers.

Ispring®: Software program that converts multimedia components into a presentable format. Movie files and animations are reproduced in a presentation file in Ispring®.

Jellybean Switch: There are a variety of augmentative and alternative communication (AAC) systems and strategies that assist to address the communication needs of those with developmental, acquired and progressive disabilities.

Keyword Search: Using specific words or terms to search for information online using an Internet browser.

Learning Disabilities (LD): Neurological disorder that may cause difficulties in reading, writing, spelling, reasoning, recalling and/or organizing information (http://www.ldonline.com).

Least Restrictive Environment (LRE): *Least Restrictive Environment* is a mandate that entitles students with disabilities to be educated with their non-disabled peers to the greatest extent possible. This means that students who have disabilities should have full access to the general education curricular, co-curricular, and any other activities that their non-disabled peers would have access.

Linear Technology: One-way mode of technology operation. A presenter controls a presentation using a projector but the technology does not enable it to interact with the audience. The projector is an example of linear technology.

Listserv: A computer-mediated communication method in which a group of people can converse through email or discussion board format.

Low-Tech Tools: Simple, non-electronic tools used to support students with disabilities such as highlighters and index cards (King-Sears & Evmenova, 2007).

Medium-Tech Tools: Simple electronic equipment such as tape recorder and books-on-tape (King-Sears & Evmenova, 2007).

Mild-to-Moderate Disabilities: This category of disabilities includes most of the students with learning disabilities, speech or language impairments, mental retardation, emotional disturbance, autism, developmental delay and some students within other categories.

Modeling: An instructional strategy by which the teacher thinks aloud, demonstrating a new concept or approach to learning. The benefits of modeling include presentation of self-regulatory behaviors such as sizing up a problem, managing task environment, and of course, completing an assignment, such as planning a composition.

Modification: A change to an activity that alters what is being taught or measured.

Multimedia: It is use of multiple forms of media (video, audio, text, animations, graphics, and pictures) to create products in digital environments.

Multiple Intelligences: It is a theory developed by Howard Gardner (1983) that identifies eight intelligences that capture the full range of abilities and talents that people possess (linguistics, logico-mathematical, spatial, musical, interpersonal, intrapersonal, naturalist, and bodily-Kinesthetic).

Muscular Incoordination: A lack of coordination or organization of muscle movements.

Net (*N*)-Generation: Young generation that is familiar with technology. Most people in the US, ages between 14-35 are used to using the Internet, connecting in social network sites, and feel comfortable with computer technologies in their everyday lives.

NIMAS: The National Instructional Materials Accessibility Standard was published in 2006. With the endorsement of the US Department of Education, NIMAS guides the production and electronic distribution of digital versions of textbooks and other instructional materials so they can be more easily converted to accessible formats such as Braille and text-to-speech.

No Child Left Behind Act of 2001 (NCLB): The No Child Left Behind Act of 2001 is a comprehensive piece of legislation designed to improve the educational performance of all students in the U. S. It mandates that the U.S. schools must be held accountable for educational outcomes for all students, including those with any type of disabilities.

Nonlinear Technology: Two-way mode of technology operation. Students use a keypad for questions and answers in the classroom to interact with the teacher. The keypad is an example of nonlinear technology.

Online Social Communities: An online community or virtual space where individuals can display their thoughts, opinions, interests, and other communications.

Optical Character Recognition (OCR): Software that converts a scanned document into an editable text file. When this is integrated with speech synthesizing TTS technology, in enables any printed document to be read. One well-known example of this technology is a Kurzweil reader.

Optimal Utterance Length (OUL): The maximum number of syllables that a student can produce without decreasing in loudness or increasing rate to complete the utterance.

Orienting: When the user specifically identifies the touchpoints from the IWB to the software system.

Orofacial Myofunctional Disorder (OMD): This speech disorder is characterized by a protruding tongue during rest, speech, or swallowing. An individual with OMD may have difficulty with consonants pronounced towards the front of the mouth (e.g., alveolar, interdental, labio-dental, and bilabial). The muscles of the tongue tip may also exhibit weakness.

Palate: The area of the mouth region commonly referred to as the "roof" of the mouth. It is characterized by a hard bone-like density towards the front and a softer density towards the rear. Generally, the palate is not visible on the ultrasound during regular speech.

Passive Articulators: These are the parts of the mouth that play a contributive role in articulatory processes but are not part of the tongue—the primary articulatory device. They are the stationary parts of the articulatory equation such as the alveolar ridge, palate, and velum.

Pedagogy: It encompasses methods of teaching and instruction. It is also a term for the art or science of teaching. A relevant pedagogy indicates correct use of the teaching method.

Perception-Related Disability: A disability that has negative effects on one's ability to perceive such as see and hear.

Personal Digital Assistant (PDA): Handheld device, such as a Blackberry or Droid, providing Personal Digital Assistance.

Phonemic: This refers to the saliency of a particular sound contrast to a speaker of a language. While the human speech apparatus can produce countless sounds, each language narrows down to a select range of contrasts. These are called phonemic contrasts. One primary task for second language learners is to both perceive and reproduce such phonemic contrasts which may or may not correspond to their first language.

Phonological discrimination: To consistently articulate a speech sound, the speaker must be able to discriminate segments of sound, or phoneme (from the φώνημα, phōnēma, "a sound uttered").

Poll Everywhere®: Web site that offers text messaging-based polls. Users answer questions by sending text message codes and the Web site displays the results.

Positioning: A bodily posture, especially a posture promoted through the use of external supports.

Presentation-Related Disability: A disability that has negative effects on one's ability to express such as write and speak.

Project-Based Learning: An approach to teaching that engages students in learning essential knowledge and life-enhancing skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed tasks.

Prompting: Cues given to elicit desired behavior.

Protowords: Protowords are sounds that are similar to, but are not quite words. Common examples of protowords used by infants between 10-12 months of age include mama, dada and baba. Whilst repetitive babbling involves repeating sounds over and over again (e.g., babababababa), protowords are shortened, typically to 1-2 syllables. Protowords generally correspond to something concrete, e.g., mama for mother. In other words, a protoword is used consistently to refer to the same object.

Recline: In a wheelchair, a back support that allows the user to lean or lie back while the seat position remains unchanged.

Relay Service: A telephone service for callers with hearing impairment, in which an operator reads the tones, and types back what the other end is saying.

Resource Bank: A collection of vocabulary words and multi-media components (e.g., pictures, animations, sounds and video) that students use to generate for a specific assignment or task. Other items in a resource bank may include design aspects such as background color/design, font color, font size, font style, freehand drawing and speech.

Scaffolding Instruction: An approach to instruction, in which a teacher models a desired learning strategy for students who are unable to accomplish a task independently. Scaffolding is a temporary support for students who learn to internalize instructional goals and take on responsibility for accomplishing a given task.

Screen Readers: Devices or software that that enhances TTS technology in its capacity to synthetically verbalize everything that appears on a screen, including text, graphics, control buttons, and menus; or to send the information to a Braille output device. In essence, a screen reader transforms a graphic user interface into an audio interface. Screen readers are essential for computer users who are blind, and a valuable tool for individuals with a print disability.

Screenr®: Web site that enables a user to video record the computer screen. The user records the computer screen with voice over and exports it to a social networking site or saves on the computer.

Second Life®: Virtual reality space where avatars live and interact as real life humans. Avatars can teleport to another virtual place to experience cyber reality.

Section 504: Authorizes federal support for the rehabilitation and training of individuals with physical and mental disabilities. Under Section 504, a student is considered to have disability if s/he functions as though having a disability. It also extends protections against discrimination beyond school settings to employment, social and medical services.

Self-Disclosure: The behavior of revealing information about yourself to others.

Signage: Text or images created to display information to a particular audience.

Significant Disabilities: This category of disabilities includes students with visual impairment, blindness, deaf-blindness, multiple disabilities, or any severe disability.

SMART Board™ Notebook: Software associated with SMART Board™ interactive whiteboards.

SMART Board™: A specific model of interactive whiteboard.

Social Bookmarking: A method for Internet users to organize, store, manage, share and search for bookmarks of resources online by creating an archive of sites that can be accessed from any Internet enabled device.

Social Initiation: Approaching a peer and making a verbalization or communicative gesture.

Soundbeam: The Soundbeam is an interactive MIDI hardware and software system developed by The Soundbeam Project/EMS in which movement within a series of ultrasound beams is used to control multimedia hardware and/or software to generate MIDI messages. Digital videos and references can be retrieved from <http://www.soundbeam.co.uk>. Digital videos titled "*Welcome to the Soundbeam Part 1*" and "*Soundbeam Performances*" (MPEG format) can also be retrieved from <http://www.youtube.com>.

Spatial Constructivist Thinking Theory: It is the integration of pictures, animations, videos, color schemes, abstract plans, applets, graphics, and formatted text in a multimedia presentation to represent verbal and auditory concepts for instruction.

Special Education: Education for students with exceptionalities, which is designed to support a student's different learning needs.

Speech Recognition Software: Assistive technology software that enables students with disabilities to record and manipulate information through the use of their voices.

Speech Synthesis: The ability of a computer of other device to change text into spoken words using a "synthetic" male or female voice. It works by recognizing individual phonemes and identifying the pronunciation of them when combined with other phonemes.

Spontaneous Communication: Interacting verbally or with gestures with others in the absence of prompts or other supports.

Stimulus: A cue that triggers a response.

Students with Exceptionalities: Any student who has been determined eligible for a special program in accordance with rules of the Florida State Board of Education. The term includes students who are gifted and students with disabilities who have an intellectual disability; autism spectrum disorder; a speech impairment; a language impairment; an orthopedic impairment; an other health impairment; traumatic brain injury; a visual impairment; an emotional or behavioral disability; or a specific learning disability, including, but not limited to, dyslexia, dyscalculia, or developmental aphasia; students who are deaf or hard of hearing or dual sensory impaired; students who are hospitalized or homebound; children with developmental delays (Laws of Florida, 2008–204, 1003.01, 3a).

Students with Special Needs: It is the classification of students who are identified as academically gifted, and physically, emotionally or cognitively challenged.

Substrand Organizers: A substrand organizer is a discrete subset of knowledge, skills and understanding within a learning area.

Summative Assessment: An activity designed to measure a student's mastery of a concept at one specific point in time.

Support Group: A group where individuals with similar concerns come together to discuss and solve problems and help themselves and others to cope with challenges.

Tactile Prompt: A device worn on the waist that can be set to vibrate on any given interval.

Tags: A label that describes a piece of data, concept, website or resource to facilitate later retrieval and categorization of information.

Talking Book: A book in analog or digital form with narration provided by paid or volunteers readers. This is the primary format of National Library Service for the Blind and Physically Handicapped (NLS) and Recordings for the Blind and Dyslexic (RFB&D).

Teacher-Researcher: The teacher-researcher becomes fully involved in an informal, interpretive and reflective (qualitative) model of inquiry with the participants (e.g., students in a school setting) to focus on the complexities of social situations such as those found in classrooms about whom the information is being collected and for whom the outcomes become a benefit and justification for the research (Allan, 1991; Glesne & Peshkin, 1991).

Tense/Lax Distinction: This refers to the vowel distinction heard by English speakers in the words “beet” and “bit.” This distinction is salient to most English speakers because the difference between the two articulations generate a change in meaning in English (e.g., a “beet” is not the same thing as a “bit”). This is one example of a phonemic distinction. Non-English languages may or may not give attention to this distinction.

Text-to-Speech (TTS): Software that uses speech synthesizers to receive information in the form of letters, numbers, and punctuation marks, and then “speak” it out loud in a computerized voice. Words are often highlighted as they are read.

Text-to-Speech Synthesis: The ability of a computer to speak text as it is typed on the screen.

Three-Stage Learning Process: A proposed learning model that includes perception, cognition and presentation.

Tilt-in-Space: In a wheelchair, the ability of the seat and back support to rotate backward while the position of the seat and back in relation to one another remains unchanged.

Touchpoint: An area pinpointed on the IWB which identifies where the uses is touching the interactive whiteboard.

Transducer: This is the plastic probe that projects ultrasound waves. The style of transducer that has been used for linguistic research thus far is oblong in shape and is easily grasped in the palm of one’s hand.

Transport: The act of carrying, moving or conveying from one place to another.

Turningpoint® Technologies: Keypad and receiver system for class interaction. An instructor connects a receiver to the computer for the reception of students’ signals sent from their keypads. Learning occurs as they use these devices for asking and answering questions on the computer.

Twitter®: Web site for short message exchange. The user can follow other users and be followed by others as well.

Ultrasound Technology: A technology that utilizes ultrasound waves to visually represent structures beneath the skin surface. The ultrasound waves construct images by reflecting off of sharp changes in density. Surfaces that border a sharp change in density are termed “echogenic.”

Universal Design for Learning (UDL): Educational framework developed by the Center for Applied Special Technology (CAST) to guide the design of flexible instructional goals, methods, materials, and assessments to meet the needs of students with various abilities, needs, learning preferences, and styles (Rose, Meyer, & Hitchcock, 2005).

Universal Design: The concept of being barrier free, so that anyone can have access. The educational philosophy that all instruction should be made accessible to all students regardless of the disability. Access can be gained through instructional change, technology, and attitude.

Urban Special Education: Special education services provided to students in the urban core, public city schools, or magnate schools.

Visual Prompts: Illustrations used to elicit desired behavior.

Voice Recognition Software: A software program which allows the user to control computer functions and enter text by speaking to the computer.

Web 2.0: Applications that promote the sharing of ideas, files, resources and tools online.

Web Accessibility: The practice of making Web pages and applications accessible to the largest number of users possible, especially users with disabilities. Web accessibility focuses on the major categories of disability: visual, auditory, motor, and cognitive. U.S. laws such as Section 508 and international guidelines such as Web Content Accessibility Guidelines (WCAG 2.0) allow web developers to adhere to a set of accessibility guidelines and best practices.

Web Archive: an online archive of information, resources, websites and artifacts that can be accessed, modified and shared through any Internet enabled device.

Web-Based Instructional Environment: An educational environment which uses the World Wide Web and Information Technology to provide students and teachers with a wide range of learning experiences and teaching environments, not possible in a traditional classroom setting. It is designed to promote the understanding of the subject matter by all students while offering supports and scaffolds to students including those with disabilities.

Wimba®: Voice recording tool consisting of voice email, voice discussion, voice recorder for instructional needs, and online virtual classroom.

Word Prediction Software: A software program that predicts the word being typed and/or the following word based upon letters typed, word frequency, and context.

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Judith K. Carlson has over thirty-five years of experience in the field of special education in diverse settings ranging from autism assessment to juvenile corrections. She holds a BA in Elementary Education, an MS.Ed in Behavior Disorders and Learning Disabilities, and a Ph.D in Special Education, all attained from the University of Kansas. She joined the faculty at Rockhurst University, a private Jesuit institution in Kansas City, Missouri in 2009, after retiring from the University of Missouri-Kansas City where she was on faculty since 1998. Carlson is best known for her work in autism spectrum disorders (ASD) while at the University of Kansas (1988-1998). She has multiple book chapters and publications in the field and continues to present on this and other topics at international, national, and regional conferences. Prior to her move into higher education, Carlson taught and directed the AYS Alternative School for juvenile felon offenders as part of a community corrections diversion program in Kansas City, Kansas (1975-1985). She values her work in the urban core and has continued to support this agenda throughout her professional career. Carlson's current research interests focus on dispositional attitudes and education of general educators to enhance support and acceptance of children and youth with exceptional learning needs in the inclusionary classroom. Infusing developing technology into both general and special education settings is a priority in her continuing professional endeavors.

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Judah B. Axe, Ph.D., BCBA, is an Assistant Professor of special education and behavior analysis at Simmons College. His research on teaching language and social skills to children with autism has been recognized by the California Association for Behavior Analysis and the Berkshire Association for Behavior Analysis and Therapy (BABAT). Dr. Axe is an associate editor for the *Journal of Behavior Assessment and Intervention for Children* and on the board of editors of *Behavior Analysis in Practice* and *The Analysis of Verbal Behavior.* In addition, Dr. Axe serves on the boards of the Verbal Behavior Special Interest Group of the Association for Behavior Analysis International, the Cambridge Center for Behavioral Studies, and BABAT.

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Susan De La Paz has expertise in developing and validating reading and writing interventions for adolescents with learning disabilities. She has worked for more than a dozen years with middle and high school general education English and Social Studies teachers in culturally and linguistically diverse schools, developing differentiated instructional writing and social studies programs that meet the needs of students whose academic abilities range from those with learning and behavioral disabilities to students who are gifted and talented. Dr. De La Paz is currently working on a federally funded project in partnership with a local school district entitled, "Disciplinary Writing Instruction for the Social Studies Classroom: A Path to Adolescent Literacy," which targets federally identified struggling adolescent readers as well as students with disabilities and general education students.

Anna S. Evmenova is an Assistant Professor of Special Education in the College of Education and Human Development at George Mason University, Virginia. Dr. Evmenova earned her Ph.D. in Education from George Mason University in 2008. She also holds MAE.d. in Learning Disabilities and Graduate Certificate in Assistive Technology from East Carolina University, NC (2003). Prior to getting her Ph.D., Dr. Evmenova taught students with learning disabilities in elementary and middle schools in North Carolina. She regularly presents at national and international conferences and has numerous publications in the area of assistive technology. Her current research interests focus on assistive and instructional technology tools for providing academic content-based instruction to students with various abilities and needs.

Helen J. Farrell has taught for more than 25 years of work in primary schooling; education and training of students with complex special educational needs; and early childhood development within and across the public education sector in the Teaching Service, Department of Education and Early Childhood Development in the State of Victoria, Australia. Her career has included the core business of learning and teaching (e.g., developing and implementing exemplary differential curriculum and assessment and reporting of classroom programs); roles as teacher educator (e.g., design and implementation of intervention programs; leadership, advocacy and training programs for parents of young children with developmental disabilities); research, editing, writing, and publishing activity; and related philanthropic activity. She initiated and developed opportunities in the use of ICT in the arts, a key learning area for students with disabilities and impairments. She continues to make contribution to the community (not-for-profit) services sector through involvement in professional associations and/or the provision of professional development or other such activities. She was admitted to the degree of Doctor of Philosophy (PhD) in the University of Melbourne, Victoria, Australia in August 2007. The thesis investigated the impact and local implementation of standards-based music curriculum frameworks for students with disabilities and impairments.Helen is a past Chairperson of the Victorian Chapter of the Australian Society for Music Education, and member of the Editorial Advisory Board of the national journal *Victorian Journal of Music Education* (VJME) and *Music Educators*' *Journal* (MEJ) (2009-2012). She was appointed as Commissioner of the *Music in Special Education*, *Music Therapy and Music Medicine* Special Interest Group of the International Society for Music Education (ISME) in 2008. In her "spare time" (she makes time), Helen sings in a leading high-profile choir with a long and highly respected tradition of performance of sacred English and European choral music in the Anglican (Episcopal) Diocese of Melbourne.

Joy E. Harris is Coordinator of Educational Technology and a Lecturer in the Department of Education at the University of Tampa. Dr. Harris has developed and/or taught numerous classes at both the undergraduate and graduate levels including *Teaching and Learning with Technology*, *Cognition and Technology*, *Educational Technology Ethics*, *Multimedia for Educators, Women and Technology,* and *Technology for Education and Leadership*. She specializes in adult education and educational technology with a focus on feminist epistemology.

Md. Mokter Hossain is from University of Dhaka, Bangladesh. He is currently a doctoral student in the department of Curriculum, Teaching, and Learning (CTL) at the University of Nevada, Reno, USA. His major is secondary mathematics education. His research interest is in using technology in the teaching and learning of mathematics including for the students with special needs, and for the students who are identified as gifted. More about Hossain could be found at his personal blog: http://m0kter.wordpress.com/

Marni Jones has worked with and supported students with special needs for several decades—as an educator for eight years in West Africa, as the Director of a preschool in DC, as a Learning Specialist and Academic Coach at Shippensburg University, and in her current position as the Coordinator of Disability Services and Assistant Director of Advising at Dickinson College in Carlisle, PA. Marni Jones has written several published articles. She has an M.A. in Theater from Miami University, a certification in Early Childhood Education from Montgomery College, a certification in ESL from the Peace Corps, and a M.Ed. in Special Education from Shippensburg University. Inspired by the needs of her son with dyslexia, as well as the many college students she works with who struggle with reading and writing, Ms. Jones is continuously researching, discovering, and applying ways to support students with disabilities.

Katie Kalata is on the faculty of the Mathematics and Computer Science Department, Lake Superior University. Her academic interests and research focus on Web tools and technologies, and she is particularly interested in Macintosh computers. She has an MBA and an MS from the University of Illinois and a BSN from the University of St. Francis.

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Andrew Kitchenham is an Associate Professor in Educational Technology in the School of Education at the University of Northern British Columbia. Dr. Kitchenham's research examines teacher transformation through the use, integration, and teaching of technology. He has published numerous articles, conference papers, technical reports, and book chapters on diverse topics from technology to special education to rural professionals to gender differences. Recently, he has edited two books for IGI Global: one on mobile learning and one on blended learning.

Maura Wechsler Linas (Ph.D., University of Kansas) is an Assistant Research Professor at Juniper Garden's Children's Project, University of Kansas. She also serves as a chairperson on the planning committee for the Midwest Symposium for Leadership in Behavior Disorders. Linas currently is involved in implementation studies in preschools testing Tier 2 and Tier 3 interventions in the areas of language and literacy in addition to testing and refining newly completed K-8 professional development curriculum focused on improving teacher practice and student outcomes. Linas is Principal Investigator of the IES funded grant (R324A090283) Professional Development that is Systematic, focused on Teacher growth, Incorporates Coaching, collaboration, cohorts, and increased Knowledge to create Student Success (*STICKS)*, and Cross-Site Project Coordinator for the IES funded (R324C080011) Center for Response To Intervention in Early Childhood (CRTIEC).

Ian Loverro is an Associate Professor at Central Washington University in the Department of Educational Foundations and Curriculum. He received his PhD in Educational Technology and Communication from the University of Washington in 2006. His primary research focus is the integration of technology and pre-service teacher education as it relates to national standards and inquiry learning. He served on the development team of the K-12 Educational Technology Learning Standards for Washington State. He teaches undergraduate and graduate courses in educational technology, statistics, and research methods. In addition to guiding graduate students through the thesis/project process, he is currently serving as the Interim Director of the Educational Technology Center and is a member of the Executive Board of the Faculty Senate at Central Washington University.

David J. Majsterek, after working in a general education classroom for two years in Cleveland, Ohio, pursued a Master's degree from University of New Mexico. An eleven-year stint as a resource room teacher in rural Libby, Montana (1994-86), and a doctorate from New Mexico State University (LD & Computer Assisted Instruction) led to college teaching at Bowling Green State University, Ohio. 1992 returned Dr. Majsterek to the "West" where he currently teaches special education, and early childhood courses at Central Washington University. Research interests include early literacy acquisition and evidence-based practices that facilitate learning in public school classrooms. Because signage is a powerful tool that can be used to facilitate learning, presentations on this topic have occupied his most recent professional activity.

Bryan Meadows is an Assistant Professor of applied linguistics at the University of Texas, Pan-American. He completed his degree at the University of Arizona where he specialized in second language acquisition and teaching. While there, he had the opportunity to complete experimental work with ultrasound technology. Additional research interests include discourse analysis and nationalism as it pertains to language learning.

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Mary Ann Sawyer teaches Cross-Categorical Special Education at Dobbs Elementary School in the Hickman Mills School District. She earned a B.A. in Elementary Education 1-8, Master's in Curriculum and Instruction/Science Emphasis, Master's in Special Education K-12, and has Missouri State Certification in Reading K-12, and is an Educational Specialist in Administration. Sawyer is currently in the University of Missouri-Kansas City's Interdisciplinary Doctoral Program in Urban Leadership and Policy Studies with a co-discipline in Curriculum and Instruction. Sawyer has been an urban teacher for twenty years, 14 in General Education, and 6 in Special Education. The last four years, she has been a Math Resource Teacher at Smith-Hale Middle School in the Hickman Mills School District. Sawyer is working toward bridging the gap between general and special education in the area of mathematics education. She has worked with diverse members of the community throughout her educational career. Sawyer values people and cultures for individual differences, as well as their contributions to the greater good of society.

Chris Schwilk received a B.S. from Miami University in secondary social studies education. He also holds an M.Div from Trinity Lutheran Seminary and a M.S. in deaf education from Bloomsburg University. Dr. Schwilk received his PhD in special education from the Pennsylvania State University. For the past five years he has been an Assistant Professor of special education at Shippensburg University. Prior to his wok at Shippensburg, Dr. Schwilk has served as a pastor of a deaf congregation in Reading, PA, teacher of the deaf and hard of hearing for the Capital Area Intermediate Unit in Harrisburg, PA, and owner director of Specialized Learning Services-a small education services company that provides staffing to schools and instruction and support to individuals with unique learning needs. Dr. Schwilk's research interests include task analysis, internalizing emotional disorders, and models of service delivery of special education services.

Linda Seybert is an Associate Professor in the School for Education at Park University. Dr. Seybert completed her Ph.D. in Special Education at the University of Kansas, working with Drs. Deshler and Schumaker in the Center for Research on Learning as a Research Fellow. Her research interests include the impact of learning strategies on student success, the impact of Response to Intervention (RtI) on regular and special educators' roles and responsibilities, and the use of authentic assessment strategies in teacher preparation programs. In her current position, Dr. Seybert teaches graduate courses and serves as the Program Coordinator for the Master of Arts in Teaching program, a post-baccalaureate teaching certification program. In her previous positions, she worked as a Social Studies teacher and a Special Education teacher in an alternative inner-city high school. She also created, implemented, and directed a community college support program for adults with developmental disabilities. As a result of these experiences, she actively promotes the use of technology to support student success, particularly for those with disabilities.

Leonard Shedletsky is Professor of communication at The University of Southern Maine. He is the author of *Meaning and Mind: An Intrapersonal Approach to Human Communication* (1989), and has co-authored three books with Joan E. Aitken: *Cases on Online Discussion and Interaction: Experiences and Outcomes* (2010), *Human Communication on the Internet* (2004), *Intrapersonal Communication Processes* (1995). Shedletsky has published numerous articles and chapters. He teaches a range of courses in communication with cognition, discourse, and meaning as underlying themes and developed and taught the course "Intergenerational Communication and the Internet."

Cindy Sherman began her career in education as a speech-language pathologist. She developed an interest in reading and writing interventions for students with learning disabilities as well as those in general education. Those interests led her to pursue a doctoral degree in special education at the University of Maryland. Ms. Sherman's expertise is in the area of written language. She has taught writing strategies to a diverse population of students in the Washington, D.C. area for the past ten years. Ms. Sherman is currently conducting her doctoral research at a local elementary school where teachers in a general education classroom are teaching academically and culturally diverse students strategies to revise expository essays.

David Shorr is a Professor at Central Washington University and currently the chair of its Department of Teaching Elementary, Adolescent and Young Children (TEACH). He received his PhD in developmental psychology from the University of Washington in 1980. While participating in a number of scholarship activities over a twenty nine year career, his primary focus has been cognitive-social, developmental psychology, particularly as it applies to birth through elementary age children. He has taught a variety of undergraduate seminar and practicum courses, graduate research and statistics courses, and mentored students through the completion of graduate theses/projects. Over his career he also has chaired other education related departments.

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Mandi Sonnenberg has been in education for over 10 years. She entered her educational career as an elementary school teacher in St. Louis using technology in her classroom to benefit her diverse group of learners. As she moved onto administration after completing her Master's in Education Administration, she became increasingly aware of the importance of technology tools being used effectively in the classroom. She earned her educational doctorate in Educational Leadership through Saint Louis University and continued her journey of keeping current with technology into teaching in higher education. As a tenured track professor at Rockhurst University, she educates both undergraduate and graduate students through Technology in Education courses. Dr. Sonnenberg strives to diminish the digital divide by educating and motivating students, teachers and parents to become aware and involved in the social justice issues surrounding technology use in today's school systems.

Mary Spillane is an Augmentative Communication/Assistive Technology Consultant for the Bellevue Public School district in Bellevue, Nebraska. Dr. Spillane has worked with students with severe disabilities for over 30 years. For the past 17 years Dr. Spillane has provided district level consultation services to both general education and special education staff members who serve students with assistive technology needs. Dr. Spillane has served on regional and state training committees and has presented at local, regional and state assistive technology conferences. She currently serves on the Nebraska Metro Regional Autism Team and the advisory board for the Nebraska Assistive Technology Project. Dr. Spillane is especially interested in the use of technology to facilitate inclusion of students with severe and complex disabilities.

Alex Thompson received her Ph.D. in Mathematics from the University of Missouri-Kansas City (UMKC). She has served as adjunct faculty for both UMKC and Ottawa University, teaching courses in applied and theoretical mathematics. Thompson had a successful career as a statistician with Hallmark Cards, Inc. in the capacity of Senior Research Analyst and Senior Project Manager. She owned and operated her own consulting business, Research Dynamics, specializing in survey design, statistical analysis, and data management. Dr. Thompson is currently retired, after successfully winning her five-year battle with uterine cancer.

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Sean Zdenek is Associate Professor of technical communication and rhetoric at Texas Tech University. He teaches graduate and undergraduate courses in disability studies and Web accessibility, rhetorical criticism, and document design. His research interests include disability and accessibility studies, methods of rhetorical criticism, and animated software interfaces. He has published articles in *Technical Communication Quarterly*, *Computers & Composition*, *Discourse & Society*, and other journals. He writes about closed captioning and Web accessibility on his blog, AccessibleRhetoric.com.

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