Digital Game-based Learning and dyslexia in higher education

Mary Dziorny
College of Education
University of North Texas
United States
Mary.dziorny@utdallas.edu

Abstract: Digital Game-based Learning (DGL) has become a hot topic in educational technology in recent years. Additionally, effective instruction for students with dyslexia and other learning disabilities is a growing concern in higher education. This paper begins with an overview and working definition of dyslexia, followed by a discussion of the most common difficulties dyslexic students experience in higher education. Common instruction techniques used with dyslexic students are presented. Advantages and disadvantages of using DGL are discussed. Finally, arguments are presented for using DGL as an instruction method with dyslexic students in higher education.

Introduction

Digital Game-based Learning (DGL) has recently become a hot topic in the educational technology field. Its advocates believe it is a better approach to learning than more traditional behaviorist theories because it more closely aligns with the way students now think and learn (Gee, 2003). Though not all supporters of DGL agree completely with this sentiment, most agree that DGL supports the development of analytical reasoning skills and self-directed learning, cooperative skills, and group problem solving. (Gee, 2003; Prensky, 2001; Carroll, Knight, & Hutchinson, 1995), skills that are all vital in the current job market (U.S. Dept. of Labor, 1991; CEO Forum, 2001). These same skills are also important to dyslexic students, though they often lack the opportunity to develop them because of the traditional instructional techniques used to instruct them (Agran, King-Sears, Wehmeyer, & Copeland, 2003).

Effective instruction for students with dyslexia and other learning disabilities is a growing concern in higher education. Instructors are faced with designing curriculum and delivery strategies that will ameliorate the effects of the disabilities their students experience. These effects include difficulties with reading, organization, memory, listening, math, and written language (Day & Edwards, 1996; Gay, 1996). On any given college campus, 10-15% of the student population acknowledges a disability (Lissner, 1995). Of that 10-15%, roughly 29% of the students report having a learning disability (Horn, Berktold, & Bobbitt, 1999; Lewis & Farris, 1999; National Center for Educational Statistics, 2000). Students with learning disabilities are the fastest growing group of individuals with disabilities in higher education (Day & Edwards, 1996). In 2001, it was estimated that a half-million students with disabilities were enrolled in higher education in the US (Schmetzke, 2001). These students were served by 98% of 2-year and 4-year public institutions, 63% of private 4-year institutions, and 47% of private 2-year institutions (NCES, 2000). Due to the higher levels of education required to succeed in the workforce, this trend is expected to continue upward (U.S. Dept. of Labor, 1999). In 2000, 85% of the jobs in the US required at least some education beyond high school. In 1991, only 61% required any type of higher education (Web-Based Education Commission, 2000).

This paper will begin by discussing dyslexia including the cognitive processes and common difficulties and strengths associated with it. It will then define and discuss DGL. Finally, it will discuss DGL as a possible instructional strategy for dyslexic students.

Dyslexia: A Working Definition

Dyslexia is a learning disability involving difficulties with reading, writing, and spelling. Unfortunately, that is where the experts cease to agree. There are currently over 28 "working" definitions for the disorder. However, none of these is a completely accurate description of all the difficulties faced by those who contend with dyslexia on a daily basis. Many of the definitions are too limited, only accounting for a small portion of the symptoms associated with dyslexia (Keates, 2002). However, the experts cannot seem to agree on what symptoms should be associated with dyslexia. They are also unable to come to any consensus about the causes of dyslexia. Until recent years, the definitions of dyslexia have been primarily concerned with the deficiencies perceived in dyslexics. However, many dyslexics do not feel they are deficient, only that they think differently than most people. Consequently, more recent definitions of dyslexia are beginning to view dyslexia from the perspective of these differences (Morgan, 1996). For the purposes of this paper, dyslexia will be defined using the following definition released by the International Dyslexia Association in 2000:

> The word dyslexia is derived from the Greek "dys" (meaning poor or inadequate) and "lexis" (words or language). Dyslexia is a learning disability characterized by problems in expressive or receptive, oral or written language. Problems many emerge in reading, spelling, writing, speaking, or listening. Dyslexia is not a disease; it has no cure. Dyslexia describes a different kind of mind, often gifted and productive, that learns differently. Dyslexia is not the result of low intelligence. Intelligence is not the problem. An unexpected gap exists between learning aptitude and achievement in school. The problem is not behavioral, psychological, motivational, or social. It is not a problem of vision; people with dyslexia do not "see backward." Dyslexia results from differences in the structure and function of the brain. People with dyslexia are unique; each having individual strengths and weaknesses. Many dyslexics are creative and have unusual talent in areas such as art, athletics, architecture, graphics, electronics, mechanics, drama, music, or engineering. Dyslexics often show special talent in areas that require visual, spatial, and motor integration. This means that the dyslexic has problems translating language to thought (as in listening or reading) or thought to language (as in writing or speaking).

Unfortunately, even this definition is not complete, as it does not account for many of the memory, coordination, and organizational difficulties many dyslexics experience. According to Fitzgibbon and O'Connor, the difficulties that most adult dyslexics experience can be divided into three categories: difficulties with memory, difficulties with communication, and difficulties with organization and self-management.

Dyslexic Cognitive Style

According to Morgan and Klein (2000), "An understanding of the dyslexic cognitive style may overcome the mismatch between how dyslexic people learn, remember and process information and the ideas, expectations and assumptions of their non-dyslexic teachers, colleagues, employers, friends, and spouses (p.18)." The cognitive style employed by most dyslexics is different from many non-dyslexics. In keeping with the current trend of recognizing dyslexia as a difference instead of a deficit, it is useful to understand the differences and, in many cases, advantages of how dyslexics think and learn. First of all, most dyslexics learn better if the knowledge is presented in a larger context. For example, most dyslexics would have a difficult time remembering three steps in a procedure if they did not know how those steps fit into the rest of the procedure. Many dyslexics also tend to be very visual thinkers. They usually think of problems in very holistic terms, often seeing the "big picture" before seeing any small details. Additionally, dyslexics tend to be very good at visualizing multiple dimensions of drawings, often being able to extrapolate the third dimension from two dimensional drawings and plans. They tend to learn very well from visual aids such as diagrams and transparencies. Tactile-kinesthetic methods of learning can also be very beneficial as many dyslexics are very good at learning through a "hands on" approach (Morgan and Klein, 2000).

Higher cognitive processing skills such as reasoning, interpreting, understanding, creating and synthesizing are generally not affected by dyslexia. However, a dyslexic student may have trouble performing higher level tasks because he or she is unable to understand and process written course material, or he or she may have difficulty processing information presented aurally. In general, dyslexic students vary greatly in their abilities and level of performance, including those who have developed exceptional compensation strategies (Cottrell, 1966) and those who are very gifted students despite their dyslexia (Aaron & Guillemord, 1993; Vail, 1990; Everatt, Steffert, & Smythe, 1999). Often, dyslexic students show an unusual aptitude for mathematical, spatial, linguistic and creative abilities which allows them to excel in such fields as engineering, architecture and design. Some researchers believe this is due to a physiological difference in the brains of dyslexics (Miles & Miles, 1993; Stein, 2001). Additionally,

dyslexic students tend to prefer higher order thinking skills, deep understanding of concepts, and personalized and applied approaches to study, usually finding them easier than rote learning (Powell, 2003). Powell (2003) compiled the following key learning needs of dyslexic students (p. 128-9):

Key Learning Needs of Dyslexic Students:

Students with specific learning difficulties (dyslexia) are likely to perform best when:

- They can be creative;
- The are relaxed and confident rather than stressed and pressurized;
- They have sufficient time to work at their own pace, double-check their actions or output, and to undertake multiple practice in new tasks;
- They can pause, relax, and focus before and during tiring or demanding tasks;
- They can plan out their task and compensate for their specific difficulty rather than being 'put on the spot';
- They are given time and space to work out how to perform a task 'from within';
- They are allowed to demonstrate their understanding in the means that best suits their disability (variously, by voice, hand-writing, typing, voiced software, production of artifact, practical demonstration, etc.);
- They can make use of their best sense modality, such as sophisticated colour coding, auditory memory, or opportunity to move about and shift position;
- Their attention is not diverted by unnecessary interruptions or distractions;
- Visual (such as overheads/handouts) and sound (such as tape) stimuli are good quality;
- Unnecessary hurdles are removed in due consideration for the additional time that tasks can take;
- Verbal instructions are accompanied by written ones, and vice versa.

Instruction Techniques

The most common instructional techniques that seem to be effective for dyslexics can be divided into three main categories: multi-sensory, technology, and interest driven. Multi-sensory approaches are the most common and are based on the oldest research. Technology approaches are relatively new and continue to develop as technology develops. Interest driven approaches are very new ideas, mostly sparked by Fink's 1998 research study of successful adult dyslexics.

Until recently, all dyslexia remediation and instruction methods were based on the research of Dr. Samuel Orton, considered by most dyslexia experts to be the father of dyslexia research, remediation, and instruction. Dr. Orton was a pathologist, neuropathologist, neurologist, and psychiatrist. His work mostly focused on the neurobiological concepts and theories surrounding dyslexia. In 1917, Dr. Orton read the manuscript Hinshelwood (1917) wrote on "Congenital Word Blindness" or unexplained reading problems experienced by intelligent children. Orton began his own research into the reading problems, calling them strephosymbolia or "twisted symbols." Strephosymbolia is known today as dyslexia (Orton, 1925). Orton believed dyslexia was not caused by vision or hearing problems, other popular hypotheses at the time, but was instead caused by a language problem or a "specific reading disability" as he labeled it in 1928. Some experts still refer to dyslexia by the name specific reading disability (Orton, 1928).

Orton also believed in focusing on the strengths of his patients, not just their weaknesses. He continually reiterated that all dyslexics are teachable with appropriate instruction. In his speech to a group of Oskaloosa teachers, he stated that problems learning to read are a disability rather than a defect, as was also popular opinion at the time. Many teachers felt that students with dyslexia were just lazy or unmotivated. Unfortunately, this opinion has remained current with many uneducated educators. Dr. Orton cautioned these teachers in his Oskaloosa speech with the following statement: "This means we do not look upon them (reading difficulties) as deficiencies which cannot be cured but rather as special handicaps requiring special methods or often simply more careful and painstaking application of usual methods (Henry, 1998 p.7)."

Orton believed that dyslexia has a biological root, but he also felt it should be treated through education. As early as 1925, he suggested that "…the logical training for these children would be that of extremely thorough repetitive drill on the fundamentals of phonic association with letter forms both visually presented and reproduced in writing, until the correct associations were built up and the permanent elision of the reversed images and reversals in direction was assured (Orton, 1925, p.614)." Thus, the idea of multi sensory instruction was born. However, even

though he felt the methods should contain "extremely thorough repetitive drill" he also insisted the instruction not be programmed and be adaptable to the individual needs of the learner (Orton, 1925).

Orton began working with Anna Gillingham in 1931 to develop an effective method of instruction and remediation for dyslexic children. This method was the Orton-Gillingham method. Gillingham believed that dyslexic children were unable to learn to read using 'sight word' methods. Instead, they needed an instructional method that "…is based upon the constant use of associations of all of the following: how a letter or word looks, how it sounds and how the speech organs or the hand in writing feels when producing it (Gillingham and Stillman,1956, p.17)." This educational theory formed the basis for many other multi sensory methods such as the Herman method, Alphabetic Phonics, Project Read, the Slingerland method, Phono-Graphix, and the LANGUAGE! Method (Henry, 1998, Morgan and Klein, 2000).

However, most of these methods were developed for children. Some of them can be used for adults, such as Project Read and Phono-Graphix, but many of them do not take into account one of the most basic tenets of adult education according to Malcolm Knowles (1998): adults must have control over their own learning or they will not learn.

Definition of Digital Game-based Learning

Perhaps it would be best to start by defining Digital Game-based Learning. Prensky never gives a concise or formal definition in his book. However, he infers that all games of any kind, including digital versions of such games as chess and Monopoly, can be used as Digital Game-based Learning (DGL). Burns offers a definition of sorts by exploring the various trends that converged to create a market for DGL. He includes Seymour Papert's exploration of microworlds at MIT (Horton, 1998), David Kolb's learning loop (van der Heijden), and social psychology experiments (Prensky, 2001) in the early epistemic roots and goes on to include the growth of corporate universities (Prensky, 2001), design for doing (Prensky,2001; Shrage, 1999), knowledge management (Beer, 2000), collaborative action learning (Beer,2000, Prensky,2001), and communities of experts (Beer,200; Prensky,2001) as having laid the groundwork for DGL learning models.

Davis Klaila believes that the key to developing a good game and also a good learning experience is a good storyline. He states,

> Gaming shows us that long, traditionally tedious, and difficult tasks can be engaging and fun when they are part of an engaging learning experience….A strong story line is key to the success of interactive e-learning. Working through a story or simulation gives participants context for learning valuable lessons as they address business challenges, resolve workplace issues, and move ahead in the marketplace. It's the experience of working through the issues that remains with learners so they're better equipped to handle real-life situations (p1, 2001).

He goes on to say that e-learning consumers should expect programs and games that incorporate the same tools and techniques used by the commercial gaming industry. These programs should include graphics, interaction, and engaging activities that are informational, relevant to the course objectives, and fun.

Advantages of DGL

According to Prensky (2001) and all his followers, there are many advantages to DGL. First of all, it is more fun than other forms of learning. People tend to be more motivated to play a game than to engage in other forms of learning, especially people from the twitchspeed generations. According to Anne Bruce, a motivational guru, people who are having fun are learning at a higher level than those who are bored (Prensky, 2001). Roger Schank, author of Virtual Learning, agrees, saying, "When learning isn't fun, it's not learning. Listening to endless lectures and memorizing countless facts and figures aren't fun activities. What's fun is doing (Shepherd, p1, 2001)." If it is constructed properly, it can be much more efficient than more traditional forms of education. Prensky (2001) cites one particularly intriguing example in his book. He and his firm developed the game The *Monkey Wrench Conspiracy* in order to teach engineers how to use a new type of CAD software. The game was very successful in its goals. However, it far surpassed its intended purpose. Non-engineers began playing the demo version of it, including an eight year old boy. By the time he finished the game, which was timed to take no more than a couple of hours to complete, he not only understood the CAD program, he also understood the basic concepts of

mechanical engineering. This child was not a prodigy or a genius; he was an average child who greatly enjoyed playing the game. He had no idea that he was learning anything until he was done. This is an excellent example of another concept embedded in much of GBL- "stealth learning." The term was coined by one of the game developers at LucasArts to describe the idea of hiding learning concepts in games (Prensky, 2001).

Another advantage to GBL is that it, according to Prensky (2001), is more appropriate for the students and young workers of today, the members of the twitchspeed generation. Several studies have been conducted over recent decades to determine what effect video games and computers have had on the children who grew up with them. Consequently, many publications have come out recently that claim these young people's minds have been 'reprogrammed' by playing computer and video games (Herz, 1997; Tapscott,.1998). Patricia Marks Greenfield (1984), a researcher in educational psychology, believes that the intensive, regular game play that these people have grown up with has helped them develop a new set of cognitive abilities. Prensky (2001) argues that these people no longer think like previous generations, causing a tremendous gap between the teaching methods that practicing teachers and trainers are comfortable with and the learning methods that are most familiar and comfortable for today's students and young workers. DGL's advocates believe it is the learning method that will help bridge this gap.

DGL also creates a learner-centered, learner-guided environment as well. The student has control over where he or she goes and what he or she does within the game. The game also allows the freedom to freely explore and experiment within the environment. As the student plays the game, he or she may adapt to the environment, pick up the game vocabulary, undertake tasks, and find treasures and bonus items and use them to progress to more complex levels. As the student continues to play, he or she must constantly readjust expectations and interactions based on the causes and consequences of each interaction (Gee, 2003). According to Begg, Dewhurst, and Ellaway, this is a description of a "model paradigm for proactive self reflective critical learning (p1, 2003)."

Students engaged in DGL manage their own learning, which helps them feel more responsible for their learning. They also develop a more interdisciplinary approach to learning. As they work through problems, they must gather and use information from a broad range of disciplines. This not only helps tie various aspects of the curriculum together, it also helps to create an authentic framework for the content. When students encounter new related information, they can more easily associate it with the rest of the framework (Gee, 2003). Additionally, students tend to be more interested in learning and retain knowledge longer if the problem is of personal interest to them (Glasgow, 1997; Gee, 2003).

DGL also strongly supports the tenets of andragogy, or adult education, as established by Knowles. According to Knowles (1998), adults are more successful in an educational environment where they have control over their own learning and the knowledge presented is personally relevant to them. Students learn in a more open-ended environment, which allows them to construct knowledge in ways that are most useful to them (Glasgow, 1997). Adults typically do not respond well to very rigid, structured learning environments where they are to passively sit and absorb knowledge (Knowles, 1998).

Disadvantages of DGL

There are a few disadvantages to DGL, though many of them are misconceptions and disagreements about the place of fun in learning (Prensky, 2001). There is still currently much resistance to incorporation of DGL into education or training because many "traditionalists" (Prensky, 2001)) believe that there is no place for fun in learning. Learning is serious business. If fun is introduced, it is no longer effective. Others believe that anything fun will not be seen as important by those engaged in the learning. Still others believe that learners will not retain anything they learned in a fun environment. Many studies have been done, most notably by Lightspan Achieve Now, that show the contrary (Prensky, 2001).

Another major disadvantage of DGL can be the cost involved. However, there are simple, inexpensive options available as well such as *Jeopardy*! and *PacMan* based shells into which different content can be loaded. The development of a full, immersive, engaging game takes about 2 years and often hundreds of thousands of dollars to accomplish. It also takes a whole team of people, from script writers, to graphic artists, to programmers. There are firms who specialize in developing DGL games. They are more cost effective than developing the games

in-house for most businesses and educational institutions. However, this option is not inexpensive either (Prensky, 2001).

Additionally, there are logistics issues to contend with. IT personnel must distribute, install, and support any software that is developed for DGL. This requires planning and careful scheduling to do smoothly. The software must also be compatible with the software and hardware already in place (Foreman, 2004).

Digital Game-based Learning for Dyslexics

To date, there is a dearth of research concerning using DGL with dyslexic adults. However, I believe DGL could be an excellent instructional method for dyslexics, helping both students and instructors to learn more easily and with less stress than many of the methods currently used, especially for adult students.

First of all, dyslexic students, like other students, must develop problem solving skills to cope in everyday life (Savin-Baden, 2000). However, most of the traditional instructional methods focus only on mindlessly repetitive tasks that require little cognitive processing. Instead, students are forced to endlessly copy letters and numbers in a very rigid, structured environment (Orton, 1928). These methods are counter to the basic tenets of andragogy. They are also hopelessly boring.

As discussed earlier, DGL helps students to develop a framework for knowledge. Dyslexics prefer to learn all new knowledge within a framework or context. They have great difficulty understanding and retaining knowledge if it is not within a framework or context of some kind. If they are allowed to create their own framework, their understanding will be even stronger. Additionally, dyslexic students have difficulty memorizing large amounts of information, as is generally required in traditional curriculum (Engel, 1997). DGL does not require this kind of memorization.

Dyslexics tend to be very visual learners, preferring visual information to text based or aurally presented information. They also generally prefer to learn facts and concepts simultaneously, which helps them form frameworks for the facts they are learning (Crux, 1991; Glasgow, 1997; Smith, 2002). Dyslexics may find that sounds and images help them understand content that would be difficult for them to understand solely from print-based information (Dimitriadi, 1999). DGL is a very visual medium which presents information situated within the context it is needed (Gee, 2003).

Another difficulty that dyslexics often face in traditional education environments is the lack of creativity inherent in them. Dyslexics are generally very creative and tend to have difficulty seeing problems in the same way as non-dyslexics. DGL allows them to solve problems and explore new material using any method they choose (Gee, 2003), thus allowing them the creativity they crave. It also allows them to represent their knowledge in creative ways, instead of requiring written or verbal communication, which is often difficult for them.

Finally, dyslexics can be highly successful if they are motivated, interested, and actively involved in what they are learning (Delisle, 1997; Fink, 1998; Glasgow, 1997; Newman, 1997). As discussed earlier, if information is presented in a way relevant and interesting to the student, the student is much more motivated to learn whatever is necessary to solve them (Gee, 2003). The same is true for dyslexic students. Fink's research showed that adults with profound difficulties resulting from their dyslexia could still persevere and be tremendously successful, often without any accommodations, if they were sufficiently motivated and interested in what they were studying. DGL can present learning situations that are very interesting and motivational to dyslexics, thus inspiring them to work through their difficulties to learn.

Conclusion

Digital Game-based learning has not been widely explored as an instructional and learning method for adult dyslexics. However, I believe DGL is particularly well suited to the needs of dyslexic students. It allows them to learn and represent their knowledge in creative ways that minimize their difficulties. It has the power to keep them interested and motivated enough to persevere through their difficulties. Finally,

and most importantly, digital game-based learning challenges dyslexics' higher thinking without overloading them with rote learning and memorization.

References

Aaron, P.G., Guillemord, J.C. (1993). Artists as dyslexics. In Willows, D.M., Corcos, R.S., Corcos, E. (Eds). *Visual Processes in Reading and Reading Disabilities*. Hillsdale, NJ: Erbaum.

Agran, M., King-Sears, M. E., Copeland, S. R. (2003). *Student-Directed Learning*. Baltimore: Paul H. Brookes Publishing Co.

Barrows, H. S. (1996). Problem-based Learning in Medicine and Beyond: A Brief Overview. In Wilkerson L, Gijselaers W H (Eds.) *Bringing Problem-based Learning to Higher Education: Theory and Practice*. San Francisco: Jossey-Bass Publishers.

Barrows, H. S., Tamblyn, R. M. (1980). *Problem-based Learning: An Approach to Medical Education*. New York: Springer.

Beer, V. (2000). *The Web Learning Fieldbook: Using the World Wide Web to Build Workplace Learning Environments*.San Francisco: Jossey-Bass Pfeiffer.

Begg, M. Dewhurst, D., and Ellaway, R. (2003). Process, Truth and Consequences; informal reflections on games, game communities and their use within higher education:College of Medicine and Veterinary Medicine, University of Edinburgh.

Burns, A. (2002). *Civilization III: Digital Game-based Learning and Macrohistory Simulations.* Retrieved 11/24, 2004

CEO Forum (2001, June). *Year 4 StaR report: Key building blocks for student achievement in the 21st century*. Retrieved August 21, 2001 from http://www.ceoforum.org/downloads/report4.pdf.

Cottrell, S. (2003). Students with dyslexia and other specific learning difficulties. *Special Teaching in Higher Education: Successful Strategies for access and inclusion*. Sterling, VA: Kogan Page Limited.

Crux, S. C. (1991). *Learning Strategies for Adults: Compensations for Learning Disabilities*. Toronto: Wall & Emerson, Inc.

Day, S., Edwards, B. (1996). Assistive technology for postsecondary students with learning disabilities. *Journal of Learning Disabilities, 29(5),* 486-492, 503.

Delisle, R. (1997). *How to Use Problem-based Learning in the Classroom*. Alexandria, VA: Association for Supervision and Curriculum Development.

Dewey, J. (1913). *Interest and Effort in Education*. Boston: Houghton Mifflin.

Dimitriadi, Y. (1999). Investigating aspects of using multimedia authoring with dyslexic learners. *Proceedings of CAL99 Conference on virtuality in education*. Institute of Education, London.

Engel, C. E. (1997). Not Just a Method but a Way of Learning. In Boud D, Feletti G I (Eds). *The Challenge of Problem-based Learning 2nd Ed*. London: Kogan Page Limited.

Everatt, J., Steffert, B., Smythe, I. (1999) An eye for the unusual: creative thinking in dyslexics. *Dyslexia, 5(1), 28-46*.

Fink, R. (1998). Literacy development in successful men and women with dyslexia. *Annals of Dyslexia, 48, 311-46*.

Fitzgibbon, G. O'Connor, B. (2002). *Adult Dyslexia: A Guide for the Workplace*. West Sussex: John Wiley and Sons, Ltd.

Foreman, J. (2004). Game-based Learning: How to Delight and Instruct in the 21st Century. *Educause Review, 39*(5), 50-66.

Gay, F. (1996). Facilitating alternative leraning techniques for adults with learning disabilities through the use of technology. In N. Gregg, & C. Hoy (Eds.) *Adults with learning disabilities: Theoretical and practical perspectives* (pp. 368-392). New York: Guiford Press.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave MacMillan.

Geschwind, N. (1982). Why Orton was Right. *Annals of Dyslexia, 32, 13-30*.

Gillingham, A., Stillman, B. (1956). *Remedial Training for Children with Specific Disability in Reading, Spelling and Penmanship, 5th ed*. Bronxville, NY: Anna Gillingham.

Glasgow, N. A. (1997). *New Curriculum for new Times: A Guide to Student-Centered, Problem-based Learning*. Thousand Oaks, CA: Corwin Press, Inc.

Heaton, P., Mitchell, G. (2001). *Dyslexia: Students in Need*. London: Whurr Publishers.

Henry, M. (1998). Structured, Sequential, Multisensory Teaching: The Orton Legacy. *Annals of Dyslexia, 48, 3-25*.

Herz, J (1997). *Joystick Nation*. New York: Little, Brown and Co.

Heshusius, L. (1989). The Newtonian mechanistic paradigm, special education, and contours of alternatives: An overview. *Journal of Learning Disabilities, 22, 403-15*.

Hinshelwood, J. (1917). *Congenital Word Blindness*. London: H.K. Lewis.

Horn, L., Berktold, J., Bobbit, L. (1999). *Students with disabilities in postsecondary education: A profile of preparation, participation, and outcomes*. Washington, DC: Office of Educational Research and Improvement, National Center for Educational Statistics (U.S. Government Printing Office, NCES 1999-187).

Hornsby, B. (2001) *Dyslexics I Have Known or Reaching for the Stars*. London: Whurr Publishers.

International Dyslexia Association (2000) Web address: www.interdys.org.

Jay, C., Blackerby, C. (1998). *Hope is not a method: How instructional strategies and technologies for the learning disabled can benefit traditional learners*. Houston, TX: North Harris Montgomery Community College District. ERIC Document Reproduction Service (ED 416919).

Jonassen, D.H. (2002). Engaging and Supporting Problem Solving in Online Learning. *The Quarterly Review of Distance Education, 3(1),1-13*.

Jonassen, D.H., Strobel, J., Gottdenker, J. (2004). Model Building for Conceptual Change. Unpublished manuscript, University of Missouri.

Keates, A. (2002). *Dyslexia and Information and Communication Technology*. London: David Fulton Publishers.

Kerchner, L. B., Kistenger, B. J. (1984). Language processing/word processing: Written expression, computers, and learning disabled students. *Learning Disability Quarterly, 7, 329-35*.

Klaila, D. (2001). Game-Based E-Learning Gets Real. *Learning Circuits*(Jan 2001).

Knowles, M. (1998). *The Adult Learner, 5th Ed*. Woburn: Butterworth-Heinemann.

Lewis, L., Farris, E. (1999, August). *An instructional perspective on students with disabilities in postsecondary education*. Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement (NCES 1999-046).

Lissner, L. (1995). Technological access and the law. *Information Technology and Disabilities, 2(2),* 1-7. Retrieved September 27, 2001 from http://www.isc.rit.edu/~easi/itd.html.

Low, G. (2000). *WebCT accessibility*. Presentation on accessibility and WebCT, 2001 WebCT User Conference. Retrieved August 27, 2001 from http://www.webct.com/service/ViewContent?contentID=4899312.

Margetson, D. (1997). Why is Problem-based Learning a Challenge? . In Boud D, Feletti G I (Eds). *The Challenge of Problem-based Learning 2nd Ed*. London: Kogan Page Limited.

Miles, T., Miles, E. (1993). *Dyslexia: A hundred years on*. Open University Press.

Morgan, E. (1996). Mapping an understanding of dyslexia. *Dyslexia, 2, 209-11*.

Morgan, E., Klein, C. (2000). *The Adult Dyslexic in a Non-Dyslexic World*. London: Whurr Publishers.

National Center for Educational Statistics. (2000, June). *Stats in brief: Postsecondary students with disabilities: Enrollment, services, and persistence*. Jessup, MD: National Center for Education Statistics. Retrieved August 21, 2001 from http://nces.ed.gov/pubs2000/200000092.pdf

Newell, A., Simon, H. (1972). *Human Problem Solving*. Englewood Cliffs, NJ: Prentice Hall.

Newman, D. (1997). Functional environments for microcomputers in education. In M. Cole, Y. Engstrom, O Vasquez (Eds.) *Mind, culture and activity. Seminal papers from the laboratory of comparative human condition*. Cambridge: Cambridge University Press.

Orton, S. (1925). 'Word-blindness' in school children. *Archives of Neurology and Psychiatry, 14, 581-615*.

Orton, S. (1928). Specific reading disability – Strephosymbolia. *The Journal of the American Medical Association, 90,1095-99*.

Picciano, A. G. (2001). *Distance Learning: Making Connections Across Virtual Space and Time*. Upper Saddle River, NJ: Prentice-Hall, Inc.

Pierson, J. (1999). Transforming Engagement in Literacy Instruction: The Role of Student Genuine Interest and Ability. *Annals of Dyslexia, 49, 307-29*.

Prensky, M. (2001). *Digital Game-based Learning*. New York: McGraw-Hill.

Raskind, M., Higgins, L., Herman, K. (1997). Technology in the workplace for persons with learning disabilities: Views from the inside. In Gerber. P.J., Brown, D.S. (Eds). *Learning Disabilities and Employment*. Austin: PRO-ED.

Ross, B. (1997). Towards a Framework for Problem-based Curricula. . In Boud D, Feletti G I (Eds). *The Challenge of Problem-based Learning 2nd Ed*. London: Kogan Page Limited.

Savin-Baden, M. (2000). *Problem-based Learning in Higher Education: Untold Stories*. Buckingham, UK: The Society for Research into Higher Education and Open University Press.

Schiefele, U. (1992). Topic interest and levels of text comprehension. In Renninger, K.A., Hidi, S., and Krapp, A. (Eds.) *The Role of Interest in Learning and Development*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Schmetzke, A. (2001). Web accessibility at university libraries and library schools. *Library Hi Tech,* 19(1), 35-49.

Shepherd, C. (2001). *Games e-learners play*. Retrieved 11/24, 2004, from http://www.fastrak-consulting.co.uk/tactix/features/games.htm

Shrage, M. (1999). *Serious Play: How the World's Best Companies Simulate to Innovate*.Boston: Harvard Business School Press.

Smith, J. (2002). Learning Styles: Fashion Fad or Lever for Change? The Application of Learning Style Theory to Inclusive Curriculum Delivery. *Innovations in Education and Teaching International, 39(1), 63-70*. Retrieved February 12, 2004, from http://www.tandf.co.uk/journals.

Tapscott, D. (1998). *Growing up digital: the rise of the net generation*. New York : McGraw-Hill.

U.S. Department of Labor (1991). *What work requires of schools: A SCANS report for American 2000*. Retrieved August 30, 2001 from http://ww.dol.gov.

U.S. Department of Labor (1999). *Futurework: Trends and challenges for work in the 21st century*. Retrieved September 17, 2001 from http://www.dol.gov/asp/public/futurework/report.htm.

Vail, P.L. (1990). Gifts, talents and the dyslexias: wellsprings, springboards and finding Foley's rocks. *Annals of Dyslexia, 40,3-17*.

van der Heijden, K. (1996). *Scenarios: The Art of Strategic Conversation*.West Sussex: John Wiley & Sons, Ltd.

Vygotsky, L. (1978). *Mind in Society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Web-based Education Commission. (2000, December). *The power of the Internet for learning: Moving from promise to practice*. Retrieved August 29, 2001 from http://www.ed.gov/offices/AC/WBEC/FinalReport/WBECReport.pdf.