Enhancing Learning for Students with Disabilities through Multimedia Instruction

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Abstract

This paper addresses the benefits of multimedia instruction with respect to how it can be utilized to serve students with learning disabilities. First, various principles of multimedia education will be described, all of which are based on the implications of Cognitive Theory of Multimedia Learning. Second, teaching strategies and technological integration of multimedia tools according to the principles highlighted will be discussed. Finally, the benefits of these teaching strategies aligned with Cognitive Theory of Multimedia Learning will be discussed in relation to how students with learning disabilities can be better served in a multimedia learning environment.

Keywords: multimedia learning, Cognitive Theory of Multimedia Learning, students with learning disabilities, multimedia as assistive technology, student motivation
Introduction

Numerous studies have been conducted regarding the effects of multimedia instruction on the learning experiences of students with disabilities. It is evident through such studies that when designed appropriately, multimedia instruction can overwhelmingly enhance learning for students with learning disabilities. For example, appropriately designed multimedia instruction can improve accessibility to content and allow for increased assistive technology resources for students with disabilities. Additionally, multimedia content is naturally communicated in multiple styles, therefore students are more likely to engage in the learning experience. Finally, since multimedia increases student engagement in learning, it therefore increases student motivation and accountability for learning.

Literature Review

Mayer’s Cognitive Theory of Multimedia Learning asserts that multimedia instruction must be designed with human cognitive processing in mind in order to be most effective. This theory is based on three assumptions; dual channels, limited capacity, and active processing (Mayer, 2014, p. 47). The Dual-Channel Assumption asserts that “humans possess separate information processing channels for visually/spatially represented material and auditorily/verbally represented material” (p. 47). Therefore, since the multimedia principle asserts that people learn more deeply from words and pictures together than words alone, it is essential to understand that spoken words are processed differently than written words. Second, limited capacity assumes that humans can process limited amounts of information in each channel at once. Additionally, it is assumed that humans actively process information by selecting, organizing, and integrating information into memory (p. 51). Finally, Cognitive Theory of Multimedia Learning is based on three separate memory stores; sensory, working, and
long-term. Each memory store has its own capacity, duration, and format in which information is stored. Therefore it is essential for educators to take each of the three assumptions of Cognitive Theory of Multimedia Learning into account as “multimedia instructional messages should be designed to guide appropriate cognitive processing during learning without overloading the learner’s cognitive system” (p. 43).

The article “Using Multimedia to Enhance the Accessibility of the Learning Environment for Disabled Students: Reflections from the Skills for Access Project” maintains that “effective use of multimedia offers a way of enhancing the accessibility of the learning environment for many groups of disabled students” (Sloan, 2006, p. 39). The article also states that a major issue is not a lack of multimedia alternatives for students with disabilities, but rather the way in which the multimedia content is presented, resulting in an inability or difficulty processing and understanding information presented on the screen. However, when multimedia instruction is designed properly, it is not only an instructional tool, but also an assistive technology.

The article “Digital Technology, Learning, and Postsecondary Students with Disabilities: Where We’ve Been and Where We’re Going” provides insight on the history of assistive technology starting in the 1990’s and also reviews current and emerging trends in e-learning and information and communication technologies (ICTs) with respect to universal design principles (Fichten, 2014). The article discusses the blurring between assistive technology ICTs and general use ICTs as many assistive technology ICTs are increasingly used as mainstream technologies by all students. For example, spell-checker and text-to-speech screen readers that were once developed as assistive technologies are now widely used by those without learning disabilities. The article continues by categorizing three types of ICTs used by students with disabilities: “general use ICTs (e.g. word processing), assistive computer technologies (e.g. Braille printer),
and adaptable technologies (e.g. dictation and screen reading software)” (Fichten, 2014, p. 370). Each of these multimedia ICTs can be used in instruction in order to increase accessibility of assistive technologies and support students with learning disabilities.

The article “Interactive White Boards Added Value in Special Education” discusses the positive effects of Interactive White Boards (IWBs) on learning for students with special educational needs due to the promotion of multi-sensory learning provided (Drigas, 2014). It is concluded that IWBs increase student motivation to learn and allow students to access multimedia information in order to benefit from their different cognitive abilities and learning methods (Drigas, 2014, p. 58). Therefore, multimedia instruction communicates through multiple learning styles, which allows for individualization of learning for all students.

The article “Authenticity in learning; multimedia design projects in the social studies for students with disabilities” asserts that educational multimedia can serve as tools to engage all students in construction of knowledge, active problem solving, and reflection (Ferreti, 1996). The article states that traditional approaches to teaching thinking and problem solving skills have yielded mixed results, especially in relation to students with learning disabilities. However, multimedia learning environments allow students to “exercise control over their own learning in ways not possible with traditional instructional materials” (p. 453). For example, video and audio can help students with little background knowledge better understand a concept, as well as “circumvent the text barrier encountered by many students with reading difficulties” (p. 454).

The article “Using Evidence-Based Multimedia to Improve Vocabulary Performance of Adolescents With LD: A UDL Approach” provides results of a research study conducted using multimedia instructional tools in alignment with the Universal Design for Learning (UDL) approach with the purpose of improving vocabulary performance of adolescent students with
learning disabilities (LD) (Kennedy, 2014). The multimedia-based instructional tool used to conduct research was called a content acquisition podcast (CAP) which was created based on “evidence based practices for vocabulary instruction, UDL, and Mayer’s multimedia instructional design principles” (p.71). Specifically, the CAP provided “multiple means of representation and engagement” while ranging in length between one to three minutes, and only providing key content as to eliminate extraneous cognitive load according to Mayer’s cognitive theory of multimedia learning (p. 73). Therefore, multimedia instructional strategies used in the CAP aligned with various principles of Mayer’s cognitive theory of multimedia learning such as coherence, where extraneous information is excluded, and signaling, where cues are added in order to highlight essential material (Mayer & Fiorella, 2014). According to the results of this research, both students with and without disabilities instructed using the multimedia CAP demonstrated significant vocabulary acquisition growth as measured by weekly curriculum-based assessments (CAB) and posttests. Additionally, the use of the multimedia CAP in vocabulary instruction resulted in increased student motivation for vocabulary learning (p. 74).

The article “Multimedia: enhancing instruction with learning disabilities” explores ways in which teachers can utilize multimedia in order to meet the needs of students with learning disabilities (Wissick, 1996). According to the article, “the use of multimedia as a tool can increase the teacher’s productivity and effectiveness at demonstrating subject matter to the whole class or facilitating group interaction” (p. 495-6). Additionally, the effect of multimedia on student motivation is discussed. Because multimedia makes content more realistic with visual representations of material, students are more likely to recall prior knowledge and become more engaged in learning. The article distinguishes between three instructional uses of multimedia;
presentation tool, tutor or learning station, and tutee or research station, all of which play a role in an increased level of student motivation for learning (p. 495).

**Discussion**

**Designing Appropriate Multimedia Instruction**

In order to ensure that multimedia instruction is designed with human cognitive processing in mind, there are three instructional goals outlined by Cognitive Theory of Multimedia Learning: minimize extraneous processing, manage essential processing, and foster generative processing (Mayer, 2014, p. 63). Therefore, if all three goals are met, multimedia instruction can effectively enhance the learning experience of all students.

Based on Cognitive Theory of Multimedia Learning, Mayer and Fiorella specifically focus on the multimedia learning principles which support the reduction of extraneous processing such as Coherence, Signaling, Redundancy, Spatial Contiguity, and Temporal Contiguity principles. All of these principles can support learners with learning disabilities in a multimedia setting because of their focus on reducing and eliminating extraneous overload. “Extraneous overload occurs when essential cognitive processing and extraneous cognitive processing exceed the learner’s cognitive capacity” (Mayer, 2014, p. 279). A learner’s essential cognitive processing is required in order to make sense of multimedia information, whereas extraneous cognitive processing is required to make sense of a confusing layout or organization of multimedia information. Therefore, it is ideal to eliminate the need for extraneous cognitive processing all together by designing multimedia instructional tools according to these principles, so that information is delivered to learners in the most concise, effective way possible. For example, the Coherence principle asserts that extraneous material which contributes to cognitive overload and therefore inhibits learning should be excluded from instruction. The Signaling
principle asserts that cues should be added into multimedia instruction in order to focus the learner’s attention on important information. The Redundancy principle asserts that identical information should not be presented in textual and verbal format simultaneously, but rather that on-screen text be excluded and instruction only include graphics and narration. The Spatial Contiguity principle asserts that similar terms should be located physically close to one another, where as finally, the Temporal Contiguity asserts that corresponding animation and narration should be presented simultaneously. (Mayer & Fiorella, 2014). In order to make multimedia instruction as effective as possible for students with learning disabilities, it is essential that extraneous overload be avoided through the integration of these principles for multimedia instruction.

**Increasing Accessibility**

Multimedia has the potential to offer increased accessibility to students with disabilities, however when designed poorly, multimedia can also exclude a disabled student from the learning. (Sloan, 2006). The presentation, style, and content of a multimedia presentation plays a significant role in accessibility for students with learning disabilities such as dyslexia and other cognitive processing difficulties (p. 42). In alignment with the Redundancy principle of multimedia learning, “arguably the most inaccessible way of presenting information is through a long page of on-screen text,” whereas the presentation of information in “alternatives ways-pictures, diagrams, animated diagrams, video clips, audio recordings- is far more effective in conveying information and experiences, and hence supporting comprehension and retention of information” (p. 42). Therefore, it is important for instructors to be cognizant of access for students with disabilities when designing multimedia curriculum and creating multimedia resources in order to ensure efficacy of instruction.
However, according to the article “Digital Technology, Learning, and Postsecondary Students with Disabilities: Where We've Been and Where We’re Going,” current emerging trends in e-learning can also help improve accessibility for students with learning disabilities (Fichten, 2014). For example, cloud computing, such as Google Apps for Education (GAFE), is said to improve accessibility for students as it is a completely free, online environment similar to Microsoft Office. Additionally GAFE has a number of assistive technology apps and extensions which allow for mobile access to multimedia instruction. The author also states that multimedia technologies such as digital textbooks, gamification of learning materials, and YouTube as a learning platform increase the accessibility and therefore have a positive effect on learning for students with disabilities (Fichten, 2014).

**Increasing Motivation and Accountability for Learning**

It is evident that multimedia instruction is an effective tool for increasing motivation for learning in all students, regardless of whether or not they are affected by a learning disability. This conclusion is presented in the research published by Kennedy, Thomas, Meyer, Alves, and Lloyd in 2014. Their article “Using Evidence-Based Multimedia to Improve Vocabulary Performance of Adolescents With LD: A UDL Approach” states that based on their research, not only did multimedia instruction improve student retention of vocabulary, but simultaneously increased student motivation to learn vocabulary.

A similar conclusion is found in the article, article “Interactive White Boards Added Value in Special Education” (Drigas, 2014). It is stated that “the combination of the verbal, auditory, and tactile features encourages participation and motivates students to learn, employing multisensory methods that are more interactive than a flat, two-dimensional display of a blackboard.” (p. 59). Using an IWB, the teacher is able to incorporate multiple learning styles in
multimedia instruction which effectively engages students with disabilities in the learning process. It was found that not only did students with learning disabilities demonstrate higher motivation for learning with the integration of an IWB, but that students with Autism, Attention Deficit Hyperactive Disorder (ADHD), visual disabilities, and auditory disabilities also displayed increased motivation due to multimedia instruction delivered through an IWB (Drigas, 2014).

Furthermore, according to Wissick, using multimedia as a presentation tool, teachers can “help students with learning disabilities distinguish important information from incidental, and connect past experiences to the present situation” which aids in student motivation for learning (1996, p. 497). As a learning station, multimedia can be used to as a learning guide incorporating drill and practice, tutorials, and simulation all at once (p. 498). This allows students with learning disabilities to “explore different paths to locate their answers using multimedia’s nonlinear capabilities” (p. 497). Finally, as a research station, students can create multimedia projects and become in charge of their own learning. At this point, the process of learning and demonstration of understanding becomes more important than the product itself, but the synthesis of knowledge is a product of true learning as multimedia motivates students to take accountability for their own learning.

Finally, this claim is also supported in Ferreti’s article “Authenticity in learning: multimedia design projects in the social studies for students with disabilities” (1996). The study highlighted in this article was conducted in a fourth grade social studies classroom containing students with and without learning disabilities (Ferreti, 1996). Students conducted a multimedia design project analyzing the advantages and disadvantages of Industrialization. Results from pre and posttests demonstrated not only that attitudes toward social studies and toward collaboration with peers improved in both students with and without disabilities, but also that students’
knowledge significantly improved (Ferreti, 1996). Results even showed that students with disabilities learned just as much as the students without disabilities. Therefore, it is concluded that multimedia projects benefit students with and without learning disabilities as they increase student motivation through high levels of involvement, individualized feedback, and the encouragement of students to take pride in their work.

**Conclusion**

In conclusion, various studies support multimedia instruction as a beneficial learning tool for students with disabilities. It is evident that appropriately designed multimedia instruction can help increase access to assistive technologies for students with disabilities while also increasing student motivation and accountability for learning. Through multimedia instruction, students are provided content communicated through multiple learning styles, which therefore engages learners in a relevant, meaningful, and effective learning experience.
References


