Increasing Accessibility: Using Universal Design Principles to Address Disability Impairments in the Online Learning Environment

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Abstract

With the increasing number of students enrolling in distance education, there is a need to consider the accessibility of course materials in online learning environments. Four major groups of disabilities: mobility, auditory, visual, and cognitive are explored as they relate to their implementation into instructional design and their impact on students in online learning, specifically for students with disabilities. This article highlights the ways in which universal design can assist in providing increased accessibility, not only for students with disabilities, but for all students in the online learning environment. Current standards for disability instruction and guidelines for creating accessible materials are shared.

The National Center for Education Statistics (NCES) defined distance education as "a formal education process in which the students and instructors are not in the same place" resulting in the online environment becoming the platform where students and teachers meet academically (NCES, 2008, p. 1). In postsecondary education, the development of distance education has significantly accelerated in the last few decades (Pittman, 2003). Allen and Seaman (2013) indicate that 6.7 million students, or about 32%, enrolled in at least one distance learning course during the fall 2011 semester, which was a 3% increase from fall 2010.

Edmonds (2004) noted that higher education institutions may neglect the needs of students with disabilities in an effort to increase online learning opportunities. With the rise in distance education enrollment, administrators should consider accessibility in the instructional design process. The invention of the World Wide Web (Web) has impacted students with disabilities by removing many of the interactional barriers they may have faced in a physical classroom setting; while creating new barriers that may exclude these students from using the Web (World Wide Web Consortium, 2013). Providing accommodations through access is not enough because courses that are inadequately designed create additional barriers to participation (Burgstahler, 2004). The purpose of this article is to identify challenges in the online learning environment faced by those with disabilities and to illustrate how the principles of universal design can be used as a means to assist instructors in increasing accessibility for students with disabilities in the online learning environment (Mace, Hardie, & Plaice, 1991).

Literature Review

With the continual increase of students in distance education, accessibility especially for students with disabilities is more important than ever before (NCES, 2011b). Students with disabilities "represent a growing and diverse population of students whose needs can vary according to the specific disability and its corresponding severity" (Barnard-Brak & Sulak, 2010, p. 83). During the 2008-2009 academic year, the number of students with disabilities enrolled in two-year and four-year postsecondary institutions was approximately 707,000 (NCES, 2011b). According to NCES data, during the 2006–2007 academic year 26 percent of the students who enrolled in a distance education course reported having mobility

disabilities, 21 percent reported having sensory disabilities, while another 20 percent indicated that they were affected by other long-lasting conditions (i.e. cognitive disabilities; NCES, 2011b; NCES, 2011c). Because it is likely that more students including those with disabilities will continue to enroll in distance education courses, providing accessible design during the course development phase could save time and money for academic departments.

Providing accessible design for students with disabilities should be considered within each academic course instead of asking students to find support outside of the course environment or having to subsequently retrofit the online learning environment (Grabinger, Aplin, & Ponnappa-Brenner, 2008; Kinash & Crichton, 2007). When institutions fail to act on behalf of students with disabilities, legal intervention may occur. For example, failing to act soon enough, the University of California at Berkeley was involved in a lawsuit and recently reached an agreement with Disability Rights Advocates to launch a massive overhaul aimed at increasing accessibility for students with disabilities beginning with course material improvement (New, 2013). Institutions should be proactive in considering the needs of students with disabilities and beginning at the course level is one way higher education institutions can start to address accessibility.

Existing Guidelines and Standards

Several guidelines and standards have been created to aid in the development of more accessible online subject matter. The Web Content Accessibility Guidelines (WCAG) developed by the World Wide Web Consortium (W3C) and section 508 of the Vocational Rehabilitation Act of 1973 establish a foundation that when followed can create accessible online content (Burgstahler, Corrigan, & McCarter, 2004). Web Content Accessibility Guidelines 2.0 uses the following accessibility principles to provide accessible content for all students: a) Perceivable - the user interface and the content must be presented in a manner that can be perceived by users; b) Operable - the user should be able to operate the interface; c) Understandable - the user must be able to both understand and operate the interface; and d) Robust - the content must be sturdy enough that it can be accessed even when technology changes (World Wide Web Consortium, 2012). Each principle includes guidelines intended to ensure that Web content is accessible to as many people as possible.

Edmonds (2004) states, "no single law or court decision requires educators to provide online courses in a format that is accessible to students with disabilities" (p. 52). However, some federal and state laws may be applied to online education. The Vocational Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990 provided students with disabilities greater accessibility (Burgstahler et al., 2004). The Vocational Rehabilitation Act bars federally funded institutions from discriminating against individuals with disabilities (Edmonds, 2004). While the Americans with Disabilities Act (ADA) not only forbids institutions from discriminating against people with disabilities, but goes one step further, and ensures that those with disabilities are not kept from receiving equal access to services (Edmonds, 2004). In 1998, Section 508 of the Vocational Rehabilitation Act of 1973 was amended, which required all federal departments and agencies to ensure that information technology was accessible to people with disabilities (Section 508 of the Rehabilitation Act, 1998). Although Section 508 only applies to federal agencies, Edmonds (2004) noted a letter written by US Department of Education officials which revealed they understood this amendment to apply to some state divisions such as public colleges and universities.

Disability Literature Review

With many instructors working to address accessibility in the online learning environment, there are some that are still unsure of the challenges inherit within the system for students with disabilities. Designing courses with accessibility in mind provides all students with easier access to online course material. Understanding how disabilities may impact a student's learning in the online classroom can help instructors during the development phase. This review of literature focuses on four major groups of disabilities as defined by Crow (2008) and their relationship to online course design features.

Categories of Disabilities

Disabilities can cover a broad range of conditions and the degree to which they may affect a student may

vary. Although there are different types of disabilities, Crow (2008) placed them into the following four categories: mobility, hearing, visual, and cognitive. The following sections provide a synopsis for each disability category.

Mobility Disabilities

Students with mobility disabilities have some type of difficulty using their extremities, particularly their arms and legs; while often requiring assistive technology such as wheelchairs or canes to assist them while moving around (National Organization on Disability, 2013a). These students may have problems positioning or lifting and may require specialized instructional materials (National Center on Accessible Instructional Materials, 2012). Mobility disabilities may result from any number of medical conditions including amputations, birth defects, cerebral palsy, limb damage or loss, muscular dystrophy, multiple sclerosis, spina bifida, spinal cord injuries, neurological conditions, or paralysis (WebAIM, 2012a, para. 1).

Due to the broad range of conditions associated with mobility disabilities, students in online learning courses may face an array of challenges (Foley & Regan, 2002). One such challenge associated with mobility and physical disabilities may include difficulties using the mouse and/or controlling the keyboard (Hudson, 2002; WebAIM, 2012a). As a result, students may have trouble interfacing with their computer or may struggle to participate effectively in synchronous discussions (Burgstahler, 2002; Crow, 2008).

Hearing Disabilities

Those who have this disability may have difficulty hearing course material. Disabled World (2013a) states, "A hearing impairment or hearing loss is a full or partial decrease in the ability to detect or understand sounds" (para 2). The National Institute on Deafness and Other Communication Disorders (NIDCD) noted that approximately 36 million Americans report some type of hearing loss (NIDCD, 2012). The severity of these disabilities can vary from mild to profound (WebAIM, 2012b). Hearing disabilities may result from a number of problems including various illnesses and injuries, age, extended noise exposure, or genetic issues (U.S. Equal Employment Opportunity Commission, 2006). In online learning, students with hearing disabilities may have difficulty understanding audio, video, or multimedia presentations.

Visual Disabilities

Students with this type of disability may struggle with viewing course material. It is estimated that approximately 10 million Americans are either blind or visually impaired (U.S. Equal Employment Opportunity Commission, 2013). Visual disabilities are classified into three categories: (a) total blindness, (b) low-vision, and (c) color-blindness (WebAIM, 2013). Visual disabilities may be caused from a variety of ailments such as damage to the eye, transmission problems between the brain and the eye, diabetic retinopathy, cataracts, or glaucoma (U.S. Equal Employment Opportunity Commission, 2013). In the online environment, students with visual disabilities may have a hard time seeing or be completely unable to see standard printed materials, videos, and PowerPoint presentations and often require specialized resources to help them access course information (Burgstahler, 2002; National Center on Accessible Instructional Materials, 2012).

Cognitive Disabilities

Students with cognitive disabilities may experience challenges in being able to mentally grasp or think contextually about course material. Novak and Paciello (2002) noted that cognitive disabilities are not as easily understood as some of the other disability groups. In fact, four times the amount of people has cognitive disabilities than those with visual disabilities, yet the latter receives far more consideration in the accommodation literature (Keeler & Homey, 2007; Rowland, 2004). Cognitive disabilities include a wide range of disorders including "memory, perception, problem-solving, and conceptualizing challenges" (Crow, 2008, p. 53). Grabinger, Aplin, and Ponnappa-Brenner (2008) categorized cognitive disabilities into five areas: (a) attention and memory, (b) language, (c) executive function, (d) problem solving and reasoning, and (e) social function. These types of disabilities can derive from medical

conditions such as autism, brain injury, cerebral palsy, epilepsy, mental retardation, neurological disabilities, dyslexia, attention deficit hyperactivity disorder (ADHD), or other genetic disabilities (Disabled World, 2013b; Rowland, 2004).

Students suffering from cognitive disabilities may find it difficult to regulate emotions, retrieve words, communicate effectively, regulate learning, solve problems, or socialize with others (Grabinger et al., 2008). Essentially, cognitive disabilities may affect a student's "ability to listen, think, speak, read, write, do math, or follow instructions" (National Organization on Disability, 2013b, para. 1). Students with learning disabilities make up the largest group of people with disabilities (Crow, 2008). In the online learning environment, cluttered websites and screen layouts may be difficult for students with learning disabilities to understand (Burgstahler, 2002). Students with cognitive disabilities often fail due to not having their problems addressed in the online learning environment (Grabinger et al., 2008). Nevertheless, this group of students is largely left untargeted due to beliefs that providing accessibility for them may become an undue burden (Rowland, 2004). For learners with cognitive disabilities, accessibility can be a far greater challenge than those with other more physical disabilities (Mariger, 2006). The diverse array of cognitive disabilities makes it near impossible to design a course or material that can address each individual class of cognitive disability, but the use of universal design principles can make instruction more accessible (Grabinger et al., 2008).

Universal Design Principles & Application

In discussing techniques to provide accessibility for students with disabilities the term universal design is often used. Universal design was coined by Ronald Mace in 1989 (Center for an Accessible Society, 2013). Mace stated that universal design is "an approach to creating environments and products that are usable by all people to the greatest extent possible" (Mace, Hardie, & Plaice, 1991, p. 156). While universal design initially started in the Architectural field of study, it has now spread to other academic areas including communication, marketing, and recreation (Russell, Hoffmann, & Higgins, 2009). Under Mace's leadership, a set of principles were developed to assist in the development of environments and other products which can be used to guide instructional designers in creating a more accessible online learning environment (Burgstahler, 2002; Center for Universal Design, 2010a).

The Center for Universal Design (2010b) highlights the ways universal design can be used to improve accessibility for all students in the distance learning environment. Accessibility is the ensuring that all students regardless of disability can access course materials and other offered technologies (Seale & Cooper, 2010). Distance learning environments often provide limited accessibility when it comes to meeting the needs of students with disabilities (Steyaert, 2005). Universal design can assist online instructional designers in developing more accessible online course content for all users, particularly students with disabilities (Eagleton, 2008).

The seven principles of Universal Design include equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (The Center for Universal Design, 2010b). The following section provides an overview of each universal design principle and offers examples of how these principles may be applied in the development of online coursework.

Equitable Use

The principle of equitable use is intended for the course design to be useful and marketable to people with diverse abilities. Dugger and Allen (2012) indicated that instructors must be committed to creating an environment accessible by all students, ensuring that course content is clear and organized, and providing alternatives when needed. Instructors should ensure that all students, regardless of ability level, are able to access course information. For example students with cognitive disabilities may have difficulty navigating cluttered websites. A cluttered website is a web page that presents many different elements and appears too busy which can be confusing for all students. Equitable use also applies to reducing the number of tools used while making sure accessible technology is being used (Passman & Green, 2009). At the same time, adding captions and annotations to multimedia are very helpful for students with hearing disabilities (Ferretto, Roccetti, Salomoni, & Mirri, 2009). Therefore, to provide equitable use, course sites need to be

free of clutter and include instructional materials in a carefully organized, easily accessible format. Employing different assessment methods is another key concept in equitable use in that it calls for instructors to provide multiple ways students can illustrate their knowledge (Darby, 2013). Using a variety of assessment methods is beneficial and increases accessibility for all learners (Burgstahler, 2007). For instance, having a mixture of individual and group activities along with an assortment of test questions (i.e. multiple choice, essay, or short answer) allows students to demonstrate their knowledge in a variety of ways.

Flexibility in Use

All manners of disabilities must be taken into account when developing online courses. Principle two, flexibility of use, implies that the design accommodates a wide range of student ability levels. Providing course lectures in both text and audio versions is one way to accommodate various learning styles and disabilities while offering additional study options for students without disabilities (The Center for Universal Design, 2010b). For instance, students who are visual learners may benefit from the use of graphics or multimedia in course designs while auditory learners may benefit from the use of additional audio materials. It is also beneficial for students with cognitive disabilities to have course information and instructions presented in both "oral and written formats" (Grabinger et al., 2008, p. 67). Flexibility in use also applies to students who have mobility disabilities. These students can experience challenges with using a mouse and or keyboard (Hudson, 2002). The World Wide Web Consortium (2013) notes that it is better for accessible websites not to rely solely on the use of a mouse, but rather provide all functionality via keyboard. Instructors can consider the use of assistive technologies such as speech input devices that can simulate keyboard functions for students with mobility disabilities (The World Wide Web Consortium, 2013). Delivering lectures in multiple formats also allows students to participate without necessarily disclosing their disability (Dugger & Allen, 2012).
Simple and Intuitive Use

The third principle, simple and intuitive use, states that the use of the course design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level.

Using consistent course designs (i.e. underlined words for hyperlinks and magnifying glasses to indicate search) can enable students to become more familiar with course navigation regardless of ability level (Dugger & Allen, 2012). Instructors should keep in mind that large blocks of text can affect students with cognitive issues and language difficulties (Rowland, 2004). Instead, using smaller blocks of text with accurate headings may help students locate and comprehend the information more easily. Attempting to avoid text that changes and or moves is also helpful (Nielsen, 2005). "Simpler is always better" when designing online courses (Passman & Green, 2009, p. 51). Failing to follow consistent designs may be problematic for students with some disabilities (Keeler & Homey, 2007).

This principle can also be utilized in the online learning environment by ensuring that instructions correspond with assignments. For example, an assignment containing three sections needs include a list of instructions at the beginning of each section, instead of referring students back to the syllabus. Further, rubrics need to be provided with each assignment to eliminate any possibility for misunderstanding on the part of the student. All students can benefit from having rubrics included with each assignment. Moreover, providing constructive feedback can help students get back on track when they make mistakes (Hudson, Weakley, & Firminger, 2005; Jiwnani, 2001; Serra, & Muzio, 2002).

Perceptible Information

The principle of perceptible information notes that the design communicates information effectively to the user regardless of ambient conditions or the user's sensory abilities. This principle can be applied by adding captioning to video, allowing text to be enlarged, and making sure color is not used as the sole method to deliver information (The Center for Universal Design, 2010b). Using features such as captioning can also be beneficial for students who are English language learners (Sapp, 2009). This principle "provides compatibility with a variety of techniques or devices used by people with sensory limitations" (Rossetti, 2006, p. 3).
To provide accommodations for various situations and disabilities instructors may offer course material in

different formats. Providing sign language interpretation of audio content can be of great assistance to those with hearing disabilities (Web Accessibility Initiative, 2012). A variety of tools such as screen readers, screen magnifiers, braille books, and instructional materials are available to help students with visual disabilities (Crow, 2008; WebAIM, 2013). Some visual disabilities may limit a students' ability to identify specific colors particularly contrasting shades of gray (Paciello, 2000). Instead, ensure there is enough contrast between the actual text and the webpage background. Keeler and Homey (2007) indicated that pop-up windows and moving screen content may cause problems for students with visual disabilities suggesting instead to provide text in the place of moving images, figures, or other graphics. In addition, students with visual disabilities can benefit from having options to change background colors along with the font sizes and styles of learning materials (Sapp, 2009)

When displaying graphics, providing alternative information for students who may have visual disabilities, can help improve access to course information. Students who are blind, may not be able to associate an image with a specific concept, instead alternate information should be offered as opposed to images. For example, providing a visual or verbal description when discussing the slope of a line instead of directing students to "look" at the slope of the line could perhaps allow the student to picture the slope given the description. Any information displayed to students should be presented in a variety of formats (Burgstahler, 2007).

Tolerance for Error

The fifth principle of universal design asks instructors to consider their course design as it relates to minimizing the consequences of a student's unintended actions. For example, students often insert the wrong information into tests, or other assignments. Ensuring the availability of an "undo" feature in the computer software allows students to correct their mistakes without consequence (Center for Universal Design, 2010b). Dugger and Allen (2012) indicated that providing students with additional instructions and giving ample amounts of time to complete assignments via online conferencing can limit errors. Numbering step-by-step procedures may also reduce the possibility of skipping steps when following instructions.

Students often enter classes with varying levels of knowledge about concepts and ideas. Providing background information while offering links to additional information and using various scaffolding tools may help students with various levels of knowledge and abilities (Burgstahler, 2007).

Low Physical Effort

The principle of low physical effort suggests that the course design be used efficiently and comfortably and with a minimum level of fatigue. To that end, providing hyperlinks to important course documents and making sure chapter activities are located within the same area, makes information easier to locate. Moreover, if third party programs such as Adobe Flash Player or Adobe Reader are needed to view material, providing students with the hyperlink to the webpage where they can either download or update the software is helpful. Keep in mind, however, that accessing some materials can be difficult with Adobe Flash. This principle is extremely important for students who may have mobility disabilities.

It is common for online courses to be segmented into modules, weeks, or chapters. Instructors should place all course materials and assignments for a specific module or chapter together in order to increase the ease of effort for all students. In classes that use chat, instructors should ensure that any feedback features are enabled, providing a means for students to offer feedback whenever necessary. While chat provides a communication channel between the instructor and student it can cause difficulties for some students with disabilities. For instance, students with visual disabilities, may have issues participating in the chat due to not being able to "see" class conversations. Providing screen readers and captioning can provide better access to the course chat feature (Passman & Green, 2009). Further, chat sessions may cause problems for students with mobility disabilities because they may have a slower input or limited hand functions (Burgstahler et al, 2004). Instructors may need to be aware of this issue and provide additional time for students to participate in chat sessions. Additionally, using software with both video and voice chat could also provide more accessibility to not only students with mobility disabilities, but also students with visual disabilities.

Size and Space for Approach and Use

The size and space for approach and use principle within universal design indicates that appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility. This principle reminds instructors to ensure video and audio controls are available for students and form fields and controls are large enough to be seen and accessible via the keyboard (Dugger & Allen, 2012).

It is important for students to have the ability to adjust settings as needed. If instructors are using video or audio components, make sure permissions are set accordingly, in order to allow students to adjust their settings. It is important for these controls (play, pause, or volume buttons) to be large enough to be easily read and seen (Burgstahler, 2007). In the event of a students' difficulty to use a mouse (i.e. students with mobility disabilities) all content must be accessible through the use of the keyboard. In addition, allowing students to resize text up to 200 percent using a standard browser, will help students adjust text to a comfortable size (Web Accessibility Initiative, 2012).

Implications

Using the seven principles of universal design as a guide when creating online courses can be beneficial for both instructors and students. Some instructors may not have received the training needed to implement these design principles into their online courses. These principles along with previously set standards can serve as the foundation for instructors seeking to create more accessible online learning environments. Using these principles may also help academic departments establish a common template based on the standards and guidelines that have already been developed to help instructors update their online courses. The use of such templates can benefit instructors, as they may save time by having an established course that is already accessible, and students may not need to request additional changes in the online learning environment.

Implementing the seven principles of universal design can be beneficial to all students. Creating more accessible online courses could possibly help increase success rates for students regardless of their ability level. Students who are second language learners can benefit from flexible and simple designs created in an online learning environment. Moreover, students who learn using multiple learning styles can also excel from the use of universal design as it employs various learning techniques not directed at any particular student type.

The application of universal design principles, can prove to be a valuable asset in the distance learning field. Aside from being advantageous for students with disabilities and second language learners, the use of the universal design principles could possibly increase student retention rates. Navigating the online learning environment can sometimes prove challenging, especially to beginning online students. Consequently, negative online learning experiences may discourage students from enrolling in future online learning courses. Using universal design principles can make navigation easier for students regardless of their previous online learning experiences.

In addition to possibly increasing students' retention rates, implementing universal design principles can be valuable toward the overall image of the online learning environment. Although enrollment in distance education is increasing, there are those that may always prefer the traditional face-to-face learning environments, over the still developing online learning environment (Bozorgmanesh, 2011). Universal design principles may possibly increase the success rates of all students regardless of disability in online learning. Increasing online learning success through the application of the universal design principles could perhaps change perceptions of the distance education field and strengthen its relevance among educational professionals.

For distance learning administrators, it is essential to understand and establish the necessary standards to provide each individual with the same opportunity to learn. Helping to prepare instructors could ensure accessibility for all students. Not all instructors are experienced in the development of online courses. To aid in this, administrators could provide instructors with templates that can be used as a guide to make

courses more accessible. In addition, it is important for distance learning administrators to make sure that online instructors are not only aware of, but also capable in dealing with any challenges that may occur as a result of having students with disabilities in an online course. Distance learning administrators should ensure that instructors and instructional designers are equipped with the tools, technology, and support necessary to develop courses that are accessible to everyone, regardless of ability level.

Conclusion

This article focused on using the seven principles of universal design to create more accessibility for students in the online learning environment. Future research may examine if the use of universal design may impact other areas in online learning. Specifically, research should be conducted to investigate whether implementing universal design may have an impact on the retention of students with disabilities, and the retention of all students in the online learning environment. Additional research could also examine whether the use of universal design principles has an impact on students' academic achievement and content knowledge gains. Because implementing the universal design principles into course design may ultimately be beneficial to all students, and not just those with disabilities, future research should also explore the impact of using these principles in all disciplines within higher education. The implementation of universal design principles into higher education as a whole could possibly change the landscape making higher education generally more accessible to all students.

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