Accessibility to E-Learning for Persons With Disabilities: Strategies, Guidelines, and Standards

NorQuest COLLEGE

Accessibility to E-Learning for Persons with Disabilities: Strategies, Guidelines, and Standards

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Introduction

0.01 Growing importance of e-learning. E-learning, or "electronic learning" is fast becoming the leading mode of distance delivery in adult education. In a keynote address at the International Open Forum on e-Learning and Standardization in 2007, Bill Curtis-Davidson of IBM suggested that e-learning is the second most popular way of learning in the world and predicted that the world market for e-learning will exceed $52.6 billion (USD) by 2010.[1] Researchers with Statistics Canada reported that over one-quarter of adult Canadians who use the Internet access the Internet for education, training, or schoolwork.[2]

0.02 Diversity among learners. As more and more learners become engaged in e-learning, instructors and course developers are finding that the pool of learners is becoming increasingly diverse. Among those learners who access adult education through e-learning, a proportion will be those who have learning challenges. Learning challenges can include having limited English proficiency, experiencing visual or hearing impairments, being blind or Deaf, facing barriers to mobility, or dealing with learning disabilities. Designers of e-learning have the opportunity to minimize barriers to learning by structuring the learning environment to accommodate those with learning challenges. This approach has an added benefit in that it not only levels the playing field for those experiencing challenges, but it also makes e-learning more accessible for all learners.

Purpose and structure of this document

0.03 Document purpose. The purpose of this document is to suggest ways in which instructors and course developers can prepare their e-learning courses so that accessibility is maximized for all learners, including those with disabilities. The document outlines the principles of Universal Design for Learning, "best practice" teaching strategies, and accessibility guidelines that will reduce barriers in an e-learning environment.

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[1] Curtis-Davidson, B. (2007, September 13). *The business case for inclusion.* [PowerPoint presentation]. Presentation at the International Open Forum on e-Learning and Standardization "Supporting Diversity through Inclusive Design." Retrieved October 28, 2007, from the conference website: http://www.openforum.elsacc.ca/node/7

[2] McKeown, L., & Underhill, C. (2007). *Learning online: Factors associated with the use of the Internet for educational purposes.* Retrieved February 8, 2008, from the Statistics Canada website: http://www.statcan.ca/english/freepub/81-004-XIE/2007004/internet-en.htm

0.04   **Document structure**. Part One of this document outlines the concept of Universal Design for Learning and briefly discusses other terms that relate to improving accessibility in an educational environment. Specific information on these related terms is offered in Appendix C.

Part Two includes best practice and accessibility considerations in four areas:

1. Providing accessibility in the areas of course promotion and registration, the learning environment, and e-learning course navigation
2. Sharing knowledge and skills with students in a manner that maximizes accessibility
3. Incorporating multiple means for students to participate and demonstrate knowledge
4. Fostering engagement

0.05   **Document focus.** Distance learning has evolved from paper-based courses delivered to learners' homes by mail to online learning using Internet access. While the focus of this paper is on electronic learning or e-learning, the suggested strategies apply to blended (hybrid) learning as well.

0.06   **Intended audience.** Our intended audience is instructors or curriculum developers who are developing e-learning courses and who want to know more about making these courses accessible. It is beyond the scope of this paper to offer detailed technical instructions for accessible design, although reference resources for course developers, a chart outlining key design considerations, and a glossary of terms are included as appendices.

0.07   **Starting point for progress.** As more and more students with disabilities access e-learning, instructors, course developers, and programmers will continue to expand their understanding of how this educational environment can be designed to be more accessible. It is hoped that this document serves as a catalyst for further exploration and progress in this area, as technology evolves and we better understand how to support learners with disabilities more effectively.

Part One: Principles of UDL

What is Universal Design for Learning (UDL)?

1.01   **Universal Design for Learning.** For the purpose of this document, Universal Design for Learning, or UDL, refers to the deliberate design of instruction to meet the needs of a diverse mix of learners. Universally designed courses attempt to meet all learners' needs by incorporating multiple means of imparting information and flexible methods of assessing learning. UDL also includes multiple means of engaging or tapping into learners' interests. Universally designed courses are not designed with any one particular group of students with a disability in mind, but rather are designed to address the learning needs of a wide-ranging group.

1.02   **Accessible design.** The related principle of "accessible design" has a narrower focus. It presupposes difficulties for a particular group of learners and attempts to address these challenges at the initial design phase or to modify an existing design in order to accommodate the particular disability experienced by that group. For example, an instructor who realizes that she has a student who is Deaf in her English class will choose only video clips that include closed captioning. What often happens when instruction is designed for accessibility is that more students beyond just the intended individuals or groups benefit from the accessible design. Not only will the student who is Deaf benefit from closed captioning, but so too will students for whom English is a second language, learners with auditory language processing disabilities, and those who prefer to take in information visually.

1.03   **Increased benefits of UDL.** Although using accessible design to increase accessibility for a particular group of learners may also increase accessibility for others, incorporating UDL principles will result in an even broader application of benefits. Instructors or instructional designers who embrace the concept of Universal Design for Learning take the concept of accessible design to the next level by developing their courses to be as flexible as possible, to be available to all students regardless of the physical modality of the student, and to appeal to a variety of learning styles and preferences. In this way, courses are made more accessible to all students.

History of Universal Design for Learning

1.04   **Movement for universal design.** The concept of UDL has its roots in the movement for universal design. The principles of universal design have often been cited in the literature as critical considerations when designing for accessibility. (Kinash, 2002; Hitchcock & Stahl, 2003; Schiller & Williams, 2006).

Universal design includes the following principles:

Principle One: Equitable Use - The design is useful and marketable to people with diverse abilities.

Principle Two: Flexibility in Use - The design accommodates a wide range of individual preferences and abilities.

Principle Three: Simple and Intuitive Use - Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

Principle Four: Perceptible Information - The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

Principle Five: Tolerance for Error - The design minimizes hazards and the adverse consequences of accidental or unintended actions.

Principle Six: Low Physical Effort - The design can be used efficiently and comfortably and with a minimum of fatigue.

Principle Seven: Size and Space for Approach and Use - Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of user's body size, posture, or mobility. [3]

1.05   **Beginnings of universal design.** Ron Mace coined the term "universal design" in the 1980s. He was a progressive architect, product designer, and educator who believed that all products should be designed to be used by all people, regardless of status, age, or ability. He advocated for the rights of persons with disabilities and founded the Center for Accessible Housing, which is now known as the Center for Universal Design, at the School of Design at North Carolina State University in

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[3] Copyright © 1997 NC State University, The Centre for Universal Design. Used with permission. The Center for Universal Design. (1997). *The principles of universal design, version 2.0.* Retrieved December 3, 2007, from North Carolina State University College of Design website:
 http://www.design.ncsu.edu/cud/about_ud/udprinciplestext.htm

Raleigh.[4] When the principles of universal design were applied in architecture, it soon became clear that the measures that improved accessibility for persons with disabilities also improved access for the population as a whole. Not only do those with physical challenges benefit from access ramps to buildings and sloped or cut curbs, so too do persons pushing baby carriages, riding bicycles, or pushing shopping carts now also have equal access. The same is true for products and services designed to facilitate access. Closed captioned television programming has made information and entertainment accessible to the Deaf and hard-of-hearing population, but closed captioning is also used by the hearing population in airport terminals, fitness centres, and sports bars.

1.06 **Retrofitting.** As the benefits of universal design for the population as a whole became apparent, it also became clear that "retrofitting" or making accessible already established buildings and products was costly, often unsightly, and usually not functional. Within the last 10-to-15 years, architects and product designers have realized the efficacy of designing for accessibility from the onset, rather than retrofitting.

1.07 **Application to instructional design.** While using universal design principles won early acceptance in the areas of architecture and product design, its application to instructional design was not so immediately apparent. But as the benefits of universal design have with time become more widely known, several educational organizations and institutions have embraced the concept, applied it to educational settings, and transformed the learning opportunities available in post-secondary institutions. The University of Washington's DO·IT Project and the University of Guelph's Universal Instructional Design principles (detailed in Appendix C) have embraced, adapted, and applied the concept of universal design.

1.08 **UDL as the focus.** In this document, aspects of the various interpretations of universal design in an educational environment are included, but the term and guiding principles of Universal Design for Learning provide the framework for our exploration.

1.09 **Development of Universal Design for Learning.** Universal Design for Learning had its beginnings when David Rose and his colleagues in Boston formed the Centre for Applied Special Technology (CAST) in the 1990s and began designing technology tools to help children learn regardless of their physical, emotional, or intellectual functioning.[5] They developed an approach to curriculum design that they called Universal Design for Learning (UDL). The UDL approach advocates designing learning materials that are compatible with the assistive technology (AT) devices used by persons with disabilities. AT devices range from sophisticated "high-tech" supports such as screen-reader software that may be used by persons who are blind (e.g. JAWS™) or learning disabled (e.g. Read & Write Gold™) to less sophisticated

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[4] For more information on Ron Mace and the Center for Universal Design, see
http://www.design.ncsu.edu/cud/index.htm
[5] For more information on CAST and Universal Design for Learning, see http://www.cast.org

"low-tech" supports for learning such as highlighter pens and Post-it notes. A widely accepted definition of AT is that it includes "products, devices or equipment, whether acquired commercially, modified or customized, that are used to maintain, increase or improve the functional capabilities of individuals with disabilities."[6] Included in the wide-ranging assortment of products, devices, and equipment devices are software and hardware that increase access to information and education for learners who are disabled.

UDL key concepts

• Presenting ideas and information in multiple ways

1.10 **Variety in presentation formats.** Instructors should incorporate a variety teaching methods and mediums including lecture, text, audio, fieldwork, video, and graphic representations. Ideally, learners could then select from a variety of presentation formats. In this way, given the wide range of backgrounds, experiences, and abilities of learners, the learning needs of all are better served.

1.11 **Organization and goals of instructional materials.** In order to construct a presentation that is focused and well organized, instructors should carefully assess the materials they use with learners, no matter what methods of presentation they choose. As with more conventional methods of presentation such as lecture or demonstration, instructional materials that are universally accessible need to be clearly and intuitively organized and instructors and course developers have to have very clear and specific objectives in mind for each activity.

1.12 **Accessibility of instructional materials.** Materials designed to be universally accessible are generally compatible with assistive technology or are more easily converted into alternative formats. For example, documents produced in Microsoft Word or HTML can be read by most screen-reader software and are also more easily converted to Braille than documents in PDF format. UDL advocates providing materials in formats that suit the learner's needs. For some, this means text-based materials are available in audio or even American Sign Language. In e-learning courses, it means that video clips are closed captioned and onscreen graphics are accompanied by ALT tags (alternative text) or longer text tags. The flexibility to choose from among alternative formats or to manipulate the format to access information means that persons with Irlen syndrome, colour blindness, or sensitivity to light, for example, are able to adjust the colour of text and background displays and persons with visual impairments are able to adjust the size of font.

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[6] Technology-Related Assistance for Individuals with Disabilities Act of 1988 as Amended in 1994. Pub. L. No. 100-407 and 103-218. Retrieved November 20, 2007 from http://www.resna.org/taproject/library/laws/techact94.htm

1.13   **Access for varying cognitive and intellectual abilities.** UDL principles also include increasing access to information for persons with a variety of cognitive or intellectual abilities. For some learners, this means providing text in "plain language" or providing supports in terms of accessible learning strategies. For others, it may include providing access to necessary background information or supplemental information to extend the learning experience.

1.14   **Response to unique individual needs.** The application of UDL principles results in instruction that is accessible to a broad audience, but to be universally accessible, courses must be flexible and responsive to the unique needs of individual learners. The key and challenge to truly accessible design is to make courses both accessible to a broad audience, but to build in the ability to appeal to personal, oftentimes necessary, individual preferences.[7]

- Providing students with multiple ways to express their understanding

1.15   **Varying formats for student response.** Universal Design for Learning advocates that learners be able to demonstrate their understanding in a format that is appropriate for that individual. Once again, instructors and course planners should plan for multiple means, options, or alternative ways to accomplish this goal. Offering learners alternative assignment formats allows them to demonstrate their understanding in ways that suits their abilities. For instance, a person with cerebral palsy may not be able to do an in-class presentation orally, but can demonstrate her knowledge with the use of screen-reader software that converts text to an electronically generated voice. A student with learning disabilities who experiences writing output challenges can demonstrate his knowledge through an oral report rather than submission of a report in text format. In an e-learning environment, a student with mobility impairment may have difficulty participating in an online discussion through a synchronous discussion board but may be able to participate using a microphone to provide input. A learner with barriers to mobility may be unable to participate in a synchronous chat without an aide, so instructors should consider offering a text log file or transcription of the discussion, which can be added to later. With this option available, not only is the learner with barriers to mobility accommodated, but so too are learners who may need additional time to formulate responses.

1.16   **Suitability of types of test items.** Test items that require certain types of responses may be a barrier to success for some students. For example, multiple-choice questions and short-answer questions on exams can be read by screen readers, but students relying on this technology will struggle with matching or drag-

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[7] Kintsch, A., & DePaula, R. (2002). *A framework for the adoption of assistive technology.* Retrieved March 16, 2007, from the website of the Center for LifeLong Learning and Design University of Colorado at Boulder: http://l3d.cs.colorado.edu/clever/assets/pdf/ak-SWAAAC02.pdf

and-drop types of interactions. The course designer can overcome this potential situation by providing exams that test learning using of variety of question types and by offering students the option of choosing from among these alternative question types. In addition, instructors need to examine the number of test questions and strive for high quality rather than high quantity of responses.

1.17   Flexibility in time limits. Individual students may also require more time to do exams and assignments than would customarily be allowed. Students with chronic health conditions, language processing challenges, and mobility impairments often benefit from flexible time limits. Negotiating with students on the amount of time that would be adequate time to complete assignments and exams should be a part of the evaluation process. Unless completing a task within a predetermined time limit is an instructional objective, allowing learners the time that each one needs is fairer to all learners.[8]

Length of exams and number of test or practice items may also cause barriers for some learners. Learners with brain injuries, visual impairments, and concentration challenges may be unable to complete long exams. Allow students to split exams into manageable segments completed over an extended time. Allow frequent breaks.

1.18   Maintaining standards. Essential to UDL is an understanding that designing to maximize accessibility does not mean instructors should compromise standards to accommodate learners. Rather, UDL provides appropriate support as well as challenges so that learners can achieve goals and learning outcomes. UDL advocates maintaining high standards but reducing barriers to learning and providing rich supports. Thus, for instructors and instructional designers, it becomes increasingly important to critically examine the goals of instruction, as well as the content of instruction.[9] In this way, instruction and demonstration of knowledge are accessible for persons with disabilities and optimized for all.

- Motivating students by building on their interests and creating appropriate challenges

1.19   Relevance to student lives and aspirations. For the many skilled instructors who currently teach in post-secondary settings, the concept of making instruction relevant and building on students' interests is self-evident. To see this included in the principles of UDL is affirming and demonstrates that best practice teaching strategies are embedded in UDL.

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[8] Stretch, L.S., & Osborne, J. W. (2005, July). Extended time test accommodation: Directions for future research and practice. *Practical Assessment, Research & Evaluation, 10(8).* Retrieved April 22, 2008 from http://pareonline.net/pdf/v10n8.pdf

[9] Rose, D., & Meyer, A. (2000). Universal design for learning. *Journal of Special Education Technology, 15(1).* Retrieved May 30, 2007, from http://jset.unlv.edu

Students are engaged in learning when they see that it relates to their interests, goals, and values. Learners respond to concrete examples, anecdotes, real-life experiences, and personal contact. They respond to a welcoming environment where their individuality is respected and nurtured. And all learners respond to instructors' efforts to provide variety and flexibility in the presentation of information and evaluation of learning.

Why adopt Universal Design for Learning principles for e-learning?

- Increasing participation of persons with disabilities

1.20 **Increased reporting of persons with disabilities.** According to an article published by Statistics Canada based on data from the 2006 Participation and Activity Limitation Survey (PALS), 4.4 million Canadians, or 1 in 7 of the population, reported having a disability. The survey indicated that there was a significant increase in the percentage of persons who reported having a disability as compared with the statistics gathered in the previous survey in 2001. With the general aging of Canada's population, it could be expected that the numbers of persons with disabilities would continue to increase; however, the report suggests that the substantial increase in reporting (21%) is in large part due to society's changing perception of disability. There are fewer stigmas associated with "admitting" to having a disability and a greater willingness to report. Problems related to pain, mobility, and agility affect the largest number of adults with almost 3 million people (age 15+) declaring these limitations in the 2006 survey. Of all disabilities, learning disabilities underwent the largest reporting increase between 2001 and 2006, for both children and adults. The number of Canadians with learning disabilities reported in 2006 rose by almost 40% over the number reported in 2001.[10]

1.21 **Access to higher education.** The Canadian Council on Learning has outlined federal and provincial government initiatives to provide financial supports designed to encourage learners with disabilities to access higher education. They further state that e-learning can expand accessibility to higher education for those with disabilities.[11] Awareness of the need to increase accessibility in post-secondary settings is expanding and organizations like the National Education Association of

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[10] Statistics Canada. (2007, December 3). Participation and activity limitation survey. *The Daily.* Retrieved January 11, 2007, from Statistics Canada's website: http://www.statcan.ca/Daily/English/071203/d071203a.htm
[11] Canadian Council on Learning. (2007, February 26). *Canada slow to overcome limits for disabled learners.* Retrieved February 7, 2008, from http://www.ccl-cca.ca/CCL/Reports/LessonsInLearning/ LinL20070222_Slow_overcome_limits_disabled_learners.htm

Disabled Students (NEADS) have launched projects to facilitate and promote inclusion.[12]

1.22 **Flexibility of time and place.** One of the key benefits of e-learning is that learners can access education at almost any time from any location. Students with mobility impairments usually have established support systems. The ability to access learning from home or from within their community eliminates costly and inconvenient travel and makes e-learning an appealing alternative. Learners who use specialized software or hardware may feel more comfortable using familiar equipment at home. Learners with disabilities welcome access to learning that is not only physically accessible but also incorporates UDL principles that can accommodate their unique learning needs.

1.23 **Proactive measures for expanding access.** As the reporting of a disability becomes less of an issue, financial supports for learners in post-secondary institutions increase, and post-secondary institutions recognize the need to be inclusive, institutions that offer e-learning need to be proactive. They need to plan to meet the needs of this expanding segment of the general population who have the potential to embrace e-learning as an alternative to classroom learning.

- ## Increasingly diverse population

1.24 **Increasing cultural diversity.** Without a question, Canada's population is becoming increasingly diverse. Not only are more learners with disabilities attending post-secondary institutions, so too are learners for whom English is a second language, students of Aboriginal descent, and older learners. Immigration continues to account for much of Canada's population growth, and in 2005 Canada's foreign-born population was at its highest level in 70 years. The immigrant population in Alberta is forecasted to be between 16.6 to18.8% of Alberta's population by 2017 and the Aboriginal population is expected to grow to 6.3% as well. The cultural diversity of Alberta is reflected in the student populations in elementary, secondary, and post-secondary systems.

1.25 **Accessibility for seniors.** Data from a 2005 Statistics Canada survey on Internet use shows that only 23% of seniors use the Internet. However, 53.8% of individuals aged 55 to 65 frequently use the Internet at home and at work. These people who have "grown up" with the notion of lifelong learning will continue to use the Internet to access educational opportunities as they age, but will require instruction designed to be accessible to their diverse needs.

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[12] For more information on projects initiated by NEADS, consult http://www.neads.ca

- Costs

1.26 **Economy and efficiency of advance planning.** As is the case when universal design principles are applied to architecture and products, "retrofitting" existing courses and curricula is costly and often ineffective. Designing courses to be inclusive from the onset saves time and money in the long run. Unfortunately, little of what we know about designing for individual differences has been implemented on a consistent basis by educators when planning, designing, and delivering online courses.[13]

- Legal responsibilities

1.27 **Human rights legislation.** In addition to the fact that accessible design of e-learning benefits learners both with and without disabilities, it is now required by law. The Human Rights, Citizenship and Multiculturalism Act was developed to ensure that people living in Alberta were protected against discrimination. Section 4 of the Act refers to post-secondary institutions and states that no person shall:

a. deny to any person or class of persons any goods, services, accommodation or facilities customarily available to the public, or

b. discriminate against any person or class of persons with respect to any goods, services, accommodation or facilities that are customarily available to the public, because of the race, religious beliefs, colour, gender, physical disability, mental disability, ancestry, place of origin, marital status, source of income or family status of that person or class of persons or of any other person or class of persons.[14]

1.28 **Providing equal access.** E-learning courses are a service provided to the public throughout the province. It is therefore the duty of post-secondary institutions to ensure that when they offer e-learning courses, students with disabilities have access equal to that of all other citizens. Students must be able to obtain the course content in the format that they require in order to learn. Assignments should be modified to meet the needs of the individual. Tests must be available in a format the student can use. As a result of the human rights legislation, e-learning course developers need to become skilled in the design and delivery of courses that can be accessed by all students regardless of ability.

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[13] Hitchcock, C., & Stahl, S. (2003). Assistive technology, universal design, universal design for learning: Improved opportunities. *Journal of Special Education Technology, 18(4)*, 45–52.

[14] Government of Alberta. (2004, August). *Duty to accommodate students with disabilities in post-secondary educational institutions* [Interpretive bulletin]. Retrieved June 12, 2007, from the Alberta Human Rights and Citizenship Commission website: http://www.albertahumanrights.ab.ca/publications/bulletins_sheets_booklets/bulletins/1136.asp

1.29 **Accommodations.** Traditionally, post-secondary courses are made accessible to students with disabilities using a process referred to as accommodation. "Accommodation is the process of making alterations to the delivery of services so that those services become accessible to more people, including people with disabilities."[15] Accommodation challenges instructors to develop a variety of methods to teach materials, test learning, and provide opportunities for students to practise skills. Designing to maximize accessibility to a wide variety of learners may reduce the need for some accommodations, but will not eliminate the need for some students with disabilities to receive additional specific accommodations. Students may still require additional accommodations such as extra time for exams, sign language interpreters, and materials in alternative formats. Designing for inclusive learning does not absolve an institution of its responsibility under the law to provide appropriate accommodations.

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[15] Ibid.

Part Two: Best Practice and Accessibility Considerations

Accessibility in promotion, registration, the learning environment, and course navigation

- Recognizing the indicators

2.01 **Accessibility indicators.** Underlying the administrative aspects associated with e-learning is the institution's commitment to providing and ensuring accessibility. The following checklist of accessibility indicators is based on one developed by the University of Washington and can act as a guide to evaluating and incorporating universal design and improving accessibility to your e-learning courses.[16]

Yes/No	Accessibility Indicator
	The distance learning home page is accessible to individuals with disabilities, (e.g., it adheres to *the* Common Look and Feel (CLF) Standards developed by the federal government, W3C - World Wide Web Consortium, or institutional accessible-design guidelines/standards).
	A statement about the distance learning program's commitment to accessible design for all potential students, including those with disabilities, is included prominently in appropriate publications and websites along with contact information for reporting inaccessible design features.
	A statement about how distance learning students with disabilities can request accommodations is included in appropriate publications and web pages.
	A statement about how people can obtain alternative formats of printed materials is included in publications and web pages.
	The online and other course materials included in distance learning courses are accessible to individuals with disabilities.
	Course designers understand the program's commitment to accessibility, have access to guidelines and resources, and learn about accessibility in training provided to course designers. Accessibility issues are covered in regular course-designer training.
	Publications and web pages for distance learning course designers include: a. A statement of the program's commitment to accessibility b. Guidelines/standards regarding accessibility c. Resources

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[16] Adapted and reprinted with permission of University of Washington, DO·IT. http://www.washington.edu/doit/Resources/dlp_access.html

Yes/No	Accessibility Indicator
	Publications and training for distance learning instructors include: a. A statement of the distance learning program's commitment to accessibility b. Guidelines regarding accessibility c. Resources d. Training for instructors on how to make content accessible
	A system is in place to monitor the accessibility of courses and, based on this evaluation, the program takes actions to improve the accessibility of specific courses, as well as update information and training given to potential students, students, course designers, and instructors.

2.02 **Accessibility template.** Mount Royal College has developed an accessibility template for web-based courses that is available for open-source sharing with eCampus consortia members. Contact Mount Royal College in Calgary, Alberta for information.

• Course promotion and registration

2.03 **Information materials.** All promotional and course information materials should be available in alternative formats and contain information on how students can request and receive disability-related supports and accommodations.

2.04 **Registration.** The registration process should be universally designed to provide equal access. Students using assistive technology need to be able to read, fill in, and submit electronic registration forms. Students should be able to navigate the form using only the keyboard and should be able to adjust response time. Registration forms designed to be completed online should be checked to ensure accessibility using a validity checker (see Appendix D: Resources for a list of available validity checkers.) Alternatively, students should be offered the choice of submitting registrations electronically or by regular mail.

• The e-learning environment

2.05 **Physical accessibility and appropriate supports.** For courses delivered using blended or hybrid learning formats, consult the following checklist to ensure that the classroom environment is accessible and that appropriate supports are in place.

❑ Ensure that the building is accessible. Is parking accessible? Is there a wheelchair ramp into the building? Are doors accessible? Are there accessible elevators?

❑ Ensure there are wheelchair-accessible classrooms, doors marked with Braille symbols, accessible washrooms, and adjustable-height counters in labs.

- Provide or ensure that students have access to assistive software and hardware such as specialized keyboards, enlargement devices, and FM systems.

- Ensure that materials are available in appropriate alternative formats.

- Include large-print safety instructions and ensure that any safety information, including evacuation procedures and lockdown procedures, is provided in accessible formats.

- Secure the services of sign language interpreters or CART (Communication Access Real-Time Translation) for learners who are Deaf or hard of hearing.

- If examinations are proctored, ensure that the examination site is accessible and that exam materials are in accessible formats. Ensure that site supervisors proctoring exams know whether learners require additional time or other accommodations for exams.

2.06   Orientation information. The orientation to the e-learning course should include information on accessibility. Include information on compatibility issues between the e-learning environment and common assistive technology with specific instructions on how learners can address barriers. Course orientation materials should include contact information to support services and technical services.

2.07   Communication among instructors and learners. It is very important for all learners that instructors provide a welcoming and supportive environment. Instructors should communicate how and when they may be contacted. Successful e-learning courses often include activities where learners can establish a "social presence" through interactions with others in their learning community.

In addition to online communication tools such as e-mail and conferencing, more traditional forms of instructor/student communication can also be available. Fax, telephone, and text-messaging communication are accessible to many learners. For learners who are hard of hearing or Deaf, other options also exist. TTY relay communication uses a teletypewriter and a relay service operator. Video relay service, faster and more natural than TTY, will soon be available in British Columbia, Alberta, Ontario, and Quebec.

2.08   Orientation activities. Courses offered online should include an introductory component where instructors familiarize learners with the content and features of the e-learning environment. Assess the learner's competence in the e-learning environment before beginning an orientation so that experienced e-learning students have the ability to proceed directly to the course.

Some course designers suggest the development of "kick-the-tires" exercises. These activities give learners the opportunity to practise using all the tools in the e-learning environment. Learners are asked to submit mock assignments, do mock quizzes, and interact using communication tools. These activities allow instructors to

assess the proficiency of learners in the e-learning environment and to identify potential technical challenges.[17]

2.09 **Course and class outlines.** Provide a detailed course outline prior to the start of classes, so that learners can preview information well before it is presented. An outline of each lecture listing main points that will be presented should be available before the lecture. Some students with learning disabilities need to see the whole before dealing with parts, so providing a general course overview in addition to a more detailed outline of each lecture is an effective teaching strategy. Detailed course and lecture outlines also benefit learners who are visually or hearing impaired as they can better prepare for classes. As with most instructional strategies that benefit learners with disabilities, all students can benefit from having information presented in an organized manner and in a variety of formats.

- E-learning course navigation

2.10 **Tools and icons.** If using a learning-management system such as WebCT or Blackboard, ensure that users have access to simple instructions for each tool or icon. Ensure that each tool or icon represented by a graphic includes an ALT tag that specifically outlines the purpose or function of each graphic.

2.11 **Banners on the home page**. Be aware that in some course-management systems the banner, which appears at the top of the home page of the course and often includes the title of the course and a graphic, is not fully accessible to screen readers. Screen readers will not read the graphic on the banner.

2.12 **Navigation for improved access.** A consistent layout and skip-navigation links improve access to the course. Ensure that a method is provided for users to skip repetitive navigation links. Learners who are blind find it especially frustrating to have to navigate through the same pages each time they enter the course in order to proceed to the place they left off.

Include a link to a course glossary and a search function on the home page of the course to facilitate navigation.

One unavoidable barrier in many course-management systems is the close placement of some navigation elements. This can cause difficulty for learners with motor skill challenges. Check to ensure that courses can be keyboard-driven as well as mouse-directed. Some learning-management systems have incorporated keyboard shortcuts or hotkeys into the software to activate controls and move the

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[17] Schiller, S., & Williams, L. (2006). *Guidelines for applying universal instructional design (UID) in the development of web courses at the University of Northern British Columbia using WebCT.* Retrieved February 20, 2008, from the website of the Centre for Teaching and Learning and the Committee for Standard WebCT Practices in Social Work, UNBC: http://www.unbc.ca/assets/disabilities/uid_guide.pdf

cursor to navigation elements. Test pages for accessibility by using only a combination of tab, enter, and arrow keys.

Instructors and course designers have an important role to play as advocates for students by providing feedback to software designers regarding observed limitations and barriers in learning-management systems for students with disabilities.

Sharing knowledge and skills through text

- Text display and screen layout

2.13 **Display of text**. There are many ways that the content of e-learning courses can be delivered, but by far the most common method is through the display of text. Whether it is by supplying notes that learners download or read onscreen or by providing links to web pages, instructors share their knowledge and skills through print and learners take in the information through reading comprehension. The following segment describes strategies for improving access to text.

2.14 **Layout.** Use a consistent layout for your course and lecture outlines. Materials that are predictably and intuitively organized are much easier for students with learning disabilities to understand and are usually accessible for assistive technology software. Many students with visual impairments use technology that allows them to enlarge images onscreen. Consequently, they are able to see only a small portion of the onscreen display at a time. If the layout of materials is predictable, it is much easier for a learner who uses screen enlargement technology to navigate the information.

2.15 **Footnotes.** If you are incorporating quotations into a text document that has been saved as a .doc file, be aware that learners using some screen-reading software, for example, Read & Write Gold, will not hear the number of the footnote read aloud and the screen-reading software will skip over footnotes at the bottom of the page. This may not be an issue, as screen-reading software such as Read & Write Gold is not designed to be used by learners who are blind and users can manually navigate the screen to reread segments the software has omitted. Other screen-reading software, for example, JAWS, will read that there is a footnote as it is encountered in the body of text but will not read the number of the footnote again as it appears at the bottom of the page. It will, however, read out the text of the footnote at the bottom of the page. Skilled users of JAWS are aware of this limitation. Offering the document in HTML format eliminates this problem. The footnote is read as a footnote, and all footnotes are moved to the end of the document where the student can read through each one.

2.16 **Text in columns.** Text that we see in textbooks is often displayed in two columns because reading text in columns requires less eye movement and peripheral vision. However, this principle does not translate well to the display of onscreen text. Often text that is displayed in columns onscreen requires users to scroll down the page as they read one column and back up to read the next. Scrolling text is sometimes necessary but not ideal for any learner. Left justified text with minimal hyphenation is most accessible to persons with visual impairments who may need to enlarge text.

2.17 **Font.** Use fonts that are designed for computer monitors. Sans serif fonts such as Arial, Verdana, and Tahoma are more legible than serif fonts such as Times New Roman. Avoid decorative fonts or those with thin strokes. For emphasis, use bold or a heavy font rather than italics or upper-case letters.

2.18 **Text size.** Generally, standard font size is between 10 pt. and 14 pt. Note that fonts that are the same size may appear to be different sizes onscreen. Learners with visual impairments may know how to adjust font size on their computer screens, but alerting all learners to these features makes text that may appear too small accessible to many other students.

Let learners know that they can adjust the onscreen size of text, but that on web pages, programmers of the site need to have included the ability to change size of text when writing the site code. To change the size of font in Internet Explorer, Netscape Navigator, or Mozilla Firefox, students can do the following:

1. Select "View" in the Browser Menu Bar (top).
2. Mouse over "Text Size" or "Text Zoom."
3. Mouse over the choice and left click.

Also be aware that in a learning-management system such as Blackboard, course navigation heading sizes are independent of the content of the course. Learners may be able to adjust the size of font on the home page and on the navigational links, but if the course content is not written in HTML, the size is not adjustable.

2.19 **Punctuation.** Use punctuation at the end of sentences. Screen readers do pause at punctuation marks and some will even produce inflections at the end of questions. Without punctuation at the end of sentences, the text will sound like a run-on. Screen readers for the blind will read out punctuation marks that appear within text: the dash, colon, quotation marks, periods, and parentheses. They do not read out commas. Be aware that proficient users of JAWS become skilled at listening to text read aloud at a very fast rate without regard to punctuation.

2.20 **Abbreviations.** A variety of screen readers will read abbreviations differently. Usually, abbreviations written in capital letters will be read correctly by most screen readers. Sometimes, especially when abbreviations contain vowels, the screen reader will read that abbreviation as if it is a word. Adding a period or a space after each letter in an abbreviation is helpful for some screen readers; however, JAWS,

for students who are blind, will read out the punctuation marks inserted into text. For example, JAWS will read "U.D.L." as "U period D period L period" and "UDL" as distinct letters, whereas a screen reader such as Read & Write Gold will read "U.D.L." as distinct letters and "UDL" as "udle." Best practice is to either insert spaces between letters in abbreviations or better yet, ensure that the long form of an abbreviation is clearly explained the first time the student encounters it in the document.

2.21 **Pronunciation.** Be aware that screen-reader software reads words phonetically. Students who are blind and who are skilled users of screen-reading software know that they can listen to words that sound peculiar, often names of persons, places, or specialized vocabulary, letter by letter. If your course includes many words that have unique pronunciation, consider offering learners a link to an online dictionary that includes pronunciation keys or audio pronunciations. Two examples are the pronunciation keys with the dictionaries at the Yahoo! Education site and at the MSN Encarta site:

http://education.yahoo.com/reference/dictionary/
http://encarta.msn.com/encnet/features/dictionary/dictionaryhome.aspx

2.22 **Colour.** Be careful how you use colour to convey information. Do not use colour as the only way to convey essential information, but do use colour to organize information. Also avoid using only colour as navigation cues. Be aware that students with visual impairments or visual-processing problems may be unable to see or appreciate the significance of colour. For example, students who are colour-blind often have difficulty differentiating among brown, red, and green.

2.23 **Transfer of accessibility features.** Modern computer systems include built-in accessibility features that allow users to adjust onscreen contrast; however, the accessibility specifications that learners select on their own computers are not always transferable to all learning-management systems. WebCT or Blackboard will transfer the user-defined colour schemes, contrasts, and font sizes from the user's system, although the transfer is not always seamless.

2.24 **Highlighting.** If working with Microsoft Word documents, students may use highlighting tools to organize essential information through colour-coding. These tools are not available in learning-management system like WebCT or Blackboard.

2.25 **Styles.** When creating documents using word-processing software, create headings by using the "styles" feature rather than by setting the font, point size, and bolding of the heading manually. When the document is converted to HTML and offered as an alternative form of text for learners who are blind, screen readers such as JAWS will "read out" that the text is a heading and identify the level of the heading if it was formatted using a style selected from the drop-down style menu. This can help the learner orientate herself to the layout of the document.

2.26   Key information. Use bold to highlight important information rather than underlining. Reserve underlining for hypertext links. Unfortunately, neither of these forms of visual cueing is accessible for students who are blind. Screen readers for the blind will not differentiate regular text from that which has been bolded or underlined. To highlight key information, consider using other strategies to create emphasis such as repeating key words, including the information in a short summary of key points, or summarizing the key information in a preamble to the main text.

2.27   Bullets and numbering. Formatting features such as bullets and numbering are helpful organizational tools for many learners. Screen reader software for the blind will read out bullets and numbers; however, some screen-reader software used by learning disabled students will skip over these features. This may not be an issue if learners are visually following the text as they listen.

2.28   RTF and HTML format. Microsoft Word is accessible for many screen readers. Text should also be saved as a Word RTF file or an HTML document. Converting a Microsoft Word file to RTF allows the document to be read by other word-processing applications, such as WordPerfect. Converting the files to HTML allows screen readers such as JAWS to read out underlying formatting, which may be an aid to navigation for learners who are blind. Converting a document to HTML also removes page breaks, which are not necessary for learners who are blind. Converting documents from one format to another may change the layout and spacing within the document, so always proofread the converted document.

2.29   PDF files. The benefit of sharing PDF documents with learners is that the documents are printable but cannot be altered. But saving documents in PDF should be avoided if possible as the format is difficult for most screen readers to read. Files created in PDF should be created using Adobe Acrobat version 5 with the accessibility feature activated. Documents in PDF require users to download plug-ins that can be difficult to access for persons who are blind. When a person using assistive technology attempts to read a PDF document, some programs will open a number of pop-up boxes, which the learner must read and acknowledge as the program attempts to convert the file to a readable form.

Screen magnification software is, however able to read PDF. If you are using PDF files, make the document available in Word RTF or HTML as well so that users may chose the format that is most accessible.

2.30   Scanners. Instructors often use a scanner to put documents into PDF file format. Scanning a document into PDF format creates a document that acts like a large image or graphic. This may make the documents inaccessible or inconvenient for persons using assistive software as a screen reader may be unable to access the text within the image. Also be aware that scanned documents need to be carefully checked and proofread as the scanning process often results in changes to the text from the original document.

2.31 Whiteboards and tablet tools. Be aware that whiteboard or tablet tools, which are used in some e-learning environments, are not accessible. Ensure that course information that is presented using these tools is also available in an alternative format.

- Reading graphics, charts, and tables

2.32 Onscreen flashing and flickering. Be aware that learners with some health conditions, for example epilepsy, may experience seizures brought on by flashing or flickering images. Avoid the use of attention-grabbing images that flash, move, or blink on-screen.

2.33 ALT tags. An ALT tag, also referred to as an alt text or alternative text tag, should be precise and make sense out of the visual context. For example, if you use a graphic of a pencil to alert learners to the fact that they should copy information into their notes, the ALT tag for that graphic should read "copy the following information into your notes" rather than simply read "pencil." The ALT tag should clearly state what the user is to do or what will happen when the icon or graphic is active. ALT tags generally contain no more than 80 characters. For longer descriptions, programmers will use descriptive or title tags. Be aware that the most common browsers will read ALT tags, but not all browsers will read descriptive or title tags.

2.34 Graphics. Students who are blind may use text-to-speech computer software such as JAWS, Window-Eyes, and Home Page Reader, which can "read" only text. Graphics, applets, maps, and pictures are not accessible unless these visual images are accompanied by descriptions. For some simple graphics or pictures, programmers include a descriptive ALT tag, which clearly describes the visual. For more complex visuals, consider including an audio clip describing the image or provide a link to an accessible document describing the visual. Be aware that learners who are blind are not the only ones who may be challenged by the use of graphics. Graphics may present difficulties for those with limited computer systems or limited access to the Internet. Some users may use browsers with the image-loading feature turned off in order to speed up the download of pages. By incorporating descriptions for all graphics, learners who may not have disabilities but who face technical challenges will also still have access to course content.

2.35 Charts, tables, and graphs. Students with visual impairments or those who are blind may have difficulty reading tables and charts. When programmers design online charts, tables, and graphs, it is important that they identify row and column headers in HTML. Screen readers such as JAWS will read the markup language used by the programmers and the learner who is blind hears that the cursor is on a row or on a header. In addition, markup language should also identify header and data cells so that the blind reader of the chart can orient herself to the information.

Learners who use screen enlargement software may also have difficulty navigating a chart. Including a text description of the chart layout can be helpful to visually impaired learners who use screen enlargement software and are attempting to navigate the chart.

How a chart, table, or graph is described will depend on why this visual information is included. If it serves to illustrate, reinforce, or display information, then the accompanying ALT or descriptive tag should describe an interpretation of the information that is presented. But if the objective is for the student to interpret the information and draw conclusions, then the ALT tag must contain only a description of the contents of the chart, table, or graph.

2.36 **Graphing calculators.** Graphing calculators are standard equipment in advanced mathematics and science classes. An accessible graphing calculator can be loaded onto a computer and functions like a handheld computer. It emits audio signals to represent points on a slope so that students have an auditory representation of slopes in addition to a visual representation.

2.37 **Graphics with embedded text.** Be aware that when screen-reading software encounters a graphic or picture with embedded text, it will not recognize the graphic but will read the text. This can be very confusing for the learner who is blind. If you wish to include a picture or graphic with embedded text, such as a cartoon, offer the user the option of hearing this visual interpretation of information in an audio clip or supply an ALT tag that describes the graphic or picture and incorporate the embedded text into the description.

- Literacy and readability levels

2.38 **Literacy levels of adult learners.** The assumption underlying the presentation of information in text-only format is that all learners are skilled readers. In reality, one in five Canadians struggles to comprehend text, and literacy levels are not always associated with educational attainment.[18] Numerous studies and articles lament the fact that the amount of reading declines as children mature and that reading and writing skills deteriorate when not used (Lindblom, K. 2005; Wigfield, A., & Guthrie, J.T. 1997; National Endowment for the Arts 2004). The International Adult Literacy Survey (IALS) found that adults with high literacy levels are more likely to engage in literacy-promoting activities at work and in their leisure time. They are more likely to have reading materials in their homes and continue to develop and hone literacy skills. Those with lower literacy skills tend not to engage in literacy activities outside of employment and rely on television for information. Text commonly available to

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[18] National Literacy Secretariat. (1994) *International adult literacy survey (IALS).* Abstract retrieved March 22, 2008 from http://www.statcan.ca/english/Dli/Data/Ftp/ials.htm
See also "Reading the Future: A Portrait of Literacy in Canada," highlights from the Canadian report of the *International Adult Literacy Survey (IALS)*, 1996. Retrieved March 22, 2008 from http://www.nald.ca/

adults, such as that found in the Sun Media newspapers, tabloids, and many magazines, is written at or below a high school reading level.

2.39 **Literacy challenges for e-learning.** Adult learners who struggled with literacy as children tend not use their literacy skills to the same degree as those who have always enjoyed reading and writing. Their literacy skills have likely not improved and may be even weaker than when they last attended school. This means that although some mature learners who access e-learning courses may have the necessary academic prerequisites, they most often have completed these courses years ago as young adults. By the time they return to school as older adults, their literacy skills may have deteriorated. Learners for whom English is a second language as well as those with learning disabilities may also struggle with complex English text. Consider including supports for learners who struggle with complex text as you design your course.

2.40 **Background knowledge.** An important aspect of reading comprehension is the background knowledge the reader brings to the page. As learners analyze and synthesize text information, they draw upon their background knowledge to connect new learning to existing understanding. Critically examine the text you are asking learners to read and identify the prerequisite understanding that is necessary to understand key concepts in the text. Build background knowledge by providing a glossary, links to accessible web pages that expand on concepts, or additional "backgrounder" information, quizzes, and exercises that can be accessed within your course. These supports may not be necessary for all learners, but the option to access these tools builds accessibility.

2.41 **Pre-reading activities.** Pre-reading activities activate prior relevant knowledge or build knowledge that is necessary to interpret text. Pre-reading activities can also motivate students' interest in a topic and provide instructors with information on the background knowledge of the group. Pre-reading activities can take the form of a class discussion or brainstorming using synchronous "chat tools" available in e-learning. Or, instructors can prepare a short pre-reading quiz to determine gaps in background knowledge. A pre-reading assignment may include the construction of a KWL chart[19]. Students construct a KWL chart by listing what they already know about the topic, what they would like to know and, after reading, what they learned from the text. Variations of this strategy include the addition of more columns in the chart; for example, students list questions the text raised for the learner that require additional research or they develop metacognitive awareness by describing how they learned from the text.

2.42 **Complexity of language.** Complex text can be a barrier to understanding for students. Complex text is characterized by complicated sentence structure and a large number of polysyllabic words. Another characteristic of complex text is the use of jargon, which is vocabulary specific to a discipline or field. Authors also create

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[19] Ogle, D.M. (1986). K-W-L: A teaching model that develops active reading of expository text. *Reading Teacher, 39*, 564–570.

complex text when they present many new concepts, with relatively brief explanations, in one segment of text. They presuppose a level of background knowledge and analytical skills that some learners may not have. Keeping in mind that you do not want to compromise the standards of the course, critically examine the complexity of language in the text that learners are being asked to read. Use the clearest and simplest language appropriate for the context. Analyze the outcomes you require and consider offering the text in a plain language version and/or offering supports through glossaries, definition of terms, and links to build prerequisite knowledge. There are numerous excellent guides to producing plain language alternatives to complex text. (See Appendix D: Resources.)

2.43   **Brevity of onscreen content.** When displaying text onscreen as part of a presentation, use short and simple sentences and avoid long, complicated explanations. If possible, avoid the need to scroll through text. Use bullet points or numbering for lists. Content that is displayed onscreen should be brief. Materials for in-depth study should be offered as text to be downloaded, a textbook, or media materials.

2.44   **Auditory and kinaesthetic materials.** Instructors and course designers should consider incorporating auditory and kinaesthetic materials for learners. In addition to providing access to text, provide manipulatives and tactile sources of information. For example, a biology course could incorporate tactile biology diagrams or anatomical models to accompany text descriptions. Assistive technology exists that can convert two-dimensional diagrams into embossed or tactile diagrams. Learners who are blind as well as those who are strong kinaesthetic learners benefit from having tactile diagrams available. Embossing machines can create tactile maps, charts, graphs, and line drawings. Consider developing a tactile kit that can accompany the other resources that e-learning students are expected to acquire.

2.45   **Options and alternative formats.** In an e-learning environment, it is common for instructors to share knowledge through visual communication in the form of text, charts, graphs, and graphics. A key concept in Universal Design for Learning and of ensuring accessibility is to provide variety and options for learners so that they may access information in the format that best suits their learning needs. Providing alternative formats of the same documents improves accessibility.

Sharing knowledge and skills through audio

• Optimizing audio in an e-learning environment

2.46   **Audiographic systems.** A practice in some e-learning courses is for information to be presented using an audiographic system such as Elluminate Live. The lecture is delivered synchronously so that all participants are "tuning in" at the same time while listening through computer speakers or listening and watching a computer screen. It

may also be offered asynchronously, which means that the lecture is recorded and available to learners at their convenience. The lecture is almost always supplemented with visuals in the form of PowerPoint slides, images, or text displays and can include interactivity through a "chat" feature, 2-way audio communication, or the use of a tablet or whiteboard. One benefit of audiographic systems is the ability to present information in a variety of modalities which benefits students with diverse learning styles and preferences.

2.47   **Disadvantages of the lecture format.** As with face-to-face learning, a pure lecture format does not optimize learning, especially for learners with auditory-processing disabilities. Students with these challenges cannot process large volumes of information conveyed in a lecture style. A pure lecture format appeals mainly to one modality and does not promote active engagement and involvement of learners. There are, however, times when relating information through lecture is unavoidable or sometimes even the most appropriate method.

2.48   **Recordings of lectures.** Providing access to a recording of the lecture (asynchronous learning) allows the student to break the lecture up into manageable segments so that learners who cannot attend to oral presentations for an extended period of time can pace their learning. Learners can also verify their understanding of key points by comparing their notes to the recorded lecture. Those who have had to miss class, perhaps due to chronic health conditions, also have access to the information after the class. Instructors involved in delivering audiographic lessons are aware that providing an audio file is part of their teaching assignment, but in a blended learning environment, students who wish to record an instructors' face-to-face presentation should seek permission from the instructor. Institutions should consider developing policy around audio recording of instruction to protect the rights of instructors and students and ensure access to information for students who benefit from using these recordings.

2.49   **Visual representations and activities.** Lectures should always be supplemented with visual information and ideally with an activity. Adding variety to presentations will engage learners with a variety of learning styles or strengths. Consider presenting key points in a manner that will be appealing to more than one modality. For example, present a key point orally by clearly stating its importance (i.e. "The most important reason …", "The key point is …"). Follow up with presenting the key points in text format. For some learners, a graphic that represents the key concept will help the individual remember. Supplementing an oral presentation with a visual representation of key points not only keeps all learners engaged but also ensures that those whose strength is not oral processing have access to important information.

2.50   **Information in text and audio formats.** Always share important announcements or important changes to your course in text as well as audio format. Post these announcements in a prominent, well-understood location and ensure that learners are familiar with the location during the course orientation.

If learners are communicating to the whole group through a microphone, consider sharing their question in print form or at the very least, repeating what the speaker has said.

2.51 **Time and multiple information formats.** When sharing information in two modes, visually and orally, be sure to leave time for learners to attend to each format. Learners who are Deaf will have a sign language interpreter interpreting your oral message. They then need time to attend to the visual cue you may have just discussed. Learners who are Deaf cannot multi-task in the two modes of communication at the same time. Pausing as you speak or pausing as you speak and show will allow learners who need extra time to process information to follow your presentation.

2.52 **Sign language interpreters and CART.** Learners who are Deaf require a sign language interpreter or CART (Communication Access Realtime Translation) to benefit from information presented orally. CART results in both real-time access and a transcript of the lecture. Students for whom English is a second language and those with auditory-processing challenges may also benefit from having real-time and post-lecture transcriptions available.

2.53 **Closed captioning.** Some e-learning tools, such as Elluminate Live, include a closed captioning tool. An aide can be given permission by the instructor to provide online closed captioning during delivery of the course.

Sharing knowledge and skills through multimedia

- Multimedia and the Internet

2.54 **Challenges of incorporating multimedia and the Internet.** Using media such as video, DVD excerpts, and PowerPoint slides is an effective way of presenting or reinforcing information. Providing links to Internet sites is also an important way of to building background knowledge or extending knowledge beyond that covered in class. However, despite the care that the instructor takes to design for accessibility, barriers may still be introduced by incorporating media and Internet links that are not accessible.

2.55 **Bandwidth considerations.** Be aware that although incorporating multimedia into e-learning environments is of great benefit and adds variety to courses, access may be constrained by bandwidth considerations. Each time another media tool or application is incorporated into an online course, access speed is reduced.

- Video and DVD

2.56 **Captioning video and DVDs.** Video or DVD clips or entire films should be captioned to provide access to learners with hearing impairments or to those who are Deaf. Captioning also benefits learners for whom English is a second language, as the speed of conversation and accents may be difficult for them to comprehend. Multimedia Access Generator (MAGpie) software developed by the National Center for Accessible Media (NCAM) allows developers to add closed captions to most multimedia files that can be played by Apple Quick Time, Windows Media Player, or Real Player.

Be aware that not all captioning is created equal. The Described and Captioned Media program (www.dcmp.org), funded by the U.S. Department of Education, provides a lending library with access to over 4000 captioned educational media. It also offers a clearinghouse of information, which includes guidelines and standards for captioning.

Also be aware of copyright considerations in producing captioning. Under copyright laws, it is illegal to produce captioning of commercially produced video/DVD without the written consent of the copyright holder. Captioning of in-house productions is permitted.

2.57 **Sign language interpretation and video clips.** As technology for learners who are Deaf evolves, educators may consider including sign language interpretation of information via video clip. Providing clear video images of sign language is a complex undertaking, which is impacted by many factors. An optimal video experience is affected by the bandwidth connection (the amount of data that can be transmitted at any one time), the frames per second of video (a minimum of 25 FPS are required to view sign language), computer RAM, and the quality of the computer video card. Students with newer home computers with a dual core processor, a fast broadband connection, and a minimum of 1 MB of RAM should be able to view crisp and clear video clips of sign language.

A further challenge with prepared sign language clips is that not all individuals who are Deaf communicate in standard American Sign Language. Skilled interpreters, who usually work one-to-one with persons who are Deaf, adjust their interpreting to the learner's needs. Some persons who are Deaf communicate in standard ASL, some in Signed Exact English (SEE), and some incorporate non-standard gestures. Some persons require more clarification and background information in order to comprehend. Persons who are Deaf and who are also from other countries are not only learning English but often are also learning American Sign Language. As with the inclusion of any media, instructors need to be aware that some learners will benefit and others will be challenged. The key is to provide a variety of modes to access the information. Presently, it is possible and necessary that only closed captioned videos be used. Providing a transcript of audio transmissions is also

possible. In the near future, it may be possible to also providing video clips in American Sign Language.

• PowerPoint and other slide presentation applications

2.58   **Slideshow applications.** Slideshow presentations, usually PowerPoint, are often incorporated into e-learning courses. Many of the considerations including layout, use of colour, and density of text outlined in the section "Sharing knowledge and skills through text" apply to PowerPoint presentations as well.

In a synchronous environment, instructors should make PowerPoint slides available to learners prior to the class. Ideally, PowerPoint presentations should also be available in HTML format or an Outline/RTF file to provide accessibility to screen readers.

• Links to Internet sites

2.59   **Internet links.** Links to Internet sites are effective tools for building background knowledge for learners who need this support, enriching the current learning experience, communicating information in alternative ways, and extending the learning experience beyond that offered during class time.

2.60   **Website accessibility.** Instructors should ensure that the sites they are linking to are accessible to learners who may use assistive technology. The World Wide Web Consortia (W3C) Web Accessibility Initiative resulted in the development of accessibility guidelines for website developers. Unfortunately, a large percentage of sites are still inaccessible to learners using assistive technology. Since 1998, programs and services receiving federal funding in the United States must ensure that electronic information is accessible to individuals with disabilities. In 2000, the US Architectural and Transportation Barriers Compliance Board drafted standards for information software accessibility. In Canada, the Common Look and Feel (CLF) standards outline best practices and offer design solutions for website designers who strive to make their sites accessible. To test websites for accessibility, consider using validity checkers, which can identify potential accessibility issues. Examples of validity checkers are available at WAVE http://www.wave.webaim.org, W3C http://validator.w3.org and the Adaptive Technology Resource Centre (ATRC), University of Toronto http://checker.atrc.utoronto.ca/index.html/.

2.61   **Descriptions of links.** Include descriptions of all hypertext links so that learners who are blind know where the link is taking them. Including only the web address as a hypertext link may not be helpful to blind learners who rely on screen-reader software. (See Appendix A for details.)

- Whiteboards

2.62 **Whiteboards.** Unfortunately, whiteboards used in a learning-management system are not compatible with assistive technology. Use prepared PowerPoint presentation files in accessible formats that can be distributed in advance to all students. If you choose to use whiteboards to illustrate concepts using drawing or typing tools, narrate what is drawn or typed and provide an accessible transcript or outline of your illustration after the class.

Learners participating and demonstrating learning

- Online discussion

2.63 **Communicating with others online.** Students taking e-learning courses can interact with the instructor and the other students through online discussion. Online discussion may be synchronous, meaning that it takes place in real time. A common form of synchronous discussion is a chatroom. An asynchronous discussion is available for all users to access at their convenience. Listservs and bulletin boards are forms asynchronous communication.

2.64 **Moderating synchronous communication.** Learners may find it hard to attend to the many elements that are active at the same time during an online course. The moderator or facilitator of the course needs to ensure that all learners are attending to the information being presented and see the relationships among what is happening on screen, what the presenter may be saying, and what is appearing in print.

If you are using synchronous chat capabilities in your course and learners are posing questions during your presentation, repeat the question before answering it or request input from other students to ensure that all learners understand what has been asked.

2.65 **Online discussion for learners who are Deaf.** Learners who are Deaf will be unable to participate in audio conferences or video conferences unless they have access to a sign language interpreter. Changes in communication technology for the Deaf, for example video relay service, will mean important improvements in the Deaf community's ability to interact with the hearing community and access important services, but as yet this technology is not readily accessible in all educational settings.

2.66   Online discussion for learners with speech impairments or language-processing disabilities. Learners with speech impairments may struggle to participate in teleconferences or video conferences. In addition, learners with language-processing disabilities may take longer than average time to compose and communicate their thoughts orally or in written form. Always supplement synchronous oral interaction (e.g. teleconference or video conference) or synchronous written interactions (e.g. chat or real-time discussion boards) with communication opportunities that allow individuals to take additional time to respond (e.g. e-mail, threaded discussions).

2.67   Online discussion for learners with mobility impairments. Learners with mobility impairments may use an alternative keyboard or speech input software to access the online course and participate in written communication. If learners lack fine motor skills to select on-screen controls, they may be unable to effectively participate in synchronous chat communication or class interaction. Plan for alternative forms of communication and participation such as threaded discussions or e-mail communication, both of which are compatible with assistive technology.

2.68   Online discussion for learners who are blind. WebCT and Blackboard chat as well as the Whiteboard tool in Elluminate Live are not accessible for students who are blind, so alternative modes of communication, such as threaded discussion boards are necessary.

2.69   Online discussion for learners requiring additional time. Most asynchronous resources such as e-mail, bulletin boards, and listserv distribution lists will not pose barriers for persons who are challenged by the spontaneous flow of communication afforded by synchronous communication tools. Students report that asynchronous discussion forums allow repeated critical reading, time for reflection, and the opportunity for extensive input. Threaded discussion bulletin boards with clearly defined and managed topics optimize interaction for many learners who are blind.[20] These forms of interaction are also advantageous for learners who need additional time to process information or to formulate responses because of barriers to mobility, chronic health conditions, or learning disabilities.

- Assignments and exams

2.70   Assignments. A common way for learners to demonstrate understanding of concepts taught in an e-learning environment is through assignments.

Provide clear and detailed information about assignments. Offer a scoring rubric that includes all aspects of the assignment that will be evaluated.

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[20] Kinash, S. (2002). *Disabled online learners in post-secondary contexts: A review of the literature.* Retrieved March 28, 2007, from http://www.crds.org/contacts/faculty_pages/kinash/index.html

Offer students examples of satisfactorily completed assignments perhaps linking examples to the assignment explanations. Modelling is a well-established instructional strategy that is effective.

Allow more time for online assignments than you would for face-to-face classes. Many individuals choose asynchronous e-learning because it allows them to incorporate this form of learning into already busy lives. In addition, technical challenges are inevitable in an e-learning environment.

2.71 **Feedback.** Provide regular and meaningful feedback to learners about their progress in the course. Provide feedback on assignments as they are being completed rather than after they have been completed.

If offering online practice activities or assignments, be mindful of the manner in which online feedback is given. An auditory signal or cue if an answer is incorrect needs to be supplemented with a visual cue so that learners who are hearing impaired or Deaf are able to understand the feedback.

2.72 **Exams.** Timed tests are challenging for many learners and especially challenging for those with disabilities. Learners with language-processing disabilities, those with attention challenges, some learners with mental health or chronic health conditions, and some learners with mobility challenges benefit from additional time for exams. If speed is not essential to the demonstration of competence, timed tests should not be used. If online tests or assignments include timed responses, the learner must be able to indicate if more time is required.

Be aware that some formats for exams are not possible for learners who are blind or attempting to access e-learning exams through screen-reading software for the blind. Tests that require learners to match items, drag and drop, fill in missing portions of a chart, or put items into a correct order are extremely difficult if not impossible for learners who are blind. These tests need to be available in alternative formats.

2.73 **Incorporating choice.** If possible, allow learners to choose from among alternative formats for exams or a variety of assignments. Incorporating choice allows learners to demonstrate knowledge in the way that best suits their learning styles and strengths.

2.74 **Learning contracts.** Learning contracts are effective tools for students to demonstrate learning and to address diversity in an e-learning environment. A learning contract is a formal agreement between the student and instructor and outlines what will be learned, how the learning will be accomplished, the timeline for learning, and the specific criteria for evaluation. Consider posting sample contracts in your course, facilitating discussions during the development of learning contracts and negotiating with individuals as you collaboratively design a learning contract.

Fostering engagement

- ## The benefits of engagement

2.75   **Engaging learners in the e-learning environment.** Engagement refers to motivation and participation. Adult students value independence. Offering alternative means to engage in learning and demonstrate understanding allows them to capitalize on their strengths and be independent learners. Creating an accessible e-learning environment for learners with disabilities fosters independence and allows equal participation.

One appealing advantage of e-learning for students with disabilities is the anonymity this environment can provide. The student is treated as an equal, and peers in the e-learning environment may not even realize their "classmate" has a visual impairment, is Deaf, or has a language-processing disability. In this way all learners can feel equally valued and connected and therefore engaged throughout the progress of the course.

- ## Laying the groundwork for engagement

2.76   **Readiness for e-learning.** Students without a great deal of experience in an e-learning environment need to learn new ways to learn. Consider administering a "readiness survey" where learners think about how they will organize the online information, take notes, ask questions, seek clarification, work in groups, or engage in discussion. In an orientation or throughout the course, provide tutorials or references to learning strategies that relate to the accomplishment of the course objectives.

2.77   **Additional considerations for accessibility.** For instructors, the need to engage learners by making courses relevant, interactive, self-directed, and experiential is the same whether learners have disabilities or not. There are, however, some additional considerations for learners with disabilities that you should keep in mind.

2.78   **Technical challenges.** Some technical challenges are inevitable in any e-learning environment, but for learners who must also integrate assistive technology into this environment, the frustration of technical challenges can seriously affect their motivation to continue with e-learning. Test your courses using common forms of assistive technology and include materials in accessible formats. Provide readily accessible technical assistance and be aware of the challenges that learners with disabilities may face.

- Maintaining learner engagement

2.79 **Application of real-life situations.** Adult learners appreciate and are motivated by the direct application of learning to their lives. Provide opportunities to apply knowledge through examining case studies and participating in role playing and simulations. Ensure that these types of activities also include the real-life experiences of learners with disabilities.

2.80 **Building connections among learners.** The varied background experiences of adult learners provide rich resources for connecting new learning to existing knowledge. E-learning affords the opportunity to connect learners with each other through synchronous and asynchronous communication tools. Guide learners to use these tools to communicate with each other and share their understanding and experiences. Encourage interaction and communication between students through e-mail or a course listserv. Students are engaged when they feel they are connected to a community of learners.

2.81 **Building connections with the instructor**. Students also need to feel a connection with their instructor in order to feel secure and confident. Be open and approachable. If possible, contact students individually and personalize feedback. Provide continuous and timely feedback. In asynchronous e-learning environments, strive for a 24-hour turnaround. Ensure that feedback is accessible.

2.82 **Multiple pathways to learning.** Building multiple pathways to achieving objectives allows learners with disabilities to choose the most accessible route to understanding the content of a course. Adult learners in general are self-directed and welcome the responsibility for managing their learning experiences.

Accessible E-Learning: A Path Forward for eCampus Alberta

3.01 An educational environment without barriers. Courses designed following UDL principles include multiple means for instructors to share skills and knowledge, multiple means for learners to demonstrate understanding, and a variety of methods to engage learners. Rather than a reactive medical model of disability where persons with a disability are asked to conform to the educational environment, UDL embraces a socio-political model in which it is not the individual's disability that creates a barrier to learning, but rather the educational environment that results in barriers for persons with disabilities.

3.02 Removing the need for "outside supports." The "burden of adaptation" should not rest with the learner. Too often, providing assistive technology supports or accommodations outside the classroom, actions such as providing materials in audio format and allowing extra time for exams, is deemed adequate support for persons with disabilities. But these supports may be necessary only because of inadequacies inherent in the original design of the curriculum or instruction. If the principles of Universal Design of Learning were implemented during the development of curriculum or instruction, learners with disabilities taking those courses would not need the same degree of "outside supports." By being proactive, anticipating barriers, and designing courses that maximize accessibility for persons with disabilities, instructors reduce barriers and also enrich the learning experience for all students.

3.03 Accessibility and eCampus Alberta. This document outlines the concept of Universal Design for Learning and design considerations that will make the e-learning environment more accessible for a wide variety of learners. It is a resource for members of the eCampusAlberta consortium to consider as they design new courses or redesign existing courses. The document outlines key considerations to maximize accessibility, but it is only a starting point as more work is needed to further explore accessibility issues and develop solutions and strategies.

The consortium members of eCampusAlberta have the opportunity to reframe the concept of accessibility. They can adopt the perspective of Universal Design for Learning and include accessible design considerations into the eCampus Essential Quality Standards with the result that accessibility becomes a way to maximize success for all learners rather than being viewed simply as an "add-on" for a few learners with disabilities.

3.04 **Training, research, and innovation.** For the goals of Universal Design for Learning to be fully realized, faculty and staff, including administrators and designers of e-learning courses, must have ready access to training and support in the area of designing learning environments that are universally accessible. It is also import that those involved in designing and delivering e-learning stay abreast of the technological developments that will further improve access. In addition, the software and hardware industry needs to be pressured to consider accessibility as they develop tools and resources used by educators.

3.05 **A collaborative undertaking.** Finally, the design of e-learning environments needs to be a collaborative work. Programmers, course designers, instructors, and disability services providers all bring their particular expertise to the establishment of learning environments. Learners themselves are also an important part of the development team. Their unique perspective will drive educators and course developers to be creative, bold, and innovative as they work to develop unique solutions to accessibility issues that will result in benefits, both anticipated and unanticipated, for all learners.

Appendix A: Technical Considerations

Design Area: Course Navigation

Technical Guideline/Standard	Rationale
Include an explanation or text description of any website outside your course followed by the hypertext link to the site. An example of a validity checker is available at WAVE (http://checker.atrc.utoronto.ca/index.html) If you are producing a document in Microsoft Word that contains hypertext links, highlight the link and right click. A dialogue box will open that allows you to substitute the web address with text.	Screen readers used by visually impaired and blind persons will be able to read the description to the link, thereby letting the person know what site the person is linking to.
Associate labels explicitly with their controls. Avoid graphics as buttons, but if using them, include an ALT tag that describes the function of the button. For information on creating effective ALT tags, see http://www.pantos.org/atw/35534.html/.	Screen readers need to read text and cannot read a graphic or picture. For example, a graphic of a green arrow to signify "proceed" should contain an ALT tag that reads "proceed to next screen," not one that reads "green arrow."
Provide information about the general layout of the course and use navigation mechanisms consistently.	Learners with visual impairments need to be able to predict where they will be able to find information. Providing an overview gives them a reference structure. Students with learning disabilities benefit from having information presented in a logical and predictable manner. Learners with physical impairments may be unable to use a mouse and instead use "speech-to-text" software such as Dragon Dictate. This software includes a "mouse grid" feature that

Technical Guideline/Standard	Rationale
	allows the user to direct the mouse orally. Having consistency in screen layout and navigation makes using a "mouse grid" much easier.
Allow users to skip repetitive links.	Learners with mobility impairments may use alternatives to a keyboard such as trackballs and sipper/puffer devices. Accessing information in a course may be time-consuming and physically taxing. Allow learners to get to where they need to be in a course with as few steps as possible and build in shortcuts wherever possible.
Users must be able to access the content even if some features are disabled or not available through the learner's browser.	Learners without high-speed Internet access may disable graphic download features to speed up downloads. Including accurate descriptions of images in ALT tags or longer text documents ensures access to the information.
Avoid timed responses. If timed responses are necessary, alert the student and include a means for the student to request additional time.	Learners with anxiety issues, those who are relying on fickle technology, and those with mobility challenges will find timed responses difficult. Examine the goals of instruction or assessment to determine whether timed responses are truly necessary. It may be necessary to provide accommodations for those unable to meet time limits.

Design Area: Screen Display

Technical Guideline/Standard	Rationale
Use standard HTML to design websites.	Most browsers and specialized assistive software are able to read standard HTML.
Avoid blinking screens and moving graphics unless the user has the ability to freeze or control the movements.	Onscreen flickering or flashing can result in seizures in learners with epilepsy or other related conditions. Learners who are easily distracted, those with ADD, ADHD, or FASD, will find it hard to concentrate on the content if there are distracting visual images.
Test linked web pages or content in your WebCT/Blackboard course	This simulates how your course will work for a person with a sensory impairment. Is the page to which you have linked still effective without

Technical Guideline/Standard	Rationale
using a "text-only" browser or a standard browser with graphics and sound-loading features turned off.	graphics or sound?
Test your WebCT/Blackboard course and all linked web pages by using only the keyboard (often tab and arrow keys) to navigate.	This simulates how your course will work for a person who is blind and uses text-to-speech software such as JAWS. JAWS uses combinations of keys, which skilled users will have memorized.
If using colour, check how the page might look for a person who is colourblind through the Vischeck website. (http://www.vischeck.com) In designing web pages, use cascading style sheets (CSS) to designate screen layout features. For information on CSS, see http://www.washington.edu/accessit/articles?1142/.	Users who have used accessibility controls to maximize accessibility will find that these settings may not transfer to learning-management systems or courses on the Web. Course designers must build in the ability to select various contrast styles. The CNIB website includes three contrast styles for users: high contrast white background with black text and blue links, high contrast black background with white text and yellow links, and soft contrast beige background with black text and dark blue links. Soft contrast reduces glare.

Design Area: Text Display

Technical Guideline/Standard	Rationale
Consider including a phonetic representation of foreign terminology and unique pronunciation or link to a dictionary that contains an audio clip of correct pronunciation.	Some screen-reader software reads phonetically. Including text where key vocabulary is written phonetically allows visually impaired, blind, and learning-disabled learners who rely on screen readers to hear the correct pronunciation.
Provide a description of how longer text and handouts are laid out at the beginning of the document.	Visually impaired and blind students who use screen readers benefit from an overview of document layout to facilitate navigation within the document. For example, write "This is a 2 page document that describes how a law is passed in Canada. It is divided into sections. The sections have titles. Each section is followed by 2 to 3 discussion questions. At the end of the document, a segment titled 'Summing It Up'

Technical Guideline/Standard	Rationale
	provides an overview of the chapter contents."
Choose sans serif fonts and, if possible, allow users to adjust font size. If specifying a font size, programmers should assign a relative value to allow users to adjust sizes. See http://diveintoaccessibility.org/day_26_using_relative_font_sizes.html/.	Learners with visual impairments may benefit from changing onscreen font size. Some e-learning programs will automatically apply the settings that the learner has specified on her system.

Design Area: Graphics

Technical Guideline/Standard	Rationale
Include an ALT tag with all graphics. For more complex graphics, such as charts or diagrams, include "longdesc" or longer text descriptions. Diagrams and equations may also require ALT tags. Be aware that WebCT/Blackboard provides ALT tags for all icons but not for "banners". Banners are graphic and decorative course headings. They are visually appealing, but they are inaccessible to screen readers. Create ALT tags for PowerPoint presentations by right clicking on the graphic and selecting Format Picture and Web tab. For information on creating effective ALT tags, see http://www.pantos.org/atw/35534.html/.	Screen-reading software used by visually impaired or blind learners cannot read graphics. Some learners may be better able to process information presented in text format than as a visual representation. The converse is also true.

Technical Guideline/Standard	Rationale
Avoid using graphic text. If using a logo, include a descriptive ALT tag.	When regular text is enlarged, it maintains its shape and clarity. When graphic text is enlarged, the image will become fuzzy.

Design Area: Chat or Discussion Features

Technical Guideline/Standard	Rationale
Create a "text log" file and post these logs on your course website as text files in HTML format.	Learners with visual impairments, those with physical impairments affecting their ability to manipulate the keyboard or mouse, and those who process information more slowly may find it difficult to keep up with the group engaged in discussion. Posting a "text log" file allows them to access the information and discussion.

Design Area: Audio and Video

Technical Guideline/Standard	Rationale
Offer a combination of Windows Media file (.wmf), Real Video (.rm), and QuickTime Video (.mov) and/or use MPEG video and MP3 audio. Be aware that users with a narrow bandwidth may have difficulty accessing video files.	Offer multiple formats of audio or video so that users can select the file type or player that works most effectively with their specialized software, and/or choose a file type that can be viewed or heard using most media players.
Captions and/or sign language video clips can be added using the Mac software "CapScribe" developed by the SNOW project at the University of Toronto. Contact Tracy Inaba, Bow Valley College (tinaba@bowvalleycollege.ca), or the Adaptive Technology Resource Centre at the University of Toronto. (http://snow.utoronto.ca/index.php?option=com_content&task=view&id=393&Itemid=356)	Providing captions or sign language interpretation for videos is essential for learners who are Deaf. Copyright laws limit the interpretation of commercially produced media. Always obtain copyright permission before modifying commercially produced media, but consider captioning and/or including video clips of sign language interpretations in all institutionally produced videos.

Technical Guideline/Standard	Rationale
Provide a text version of narration and sound effects with onscreen visuals. Synchronize captions and audio descriptions. Synchronized Multimedia Integration Language (SMIL), developed by the World Wide Web Consortium (W3C) is supported by a large variety of media players. Synchronized Accessible Media Interchange (SAMI) is supported by only Windows Media Player and other Microsoft products. For information, see http://www.w3.org/AudioVideo/	A text version of narration and sound effects can be useful for learners who are Deaf. Closed captioning is excellent for many learners, but the speed with which the onscreen text appears may be too fast. Having the text version available before the presentation allows learners to prepare and then benefit even more from the closed captioning. A text version of onscreen visuals is necessary for learners with visual impairments who may follow the narration and sound effects, but cannot benefit from the visuals.
Insert audio descriptions between audio tracks or segments.	Audio descriptions are short descriptions of onscreen visuals. In movies, they are often inserted during dramatic scenes and action sequences where there is no dialogue. In educational videos, they might be during the time an instructor is demonstrating a skill or process.

Design Area: Presentation Software

Technical Guideline/Standard	Rationale
The most commonly used presentation software, Microsoft PowerPoint is often used in e-learning, but needs to be made available in an alternative format. For information on converting PowerPoint presentations to an accessible format, see http://www.webaim.org/articles	Persons using screen readers will have difficulty with PowerPoint. The presentation is in a graphic format. Some screen-reading software will attempt to convert the file, but the process is complex and time-consuming. It is best to make the PowerPoint presentation available in more than one format.

Appendix B: Glossary of Terms

Accessible graphing calculator: The Audio Graphing Calculator is a program similar to the TI-83 graphing calculator, but is made specifically for visually impaired students. Graph functions can be produced and understood by students as a description of the graph shape is given by audio tones and cues. The greater the y value at any given point, the higher the tone. Also, as a graph falls below the x-axis, the sound instantly sends a fuzzy interference signal. The calculator also includes speaking menus, tactile output options, embosser transfer capabilities, a matrix function, an expression evaluator, and sum/difference display. It computes statistical functions, calculates intersection points, and has the ability to display multiple graphs at once. Another beneficial feature is that data can be imported from Excel or other applications. The Audio Graphing Calculator comes with a manual with hotkeys and practice exercises.
It can be downloaded online from:
http://www.viewplus.com/products/braille-math/AGC/

Accessible learning: Instruction designed to accommodate a specific group of learners with challenges. For example, to accommodate learners who are blind, designers will include text-based materials delivered in Braille format or audio. Ideally, designing for accessible learning occurs at the initial stages of course design, but often courses are retrofitted to accommodate learners with challenges.

In contrast, universal design for learning seeks to address accessibility issues at the initial stages of course design by designing not for a specific learning challenge, but rather to accommodate a wide spectrum of learning modes.

ALT tag: Also referred to as alternative tag, alt text or alternative text. When the cursor is moved over an icon or a picture (graphic), a text box appears containing a description. This is an ALT tag.

American Sign Language (ASL): ASL is visual, gestural language used by persons who are Deaf in the United States and much of English-speaking Canada. It is distinct from English, with its own grammar and syntax. Meaning is communicated in ASL through hand shapes, motions, and location, as well as facial expressions. ASL is not mime and not simply gestures. It is a complex language, which is at the heart of Deaf culture. Each country in the world has a unique form of sign language, different from ASL. In Canada, Quebec's sign language is called Langue des Signes Québécoise (LSQ).

Applet: A small program written in a computer code language called JAVA. Applets are embedded into web pages and are often used to display an animation. They often do not work with assistive technology, and it is important that programmers provide ALT tags with applets.

Assistive technology: "Products, devices or equipment, whether acquired commercially, modified or customized, that are used to maintain, increase or improve the functional capabilities of individuals with disabilities." (1988. USA Public Law 100-407 Technical Assistance to the States Act)

Blended learning: Courses that combine a traditional face-to-face classroom setting with online components. Online components may consist of course notes, student grades, exams, or materials that supplement face-to-face delivery. The online components may be delivered via the Internet through a learning-management system (LMS), such as Blackboard. Blended learning may also be referred to as hybrid learning.

Braille: A writing system in which raised dots are read using the fingertips. The system of dots can represent letters, numerals and math symbols, words, or even music. Electronic documents can be converted to Braille using specialized software and a specialized printer.
Website: www.cnib.ca

Captioning: Captioning is the translation of information presented in audio to a text format. Closed captioning (CC) is text that is visible at the discretion of the viewer. Open captioning (OC) is captioning that remains visible for all viewers at all times. Captioning is not the same as subtitling in that captioning includes information about who is speaking as well as background sounds, including sound effects and music. Captioning is essential for learners who are Deaf but is also of benefit to those for whom English is a second language and those with auditory processing challenges.

CapScribe: This open source software is designed to create captions for video. The editor requires a Mac, but the edited content can be played on both Mac and Windows.

CART (Communication Access Realtime Translation): This service allows Deaf or hard-of-hearing individuals to view a real-time English text translation on a screen (laptop, computer, large projection screen) as information is presented orally. CART, sometimes referred to as classroom captioning, is provided by a trained court reporter using a stenographic machine, a computer, and computer-aided transcription software. The benefit of CART is that the individual has access to the information at the same time as others who are in that environment. It may be challenging for some individuals who struggle with literacy to benefit from real-time translation. A transcript of the interaction is often available for the individual using CART. CART is used in educational settings, Internet webcasts, meetings, conventions, courtrooms, and corporate training events.

Cascading style sheets (CSS): CSS is a web markup language that enhances accessibility by separating the content of the page from the visual presentation. The "styles" set by the programmer when setting up CSS determine such elements as background colour, fonts, and page layout. Using cascading style sheets allows the programmer to change the look of a website by changing the code on a single file, the style sheet, rather than making changes to code throughout the site. Because content is separated from style, users can override the programmer's style settings and access the content by applying their own style sheet customized to suit their own needs.

Distance learning: Distance learning delivers instruction to learners regardless of their location. Currently, distance learning is often a combination of traditional text-based instruction with technological modes of interaction and communication.

E-Learning: Electronic or computer-supported learning that is available to learners at any time. It is also often referred to as web-based training.

Elluminate Live: This online learning tool allows instructors to offer instruction, interaction, and collaboration in real-time.
Website: http://www.elluminate.com/about.jsp

Embossing machines: Embossing machines can convert two-dimensional elements into three-dimensional elements, creating tactile maps, charts, graphs and line drawings.

Pictures-In-A-Flash (PIAF): This relatively inexpensive machine converts photocopied images (line drawings, diagrams) into embossed or tactile images on special paper. Consult distributors of assistive technology in your area for ordering information. The following site includes a manual to produce PIAF tactile resources. Website:
http://www.htctu.fhda.edu/trainings/manuals/contributions/myra/piaf_TrainingGuide.pdf

Tiger Embosser: Similar to PIAF, the embosser produces tactile images. But the Tiger Embosser uses a standard Windows printer driver to emboss images so instructors can produce tactile diagrams directly from their computer to the embosser. Consult distributors of assistive technology in your area for ordering information.

FM systems: Also known as personal FM systems or auditory trainers, FM systems are used by hearing-impaired individuals and are comprised of a receiver and transmitter. The learner receives sounds through earphones, and the teacher transmits sound through a microphone that is fastened onto her clothing or hung around her neck. FM systems can also be installed in classrooms, amplifying the instructor's voice through a speaker to all students. The benefit of an FM system for hearing-impaired individuals is that the voice of the primary speaker (instructor) is louder than the environmental noise picked up by hearing aids. One limitation of the system is that since the auditory focus is on the instructor, the student is unable to hear interactions and contributions of class members.

Home Page Reader: This IBM product is an Internet browser designed for persons who wish to access the Internet in a non-visual or combined auditory and visual way. This includes blind or partially sighted users, people with dyslexia or learning difficulties, and users who are learning new languages.
Website: http://www-03.ibm.com/able/europe/software.html

Irlen syndrome: Also known as scotopic sensitivity syndrome, this visual perception problem makes reading very difficult. Persons with Irlen syndrome may be sensitive to bright or fluorescent lights, glossy paper, or stark colour contrasts. They may perceive that the print on the page is moving or disappearing. Colour filter overlays, tinted glasses, and the ability to control computer screen colours are sometimes effective in reducing the effects of Irlen syndrome.

JAWS: The acronym stands for Job Access with Speech. It is screen-reading software for persons who are blind or visually impaired that converts text and components of Windows-based computer systems into speech output. Users of JAWS can navigate the Internet as well as any Windows-based program through keystrokes and by hearing what appears onscreen. In addition, the program reads out anything the user inputs.
Website: http://www.freedomscientific.com/

Learning-management system (LMS): Software that tracks or records learner progress. A learning-management system often includes a calendar outlining topics covered in the course, assignments and grades, supplemental information, a method for contacting the instructor or "class members," as well as audio or video recordings of lectures and notes. Two widely used management systems are Blackboard and WebCT.
Website: http://www.blackboard.com/us/index.bb

Multimedia Access Generator (MAGpie): Software that creates captions. Website: http://ncam.wgbh.org/webaccess/magpie/

Mark-up language: A mark-up language is the code and text used by a programmer to design web pages. The browser displays or renders what we see on screen based on how it reads the programmers' mark-up language.

Netiquette: This term refers to online etiquette especially for online conferencing. For an excellent description of considerations for online conferencing, including considerations that will maximize accessibility, see the Glasgow Caledonian University document "Communicating in Online Discussions."
Website:
http://www.learningservices.gcal.ac.uk/apu/eguides/communicating_online.pdf

Read & Write Gold: This software is designed for students with literacy difficulties or learning disabilities. It includes screen reading, word prediction, spell checking, voice recognition, and other features to support learners who struggle with reading and writing.
Website: http://www.readwritegold.com/

Screen-reader software: This type of software "reads" orally what appears on a computer screen. There are many types of screen readers. JAWS is a well-known software designed for persons who are blind. Not only does JAWS read aloud text that is displayed onscreen, but also reads the contents of menu items and navigation bars. As a person who is blind types or navigates the screen using the keyboard, JAWS will "read" what the user has typed or "say" the controls that have been accessed. Kurzweil 1000 is another brand of screen reader for the blind. Other screen reader software is designed for students with reading disabilities. Some examples of this type of software are Wynn, Kurzweil Reader 3000, Read & Write Gold and ReadPlease. These types of screen-readers are designed for visual learners.

Sipper/puffer device: Sipper/puffer devices are assistive technology tools that allow a person with severe mobility or dexterity impairments to operate equipment by air pressure. These types of devices are known as "hands-free devices." The IntegraMouse is an example of a computer mouse that is controlled by variations of air pressure through sipping or puffing on the device.

Trackballs: These forms of assistive technology allow persons with mobility impairments to operate equipment. Larger trackballs require less fine motor coordination and allow students with limited mobility to operate a computer.

TTY: People who are Deaf use TTY machines to communicate with each other and hearing people by phone. Hearing persons who do not have access to a teletypewriter call a toll-free number within Alberta (1-800-232-7215) and relay their message through an operator. The operator types the communication for the learner who is Deaf to receive on his TTY.

Universal Design (UD): "The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." (http://www.design.ncsu.edu/cud/univ_design/ud.htm)

Universal Design for Learning (UDL): A research-based set of principles that together form a practical framework for using technology to maximize learning opportunities for every student." UDL includes multiple means for learners to acquire information, multiple means for learners to demonstrate knowledge, and multiple means to increase students' engagement, motivation, and interest. (Center for Applied Special Technology [CAST] http://www.cast.org)

The terms, Universal Design for Instruction (UDI) and Universal Instructional Design (UID) are also used to refer to the concept of designing inclusive learning environments. See Appendix C for detailed information on these terms.

Video Relay Service: Video Relay Service allows a Deaf or hard-of-hearing person to make a call from her video phone to someone who uses a regular phone. This occurs via a Video Relay call centre, which is staffed with professional sign language interpreters. The interpreter and the Deaf person can see each other onscreen, similar to video conferencing. At the same time, the interpreter is connected to the hearing caller through a phone line and is interpreting in real time. This allows conversations to occur at approximately normal speed with the benefit of both parties being able to communicate in their own language and without the need for specialized equipment. Of course, as with any interpreted interaction, all information discussed remains confidential.

Window-Eyes: Screen reader software for persons who are blind or visually impaired.
Website: http://www.gwmicro.com/Window-Eyes/

Appendix C: Terms Related to Universal Design

Universal Design of Instruction (University of Washington)
Website: https://www.washington.edu/doit/Faculty/Strategies/Universal/

1. **Class Climate.** Adopt practices that reflect high values with respect to both diversity and inclusiveness. Example: Put a statement on your syllabus inviting students to meet with you to discuss disability-related accommodations and other special learning needs. Interaction.

2. **Physical Access, Usability, and Safety.** Assure that facilities, activities, materials, and equipment are physically accessible to and usable by all students and that all potential student characteristics are addressed in safety considerations. Examples: Develop safety procedures for all students, including those who are blind, deaf, or wheelchair users; label safety equipment simply, in large print, and in a location viewable from a variety of angles; repeat printed directions orally.

3. **Delivery Methods.** Use multiple, accessible instructional methods. Example: Use multiple modes to deliver content and motivate and engage students— consider lectures, collaborative learning options, hands-on activities, Internet-based communications, educational software, field work, etc.

4. **Information Resources.** Ensure that course materials, notes, and other information resources are engaging, flexible, and accessible for all students. Example: Choose printed materials and prepare a syllabus early to allow students the option of beginning to read materials and work on assignments before the class begins and to allow adequate time to arrange for alternative formats, such as books on tape.

5. **Interaction.** Encourage effective interactions between students and between students and the instructor and assure that communication methods are accessible to all participants. Example: Assign group work for which learners must support each other and that places a high value on different skills and roles.

6. **Feedback.** Provide specific feedback on a regular basis. Example: Allow students to turn in parts of large projects for feedback before the final project is due.

7. **Assessment.** Regularly assess student progress using multiple, accessible methods and tools and adjust instruction accordingly. Example: Assess group and cooperative performance as well as individual achievement.

8. **Accommodation.** Plan for accommodations for students whose needs are not met by the instructional design. Example: Know how to get materials in alternative formats, reschedule classroom locations, and arrange for other accommodations for students with disabilities.

Universal Design for Learning (Center for Applied Special Technology [CAST], Wakefield, MA)
Website: http://www.cast.org/

1. Multiple means of representation, to give learners various ways of acquiring information and knowledge

2. Multiple means of expression, to provide learners alternatives for demonstrating what they know

3. Multiple means of engagement, to tap into learners' interests, offer appropriate challenges, and increase motivation

Universal Instructional Design (University of Guelph)
Website: http://www.tss.uoguelph.ca/uid/

Instructional materials and activities should:

1. Be accessible and fair. All students should ideally use the same means to fulfill course requirements—identical if possible, equivalent when not. Instruction should be designed to be useful and accessible by people with different abilities, to be respectful of diversity, and to communicate high expectations for all students.

2. Be flexible. Learning is most effective when it is multimodal—when material is presented in multiple forms, and when students have multiple means of accessing and interacting with material and demonstrating their knowledge (being evaluated). Instruction is designed to meet the needs of a broad range of learner preferences. Students can interact regularly with the instructor and their peers.

3. Be straightforward and consistent. Instruction is designed in a clear and straightforward manner, consistent with user expectations. Tools are intuitive. Unnecessary complexity or distractions that may detract from the learning material or tasks are reduced or eliminated.

4. Be explicit. Course expectations are transparent. Instructions are easy to understand. Communication is clear. Any barriers to receiving or understanding are removed. Information may be presented in multiple forms.

5. Be supportive. Instruction anticipates that students will make mistakes. While instruction recognizes that errors are necessary, and if handled properly, present powerful learning opportunities, it tries to minimize hazards that can lead to irreversible errors and failures. Instruction also recognizes that systems will fail and things can go wrong—thus, a tolerance for error and preparation by way of backup are important so that learning will not be interrupted.

6. Minimize unnecessary physical effort. Instruction is designed to minimize non-essential physical effort (i.e., not related to a learning outcome) in order to allow maximum attention to learning.

7. Accommodate students and multiple teaching methods. The learning space is accessible and the environment supports multiple instruction strategies.

Four domains:

1. Design of learning (courses, activities, assignments, assessment)

2. Planning of delivery strategies

3. Design of materials or tools (manuals, CDs, learning objects, handouts),

4. Design of environments (websites, classrooms, learning spaces)

Appendix D: Resources

Access E-Learning
Access E-Learning (AEL) from the Georgia Tech Research on Accessible Distance Education (GRADE), Center for Assistive Technology and Environmental Access (CATEA) is a free, ten-module tutorial that is a resource for those seeking to make their distance education accessible for individuals with disabilities. AEL offers information on the most common needs in distance education and provides instruction in techniques that will enhance the usability of online materials for all students.
Website: http://www.accesselearning.net

Accessibility in Distance Education
The Accessibility in Distance Education website at UMUC aims to educate online faculty about how people with disabilities navigate the web and the things they (faculty) need to do to ensure that electronic learning materials are accessible to all students. It is divided into five major sections: "What is Accessibility," "Legal Issues," "Understanding Disabilities," "How To," and "Best Practices."
Website: http://www.umuc.edu/distance/odell/cade/ade/index.html

Accessibility Standards in Canada
The Common Look and Feel (CLF) standards for the Internet outlined by the federal government of Canada are explained on this web page. They align with the standards outlined by the World Wide Web Consortia (W3C) and the USA Section 508 of the Rehabilitation Act.
Website: http://www.tbs-sct.gc.ca/clf-nsi/inter/inter-01-tb_e.asp

Accessible Web Publishing Wizard for Microsoft® Office
This software tool creates accessible and standards-compliant web versions (HTML) of Office documents (Word, Excel and PowerPoint). Note that the Wizard does not currently work with Office 2007 or Windows Vista.
Website: http://www.virtual508.com

Adobe PDF Forms Access
This two-part course explains how to create PDF forms that are accessible. Website: http://www.adobe.com/products/acrobat/pdfs/instructor_forms_acess.pdf

Audio resources
The following resources may have audio recordings of text:
- Alberta Learning – Materials Resource Unit
- Recorded Books
- Local public libraries
- Amazon
- Chapters/Indigo
- Barnes and Noble,
- Amicus
- Library and Archives Canada – Canadian National Catalogue
- American Printing House for the Blind
- CNIB

Note that the Association of American Publishers and Recording for the Blind and Dyslexic will not ship to Canada.

Canadian National Institute for the Blind (CNIB)
One of the many services offered by the CNIB is expertise in the area of accessibility for persons with visual impairments or persons who are blind. The CNIB website offers free documents outlining clear print design standards and consultation services for accessible environments and website design.
Website: http://www.cnib.ca/

Captioning Key - 2007
Everything you ever wanted to know about captioning. This manual was produced for agencies that produce captioning through the Described and Captioned Media Program (DCMP) and offers guidelines for the production of captioning. It was produced through the co-operation of the National Association of the Deaf and the US Department of Education.
Website: http://www.dcmp.org/caai/nadh7.pdf

CAST (Center for Applied Special Technology)
This organization spearheaded the movement of Universal Design for Learning.
Website: http://www.cast.org

Described and Captioned Media Program: The Described and Captioned Media program, funded by the U.S. Department of Education, provides a lending library with access to over 4000 captioned educational media. It also offers a clearing house of information that includes guidelines and standards for captioning.
Website: http://www.dcmp.org

Dive Into Accessibility
This online book gives specific information on creating websites that are accessible for persons with disabilities. It is written for programmers, but offers specific programming tips based on different types of disabilities, by design principle, by web browser and by publishing tool.
Website: http://diveintoaccessibility.org

EASI (Equal Access to Software and Information)
This online resource offers information on accessible instructional technology through online courses, listserv discussion, the *Information Technology and Disabilities E-Journal*, and an extensive website.
Website: http://easi.cc/

Elluminate Live Accessibility
These documents outline the accessibility features of Elluminate Live software. The first document includes instructions on how to download Java Accessibility Bridge, which is necessary to allow screen-reader software like JAWS to operate.
Website:
http://www.elluminate.com/support/docs/8.0/Elluminate_and_Accessibility.pdf

Elluminate Live!® Accessibility Whitepaper No User Left Behind™ (June 2007). Retrieved from the Elluminate Live website:
http://www.elluminate.com/support/docs/8.0/Elluminate_Live_V8_Accessibility_Whitepaper.pdf

DO•IT - (Disabilities, Opportunities, Internetworking and Technology), University of Washington
An excellent website that outlines many issues relating to accessibility including information specific to the development of online learning courses.
Website: http://www.washington.edu/doit/Resources/udesign.html

DO•IT "The Faculty Room"
This section of the DO•IT website has been developed specifically for faculty in post-secondary institutions. "'The Faculty Room' is a space for faculty and administrators at postsecondary institutions to learn about how to create classroom environments and academic activities that maximize the learning of all students, including those with disabilities."
Website: http://www.washington.edu/doit/Faculty/

Literacy for Independent Living (LIL)
This online library provides literacy information and resources for people who work with adult learners with disabilities.
Website: http://www.nald.ca/ava/english/english.htm

Microsoft Accessibility
This site offers a guide and online tutorials that explain the accessibility features included in Microsoft products.
Website: http://www.microsoft.com/enable/education/default.aspx

National Education Association of Disabled Students (NEADS):
With its roots as a campus club for disabled students at Carlton University, it has become an organization with a mandate to encourage the self-empowerment of post-secondary students with disabilities. It provides information on services and programs for students with disabilities nationwide, publishes a regular newsletter, and conducts research on issues of importance to its members.
Website: http://www.neads.ca

Online Accessibility
This website, developed in the United Kingdom, offers a self-paced tutorial on designing accessible websites and accessible software. It includes coding examples that may be helpful for programmers.
Website: http://www.umich.edu/~webacces/home.html

PASS IT (Pedagogy and Student Services for Institutional Transformation)
This site, developed by the University of Minnesota, offers comprehensive information on implementing Universal Design for Instruction in post-secondary settings. It includes training tools that can be used to orient staff to UDI and move educational institutions in the direction of designing for accessibility.
Website: http://cehd.umn.edu/passit/about.html

Plain language
The following sites offer guidelines for producing text in plain language.
• http://www.fanshawec.on.ca/accessibility/writing.asp
• http://www.techcommunicators.com/pdfs/style-diction.pdf
• http://www.plainlanguagenetwork.org/plaintrain/ (Plain language online training)
• http://www.nwt.literacy.ca/plainlng/auditool/audit.pdf (a plain language audit)

Simplified Web Accessibility Guide
Glenda Watson Hyatt, Open Learning Agency, B.C. (2002)
This resource outlines Web Content Accessibility Guidelines 1.0 (WCAG 1.0) in simplified details by asking 14 key questions about a web page. It then answers these questions and provides programming details that make web pages more accessible.
Website: http://workinfonet.bc.ca/webaccessguides/accessguide/about.htm

SNOW (Special Needs Opportunity Window),
University of Toronto – Adaptive Technology Resource Centre. This site offers current information on assistive technology.
Website: http://www.snow.utoronto.ca

Treasury Board Common Look and Feel (CLF) Standards: This site was developed for Government of Canada programs and services. The standards include designing for accessibility.
Website: http://www.tbs-sct.gc.ca/clf2-nsi2/tb-bo/td-dt/mta-rta-eng.asp

Universal Instructional Design (UID): A Faculty Workbook
This PDF document from the Government of Ontario is a workbook for faculty and instructional developers. It outlines 12 goals of designing and then offers concrete examples of how the principles may be incorporated into a course.
Website: http://www.uoguelph.ca/tss/uid/uid-workbook-FTF.pdf

Validity checkers
These tools can be used to assess the accessibility of your web page. They are not foolproof, but they do point to accessibility challenges that you may want to address. As of February 1, 2008, Bobby online products, which offered an open source tool for measuring web accessibility, are no longer publicly available.
- WAVE - http://www.wave.webaim.org
- W3C - http://validator.w3.org
- Adaptive Technology Resource Centre (ATRC), University of Toronto - http://checker.atrc.utoronto.ca/index.html

WAI (Web Accessibility Initiative)
The W3C (World Wide Web Consortia) is an international standards organization that has produced web-accessibility guidelines. The purpose of these recommendations is to make websites accessible to persons with disabilities, as well as ensuring accessibility for persons using peripheral devices. This web page outlines the concept of web accessibility and offers tips for designing accessible web pages.
Website: www.w3.org/WAI

WebCT/Blackboard
The Ultimate WebCT handbook is an online resource to assist persons developing WebCT courses to reduce and sometimes even eliminate accessibility challenges in courses delivered in a WebCT platform.
Website: www.ultimatehandbooks.net/excerpts/accessibility.html

The Web Accessibility Center at Ohio State University offers an online resource that includes free tutorials on improving accessibility on a number of topics including accessibility and Flash, Dreamweaver, PDF files, accessible forms, and WebCT.
Website: http://www.wac.ohio-state.edu/tutorials/webct/index.html :

The Blackboard website offers some information on improving accessibility in WebCT courses. The link below is to a WebCT course design accessibility checklist, which outlines very general accessibility considerations.
Website: http://www2.blackboard.com/service/ViewContent?contentID=16339796

WebAIM (Web Accessibility in Mind)
An initiative of Utah State University, this site includes numerous articles on accessibility considerations with specific information for programmers. It includes a tutorial for creating captioning.
Website: http://www.webaim.org/articles/

Web Accessibility for All
The University of Wisconsin-Madison's Center on Education and Work, in partnership with the university's McBurney Disability Resource Center has developed a number of online tutorials related to developing accessible online learning. Topics include, but are not limited to, making Microsoft Office documents accessible, creating descriptive texts for graphs, charts, and graphics, ALT tags and creating accessible PowerPoint presentations.
Website: http://www.cew.wisc.edu/accessibility/tutorials/default.htm

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