

# 18

## Blending Universal Design, E-Learning, and Information and Communication Technologies

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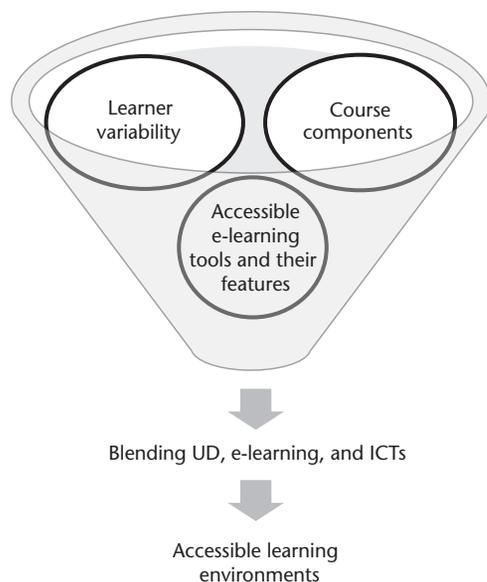
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*The authors of this chapter examine how to blend universal design (UD) with e-learning tools used by postsecondary faculty and with information and communication technologies (ICTs) used by students in traditional classroom, hybrid, and online courses. The focus is on how instructors can design and deliver their courses in an accessible way using e-learning.*

E-learning is in a state of constant flux and is partly dependent on developments in different disciplines. Here we define *e-learning* as instruction that involves technology, online course delivery systems, digital communication, and educational paradigms used by higher education faculty (Sangrà, Vlachopoulos, & Cabrera, 2012). This includes information and communication technologies and the learning management systems (LMSs) that are used to support instruction in traditional, hybrid, and completely online courses, including massive open online courses (MOOCs). In this chapter, we examine how ICTs are used by students in these courses to facilitate their learning.

E-learning and ICTs hold the potential for greater access to higher education than ever before. However, just because a course is digital does not ensure that it is usable by everyone or that it is accessible to all (Berkowitz, 2008). It is our premise that the application of UD principles can promote increased access by focusing on how students learn and how instructors teach using e-learning tools and ICTs. At the core of

**FIGURE 18.1** Learner variability, course components, and accessible e-learning tools result in blending UD, e-learning, and ICTs. This results in accessible learning environments.



this notion is the combination of three key components described below and illustrated in Figure 18.1:

- The diversity of students in a course—for example, their learning preferences, abilities, processing speeds, cultural backgrounds, and prior knowledge.
- The course components—for example, delivery, content, communication, and evaluation.
- E-learning tools, ICTs, and their features—for example, LMSs, mobile devices, software, and applications used by both instructors and students.

### UNIVERSAL DESIGN PRINCIPLES AND FRAMEWORKS

UD, which originated in architecture, offers a method to design structures that work for everyone because the physical, sensory, and other needs of all potential users are taken into account during the planning stages. One benefit of the UD approach is that it avoids costly retrofits by responding to the diversity of users from the outset (e.g., making curb cuts as the sidewalk is being built rather than after it is completed). Seven principles governing the UD of products and environments were initially proposed by the Center for Universal Design (CUD) (Story, Mueller, & Mace, 1998). These were later adapted to other fields, including education. As discussed in Chapter 2 of this book, several frameworks for the application of UD to instruction have emerged. They include universal design of instruction, universal design for teaching, and universal design for learning. These have a common goal, which is to render learning environments welcoming, accessible, and usable by all students (Burgstahler, 2008).

**TABLE 18.1 Universal Design for Learning (UDL) Principles**

<i>Principles</i>	<i>Descriptions</i>
Multiple means of representation	Course content is offered in a multitude of formats (e.g., PowerPoint, video, podcast, images).
Multiple means of engagement	Instructors offer multiple pathways to engage students in the course material (e.g., wikis, group chats, online mind mapping).
Multiple means of action and expression	Instructors offer multiple methods of expression/evaluation of students' knowledge of course content (e.g., participation in discussion forum, online multiple-choice quiz, virtual group project).

Adapting the UD approach to higher education is intended to create inclusive learning environments that respond to the diversity of the student population, thus ensuring the accessibility of learning activities, environments, and products. For example, the universal design for learning (UDL) framework extends UD by promoting flexibility in curriculum design through the application of three principles: (1) multiple means of representation, (2) multiple means of engagement, and (3) multiple means of action and expression (Rose & Meyer, 2002). Addressing the diversity and variability of potential students enrolled in a course, UDL provides students with multiple pathways to perceive, engage with, act upon, and express course content (Center for Applied Special Technology [CAST], 2011). Table 18.1 includes the three principles of UDL, along with descriptions of the principles, and examples of their applications in online learning.

The proactive application of UD has the potential to reduce the need for disability-related accommodations and expand access to learning for all students (Fovet & Mole, 2013). However, taking one step in applying a principle of UD does not always lead to full accessibility to all learners. For example, offering students a video as an alternative to text provides multiple means of representation, but will not provide full access for a student who is deaf unless the video is captioned.

### **ACCESSIBILITY, E-LEARNING, AND ICTS**

There are many opportunities for instructors to blend e-learning and ICTs with UD to respond to learner variability. However, in the rush to integrate technology into teaching, instructors and those responsible for designing, supporting, and implementing e-learning often fail to think about the specific accessibility requirements of students with different needs (Bissonnette, 2006). For example, those in charge of supporting and deploying e-learning generally do not confirm ahead of time whether academic software being considered for purchase is compatible with assistive technology (AT) used by students with disabilities. AT includes screen reader technology used by students who are blind or who have learning disabilities that impact their ability to read printed text, and technology used by individuals with limited hand function that fully emulates the keyboard, but not the mouse. To be accessible and usable to these students, all LMS functions need to be accessible via screen reader and

through the use of the keyboard alone. Although U.S. laws and court challenges have increased the accessibility of software and hardware sold by vendors of e-learning products (Rowland, 2012), there are still accessibility issues regarding specific types of ICTs used in higher education institutions (U.S. Department of Justice and U.S. Department of Education, 2010; U.S. Department of Education, 2011).

In addition to accessibility problems, there are also barriers due to the high cost of ICTs and to inadequate opportunities to experiment with them before purchasing. Some organizations have addressed this issue. For example, the Adaptech Research Network (n.d.) maintains a database of free or inexpensive hardware and software for both Windows and Macintosh platforms, as well as applications for Apple and Android mobile devices. These tools may support not only students with disabilities, but also the many individuals looking for tools that match their needs and budget.

At least five postsecondary groupings have a stake in promoting UD of e-learning in colleges and universities: the students themselves, professionals who provide disability-related services to the campus community, instructors who use and implement e-learning in their courses, e-learning professionals on campus who provide leadership and select e-learning products for campus-wide use, and the vendors who develop and sell e-learning products to colleges and universities. Because of their different perspectives, these groups are likely to have different views about UD and e-learning accessibility (Fichten et al., 2009).

When choosing e-learning tools and digital course components, instructors need to keep in mind that students use a variety of ICTs to access learning materials. Thus, in reviewing the various elements of e-learning it is important that instructors ensure the following: that the LMS works on multiple platforms (e.g., desktops, laptops, mobile technologies); that lecture presentations are inclusive of students with a variety of skills, preferences, and abilities; that course materials are accessible and usable by the largest number of students possible; that a variety of communication modalities, content representations, engagement methods, and evaluation techniques are made available; and that accessibility to learners with diverse disabilities has been taken into account.

## **USING UD, E-LEARNING, AND ICTS TO FACILITATE ACCESSIBILITY**

Described in this section are accessibility challenges related to e-learning tools and methods, as well as examples of solutions that apply the UDL principles of multiple means of representation, multiple means of engagement, and multiple means of action and expression to on-site, hybrid, and fully online courses including MOOCs.

### **Web Platforms and Learning Management Systems**

Web platforms and LMSs (for example, Blackboard, Moodle, Desire2Learn, VClass, SAKAI) used by higher education institutions offer an assortment of features, which allow instructors to customize their courses. As these platforms have evolved, some of the features offered have enhanced accessibility while others have created barriers (Rangin, 2013). Some accessibility features have even been lost once a provider moves from one version of the product to the next.

There is much that the instructor can do to apply UD principles to a course design within the structure the LMS provides. For example, instead of presenting material in an idiosyncratic manner, which can lead to confusion for students, an instructor can organize the content in clearly identified modules or chunks of learning material that are obviously tied to the course learning objectives. In addition, specific learning objectives should be reflected in the course calendar feature provided in the LMS. Both in-person and virtual office hours can also be noted on the LMS course calendar. Instructors can verify that their material is presented in an organized way by using the “student view” feature available in most LMSs. By doing so, instructors are placing themselves in the students’ position and verifying that what they have posted is, indeed, presented in an organized manner from the students’ perspective and that a diverse group of students will be able to access the material.

### **Specific Course Methods and Materials**

Some of the many online resources available for directions on implementing specific suggestions made below can be found in the Training and Support section at the end of this chapter.

*Syllabus.* A student’s customary first contact with a course is the syllabus/course outline. A universally designed course syllabus would include a photo or captioned video introducing the instructor, a course tour presented in printed and captioned video formats, a link to instructions on how to use the LMS, a description of the multiple pathways to reach the course objectives, and information on how to arrange for disability-related accommodations. The syllabus should be presented in an accessible format. Guidance for the UD of a syllabus can be found in several of the online resources listed in the Training and Support section at the end of this chapter.

*Lectures.* When using presentation software, such as PowerPoint, instructors can ensure that their presentations are accessible and usable by all students by considering the amount of content per slide, font size, colors, contrast, and animations. A basic listing from WebAIM (n.d.) includes the following:

- Ensure that font size is sufficient.
- Provide sufficient contrast.
- Do not use color as the only way to convey content.
- Avoid automatic slide transitions and use simple slide transitions when possible. Complex transitions can be distracting.
- Use simple language.
- Check the reading order of text boxes that are not part of the native slide layout. A screen reader usually reads these last.
- If you have embedded video, ensure that the video is captioned, and that the player controls are accessible.
- If you have embedded audio, ensure that a transcript is included.

Instructors often post their PowerPoint presentations or lecture notes online. For instructors concerned about copyright, this can be assigned through a free license provided by Creative Commons (n.d.). When notes are posted online, they should

be presented in an accessible, text-based format—not, for example, as scanned PDF documents, as described in the Documents section below. If notes are supplied before an in-class presentation, they should be posted early enough to allow sufficient time before the class session so that students can modify the format to be compatible with their note-taking preferences.

Some universities and colleges provide lecture recordings, including video and audio capture, especially in large classes (Leadbeater, Shuttleworth, Couperthwaite, & Nightingale, 2013). These recordings are typically stored on the university or course website, allowing students to review the lecture at their own preferred time and pace. Providing captions benefits not only students with hearing impairments or auditory processing difficulties, but also English language learners and all students as they learn to spell terminology used in the video.

*Textbooks.* To access course content, students are often required to read textbooks, book chapters, journal articles, and other academic material. If these are provided only in printed format, the disability services office on campus may be required to convert them into accessible digital text for a student who uses screen reader technology to read aloud digital text. Digital textbooks have become increasingly popular and are being used in addition to traditional textbooks because they provide advantages that include portability among devices, such as laptops, tablets, e-readers, and smartphones (Lepi, 2012). While digital textbooks seem to promote accessibility overall, many academic book publishers use proprietary formats that may, in fact, restrict accessibility (for example, they may not allow the option to select text for reformatting or have the capability to be used with screen readers, or they may use complicated navigation schemes). Before selecting a digital textbook, instructors should ask the vendor to provide specific information about accessibility and usability features.

*Documents.* All documents that students are expected to read before class should be made available in advance and in accessible formats. To make images on digital documents accessible to students with visual impairments, alternative text, also known as “alt text,” can be provided. Alt text is a brief, meaningful description connected with an image. It allows individuals who cannot see the image to obtain the necessary information with screen reading software that can read the alt text. In the same vein, instructors should select videos with captioning or subtitles—or add captions themselves or through a campus unit—and verify that they are, indeed, accurate. If the video is captioned or subtitled in-house or by the professor, there will need to be an internal review of this work for accuracy. In addition, the provision of audio description (which inserts commentary into the video that describes body language, expressions, and movements) ensures full accessibility to students who are blind.

Students are frequently required to read course materials, such as course handouts and journal articles, that have been posted online as a PDF file. Although many journal articles now found online are accessible, many are not, particularly to screen readers used by students who have a visual or print impairment. When a paper document is simply scanned and saved as a PDF file, the text is saved as an image and cannot be selected, copied, or read by screen reading software. The scanned PDF must be

rendered accessible through the use of optical character recognition (OCR) software. This process extracts the text from the image and creates an editable, selectable, and accessible document that can also be read by a screen reader. Students can use accessible PDF files in many ways, including highlighting, taking notes, listening to text, searching terms, and looking up definitions. Some instructors have posted PDF files from old photocopies of book chapters and journal articles that have been annotated or highlighted. These files are very difficult to render accessible and should be avoided whenever possible. Some of these documents can be found online and can be downloaded to use instead of the older, illegible documents.

*Communication.* Students can engage with course content by communicating with their professors and their peers, both with individuals as well as with the whole class, through online synchronous or asynchronous communication built into the LMS (Giesbers, Rienties, Tempelaar, & Gijsselaers, 2014). Online communication options are used in e-learning courses, but they are also useful to students who are unable to attend class or be on campus due to mobility issues, illness, or inclement weather. There are also students who are better able to communicate with others through technology than in person. These individuals may include students with speech and hearing impairments, with anxiety disorders, who are on the autism spectrum, or who are second language learners.

Asynchronous communication, such as e-mail and Internet forums, can be used in courses to facilitate online discussions where individuals can post content and then reply to one another. Providing asynchronous communication methods ensures that all students have the opportunity to communicate with one another at a convenient time and at their own pace, allowing for self-review of content and grammar. If a discussion board provided within an LMS is not accessible to a specific student, perhaps because they are blind and using screen reader software, an accessible alternative such as e-mail should be used.

Synchronous communication, which occurs in real time (for example, chat rooms and instant messaging), presents more accessibility and usability challenges than asynchronous options. There are potential barriers for second language learners, beginner typists, students using specific types of AT that do not allow input at a high speed, and students with spelling difficulties who may be uncomfortable with rapidly written communication. Providing multiple means of engagement is key. Since Skype and other videoconference programs may not be accessible to and usable by all students, instructors should provide multiple communication options that include e-mail. Another application of tools such as Skype or Adobe Connect is to host guest lecturers; in those cases, accessibility solutions include the creation of a captioned recording of the presentation, using features included in the LMS or external tools. Audience response tools (clickers), surveys, and other synchronous tools are not all universally designed. For example, certain brands of clickers have small screens that are not accessible to students with low vision or to some individuals with mobility impairments. UD requires that engagement alternatives be provided to ensure that everyone can participate.

### **Evaluation**

To ensure that students can optimally demonstrate their learning, multiple evaluation activities should be employed and students should be given options to demonstrate their knowledge. Instructors can conduct evaluations by reviewing written papers, virtual group projects, online tests, blogs, portfolios, mind/concept mapping, discussion forums, hands-on demonstrations, student presentations, and online oral examinations through Skype or similar tools. Course participation can also be measured in multiple ways, including in-class and online discussions.

Providing the option of completing testing online outside of or within the LMS (such as online quizzes) may be beneficial for students who are disadvantaged by a paper format. In the same vein, when completing in-class essay writing, students may benefit from working on a mobile device that can e-mail the essay to the instructor at the end of class. To ensure that exams are accessible to the majority of students, lengthy online exams and speed testing need to be avoided when possible and if academically appropriate. In keeping with UD principles, it is best to design a test so that adequate time is given for all students to complete it. However, because some students may be eligible for extended time on tests, it is important to ensure that extended time can be specified on the LMS on which the exam is delivered or that other options can be employed to ensure that reasonable accommodations are provided. It is also important that all testing options are accessible to those using screen readers and other assistive technology. Providing students with an option to submit their test via e-mail is a possible solution when testing features in the LMS are not accessible.

### **DESIGNING A NEW COURSE**

Based on our experiences as instructors in traditional and online environments, disability service providers, students, and educational technologists, we suggest seven key questions to ask when developing a course where blending UD and e-learning is expected to contribute to increased access and reduction of barriers.

1. Has careful thought been given to the diversity of learners in the course? Are there barriers in any area of the course for learners with different abilities (e.g., artistic, numerical), circumstances (e.g., second language learners), concerns (e.g., finances), and disabilities (e.g., visual impairment)?
2. Has the accessibility of the LMS, including its various components, been considered for all persons, including those with different disabilities (for example, are the calendar, announcements, discussion board, chat, and quizzes accessible; can students easily distinguish new discussion threads; does the announcements tool indicate the number of new announcements posted)?
3. Has consideration been given to the variety of platforms and mobile devices students could be using to interact with the e-learning course and the course material?
4. Are there alternative digital representations of course content that are accessible and usable?

5. Are there options offered for student engagement with the course content and the course objectives through accessible e-learning tools (such as online mind mapping and discussion forums)?
6. Are there alternatives offered to students to demonstrate what they have learned through accessible ICTs or e-learning tools (such as audio, visual, written, and demonstrations)?
7. Has the institution's access technologist been consulted as the e-learning and digital learning modules and activities are designed (to ensure that all aspects of the course structure and components are accessible and usable—for example, how readily and easily can the website be navigated)?

## TRAINING AND SUPPORT

It is important to note that many instructors need training on how to use their LMSs, on how students with different access needs use ICTs, and on how to employ UDL in designing course materials and methods. Support can include direct instruction as well as providing links and contact information to personnel who can provide assistance with making IT accessible. The following resources are particularly relevant to the application of UD to e-learning courses.

- AccessDL: <http://www.washington.edu/doi/programs/accessdl>
- Adaptech Research Network Database of Free and Inexpensive Computer Technologies: <http://www.adaptech.org/en/research/fandi>
- CAST: <http://www.udlcenter.org/aboutudl/udlguidelines>
- Center for Universal Design in Education: <http://www.washington.edu/doi/programs/center-universal-design-education>
- JISC TechDis Inclusion Technology Advice: <http://blog.jisctechdis.ac.uk>
- Province of Ontario: Making Your Website Accessible: [http://www.mcsc.gov.on.ca/en/mcsc/programs/accessibility/info\\_sheets/info\\_comm/website.aspx](http://www.mcsc.gov.on.ca/en/mcsc/programs/accessibility/info_sheets/info_comm/website.aspx)
- UDL-Universe: UDL Course Changes: <http://www.udluniverse.com>
- UDL On Campus: Selecting Media and Technology: [http://udloncampus.cast.org/page/media\\_landing#.VK8Rg1Z3E3g](http://udloncampus.cast.org/page/media_landing#.VK8Rg1Z3E3g)
- WebAIM: <http://webaim.org/techniques/powerpoint/>
- Web Content Accessibility Guidelines: <http://www.w3.org/WAI/intro/wcag>

## CONCLUSION

Considering UD when selecting and using e-learning materials in traditional, hybrid, and online courses can ensure an accessible learning experience for the diversity of students in today's colleges and universities. Collaboration between the wide array of stakeholders is needed to design, implement, and support accessibility and usability. This includes the students, instructors, ICT vendors, institutional IT procurement specialists, and campus disability service providers.

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