

# **Reflections on the State of Accessibility in E-learning in the Sciences**

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## **What Is E-learning and how does it Impact the Learning Process?**

Twenty years ago, I was told that I was “handicapped” and a pioneer in “distance education”. Now I am print disabled, physically challenged or visually impaired and deeply involved in online learning or e-learning or maybe hybrid learning. I haven’t changed all that much, but the technologies are changing at increasing speeds and the labels for them are flashing by at even a more rapid pace. I played a key role in the Rochester Institute of Technology becoming involved in distance learning. However, we discovered that, by far the most of our students lived within an hour’s drive of campus, and some of them resided on campus itself. So, where was the distance in distance learning? True, there were some students who were across the country, and others were across the ocean in other continents, but there was a need to reconsider the label. I have taught several thousand students in more than 3 dozen countries and on every continent except Antarctica.

The term, distance learning, did include both correspondence courses and instruction delivered by broadcast television, but, increasingly this learning revolution refers primarily to courses delivered by and accessed by computer networks or by telecomputing. Further, in recent years, many courses which primarily take place in a physical classroom also include online content as a part of the course. Classes which blend both physical classrooms and a virtual classroom have become called either blended learning or hybrid learning.

Several states still have television networks connecting students and classrooms several miles apart, and some of these connected classrooms permit two-way broadcasts and encourage interactive participation by students from several sites. Trends seem to suggest that these networks will be delivered over the Internet in the near future.

## **How Have E-learning Applications and Practice Changed during the Last 20 Years?**

Twenty years ago, to participate in e-learning, you had to phone long distance to a modem, usually 1200 or 2400 BAUD and connect to the mainframe hosting the course. The interface was command line, and the content was only text with no graphics or multimedia. The advent of the graphical user interface meant a shift to a menu-driven interface, and gradually it meant the possibility of including graphics and later multimedia. Then in the early 1990s, the emergence of the World Wide Web meant you no longer had to phone long distance but could reach the courses over the Internet on the Web.

The command line interface worked nicely with early screen reader programs as well as screen magnification applications and also with some applications for people with motor impairments. With the move away from DOS and the command line interface, all of this accessibility software required a major retrofit with the GUI interface, but it was a boon for users with learning disabilities. The proliferation of graphics and multimedia on the Web created problems for users who are blind and/or deaf. The World Wide Web Consortium Web Accessibility Initiative established widely recognized guidelines for Web accessibility at the turn of the century, and this was followed, in the US, by the Federal Access Board's Section 508 Standards for Web accessibility.

There is also a general shift in how faculty and instructional designers think about distance education. They have drop the word, education, and replace it with the word, learning. This reflects their belief that courses delivered using these technologies focus less on teaching and more on learning, that they become more interactive and more learner-centered.

## **What Are the Differences between Synchronous and Asynchronous E-learning?**

Asynchronous courses consist of content that is available online at any time that the student wants to access it. This includes textual content, graphics and, increasingly, on-demand multimedia of all kinds. It also includes some kind of discussion board where everyone can post comments and reply to previous postings. Two of the advantages of asynchronous courses is everyone can work at their own time and also at their own pace. The student can linger, repeat content and ponder for a long time before making

comments. Others can skip and skim content and move through it rapidly. If people access the content very frequently, it still maintains the feeling of interactivity.

Many faculty and students have commented that they had more interaction and felt more connected than in some live classrooms. The Internet is a highly interactive medium. However, an instructor who is not very interactive will not be transformed into a friendly, accessible professor by the technology.

Synchronous systems include text chat rooms, voice chat rooms, desktop video and other applications where participants have to be connected at the same time to the same course delivery system. This does permit participation in real time. It does not permit anyone to work at a personal pace different to the class's pace. While you ponder something, the class has moved on. While the class covers content you already know, you can't skip ahead but have to sit through what may be repetitive and Time-wasting.

Each system has its advantages, and each may work best for some people and work best for different types of content.

## **What Are the Accessibility Benefits and Problems of E-learning?**

Digitized information is display independent meaning it has the potential of being delivered in modes that are most accessible for users with different disabilities. The previously print disabled can have information delivered to them through a speech synthesizer. Small print can have the monitor display enlarged. Someone who cannot hold a book may be able to use special switches to manipulate text on a computer monitor. Multimedia has the potential to deliver content using different communication modes, audio and video to accommodate different disability groups.

These benefits assume that the content provider has taken the special needs of users with disabilities into consideration during their designing of the content. When this is not done, graphics, small font, cluttered page design, audio with no transcription and other features can make it impossible for users with disabilities to access course content. When a faculty member has no students with disabilities in a course, he or she may see no need to consider their needs in designing course content. When such students learn the content is not accessible, they do not take the course reinforcing the teacher's belief that there is no need to consider accessibility in designing their online courses.

## **How Effective is E-learning in the STEM Disciplines?**

Twenty years ago when e-learning was almost exclusively text, it created a number of problems in these fields. Computer code represents letters and punctuation by digits, and this ASCII code did not include many representations for many symbols that are important in these disciplines. The systems were excellent for discussions about the

sciences but frequently had problems actually displaying scientific and mathematic formulae.

When graphics were added to the use of text, graphics were frequently used to convey these symbols that were not included in the ASCII code. These courses traditionally relied heavily on hands-on lab work requiring actual presence in a physical lab. Now, even live classrooms are increasingly using computer simulations to replace at least some lab activities. The ability to collect and manipulate data rapidly by computer is another change in these fields. A number of multimedia tools such as Flash permit the representation of various processes in computer graphics and animations that can be paused, repeated and then altered to show a process under different conditions. HTML has been expanded with the development of XML and now with MathML which now enables the STEM disciplines to make rich use of e-learning.

### **What are the STEM Accessibility Problems and Solutions of E-learning?**

Complex, detailed graphics and intricate diagrams frequently are a problem to make accessible especially for students who are blind and, to some extent, for those with limited vision. Simple graphics and diagrams probably can be described in an accompanying text file or in an audio version, but in advanced material, there is no real substitute for the visual representation. If the file format will permit someone with limited vision to print a hard copy and to enlarge that print copy, this would be a solution. For the student who is blind, it will be necessary to make a tactile, raised-line hard copy and deliver it by mail. Even this may not be adequate. The eye can comprehend content with a different resolution scale than one can grasp by touch. This may require producing a set of diagrams each with increasingly detailed content.

In a legal case more than a decade ago, Loyola Marymount, the court said that Nemeth Braille was the most accurate method of reproducing complex math for a student who was blind assuming the student was a Braille reader. Unless and until MathML is able to conquer displaying complex math in an accessible format, schools may also need to produce hard copy Nemeth Braille and have it mailed to a student also.

### **What Are the Benefits and Problems Inherent in Courseware Management Systems?**

In recent years course management systems have made significant strides towards making their interface accessible. All have more work to do, and every time they make a system upgrade, they frequently create an unintended new accessibility problem.

Faculty and instructional designers find course management systems simplify their work. They are able to use every day content creation tools like Word, PowerPoint and Excel which they had been using before becoming involved in e-learning teaching. Without

knowing anything about Web design or about HTML code, the system permits them to take content developed in these authoring tools and directly upload them to the Courseware system. It handles any technical details involved in modifying the output for display as Web pages. For some faculty who are advanced Web designers, they may find this limiting, but the vast majority of faculty are grateful that they do not need to learn anything about Web design. Obviously, faculty avoiding learning about technical aspects of preparing content for the Web will have absolutely no desire to learn any of the intricacies of retrofitting Web design to make it accessible for students with disabilities.

There is an urgent need to get courseware to provide some kind of wizard to walk faculty through how to make their content accessible. There also needs to be training on simple access issues for faculty who are not willing or able to take on the task of becoming Web accessibility experts themselves.

The problems that students with disabilities have with the courseware have to do more with usability rather than with technical accessibility. The courseware systems almost all have 2 or usually more frames. A keyboard user has to tab multiple times to reach the desired choice. Then, a similar list of choices has to be navigated again for the next selection. Once the student gets into the actual content, large portions of the screen are still devoted to navigation links. For a screen reader user, this means that when the student picks a new content link, the entire page is refreshed forcing the student to listen to 20-30 links being repeated over and over whenever the actual content itself is changed. Students with learning disabilities will also find these navigation links distracting his or her focus from the content.

The areas providing some of the most difficulty accessibility problems are course discussion boards, a white board and a live chat area. Many systems have tried to make these accessible, but all require skill with the adaptive software and a great deal of patience and persistence.

## **Conclusion**

In today's technology world, everyone is running hard and still falling behind. Accessibility is all too frequently the last consideration, and providing systems that are accessible and creating tools to facilitate accessibility are usually a couple steps behind the current changes. Where schools providing distance learning have policies in place about accessibility, the faculty knows at least that the school takes the issue seriously. This is a first step. Having courseware systems and content authoring tools assist content designers with accessibility without having to know the technology itself is crucial.

Someone once said that the price of freedom is vigilance. The same is true of the price for accessibility.