

# Adapting Online Instruction for a Learning Disabled Audience

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## **Introduction**

"The most universal quality is diversity" (Montaigne 1588). Human differences are both physical and intellectual. Howard Gardner's theory of multiple intelligences asserts that individuals vary widely with regard to seven dimensions of intelligence: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal and intrapersonal intelligences. The notion that teachers should value students' intellectual diversity, or "differences of mind," has been embraced by educators and applied across the spectrum of educational institutions, from preschool to postsecondary (Smith 2002). If all minds are not the same, then educators must vary teaching practices in appropriate ways. "Rather than starting with a preconceived notion of how students ought to learn, teachers sensitive to intellectual diversity start by investigating how their students actually *do* learn" (Witherell and Rodis 2001, 168). This concept of intellectual diversity is especially relevant to the task of creating a fair climate in the classroom for students who have learning disabilities.

This paper provides an overview of strategies that may be used by academic librarians as they design instruction that will be appropriate for the entire, intellectually diverse range of students in the college classroom. It presents information on characteristics and prevalence of learning disabilities in the postsecondary population. Universal Design for Learning, a paradigm that serves as a useful guide for development of instructional efforts, is discussed. Specific instructional techniques that are effective for students with learning disabilities and/or ADHD and can be implemented as cognitive supports in Web-based instruction are described. Finally, the paper presents Web design strategies that are effective for making online content accessible to the widest audience.

## **Characteristics of Students with Learning Disabilities**

### *Definitions*

Learning disabilities are specific neurological disorders that affect the brain's ability to store, process or communicate information. They include difficulties

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related to processing language (dyslexia), math skills (dyscalculia), written expression (dysgraphia), and fine motor skills (dyspraxia), as well as related visual and auditory information processing disorders. A person with a learning disability may experience a range of problems, such as:

- difficulty decoding and comprehending text;
- lack of organizational skills;
- weak problem-solving skills;
- difficulty with abstract concepts; and
- short and long term memory problems.

(National Center for Learning Disabilities 2004).

Attention Deficit Hyperactive Disorder (ADHD) is a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequent and severe than is observed in individuals at comparable levels of development. Defining characteristics include: inappropriate levels of attention, concentration, activity levels, distractibility, and impulsivity. Individuals with the inattentive type of ADHD have similar problems that impede learning:

- difficulty following instructions;
- working memory deficits that cause students to lose train of thought;
- difficulty reading text with a low interest level; and
- problems planning and organizing written work like research papers, editing for details. (Byron and Parker 2002, 344–45)

Problems with reading, planning, organization, and memory are common to both types of disability. A significant number of those with ADHD also have learning disabilities. In the 2000 National Postsecondary Student Aid Survey, 63 percent of students with ADHD also reported having learning disabilities (HEATH Resource Center, 4). Although Attention Deficit Hyperactive Disorder is a distinct condition, in this paper the term “learning disability” is meant to encompass both the wide spectrum of specific learning-related disorders as well as ADHD.

### *Prevalence and Persistence*

Data on the prevalence of learning disabilities at the college level is not collected on a regular basis. Although the Individuals with Disabilities Education Act (IDEA) requires schools and colleges to provide reasonable accommodations to students with disabilities,

postsecondary institutions are not required to report on enrollment or services to these students. Data on student progress is extrapolated from various research studies and from student or institutional surveys conducted at infrequent intervals (U.S. Department of Education 1999a, iii).

As Izzo and Murray (2003, 29) note, “National data indicate that more students with disabilities are going on to college. The percentage of college freshmen with a disability has more than tripled in 20 years. According to the survey of college freshman conducted by the HEATH Resource Center, the share of college freshmen who self-reported that they had a disability increased from just under 3% in 1978 to over 9% in 1998 ...”

Learning disabilities (LD) are the most common type of disability reported by college students. The National Center for Learning Disabilities indicates that 46 percent of all students with disabilities enrolled at post-secondary education institutions reported having learning disabilities. The prevalence of learning disabilities in college ranges from 38 percent of students reporting disabilities in public 2-year institutions, to 51 percent at public 4-year institutions (NCLD FastFacts 2004).

Harrison (2003, 133) reminds us that not all students with learning disabilities identify themselves as learning disabled, for reasons including social stigma, loss of esteem by professors, and fear that future employers will have access to their record. Some may not know that they have a learning disability. It is important, therefore, for instructors to “be aware that the student who has chosen to identify may not be the only one in the classroom with a learning disability and others may be silently struggling with the course material without institutional support services.”

Although federal legislation and increased support at the secondary level have resulted in increased participation of students with various kinds of disabilities at the college level, longitudinal studies indicate that these students lag far behind their peers with regard to success in post-secondary education and are less likely than those without disabilities to have attained bachelors or associates degrees. In a study completed in 1994, about 53 percent of students with disabilities who enrolled in college persisted in their postsecondary program (received a degree or were still enrolled), while 64 percent of students without disabilities had

done so (U.S. Department of Education 1999b, 37–38; 2000, 2).

More support from college instructors with regard to course design and delivery could help to close this achievement gap and enable more students with learning disabilities to complete degrees. The next sections of this paper discuss a model and some specific techniques that may be adapted by librarians involved in instruction to enhance the accessibility of their online learning resources for this audience.

### Universal Design of Learning (UDL) Theory

Technology is often used to deliver instruction to college students. Most colleges, and many academic libraries, offer Web-based instruction, ranging from tutorials to Web-delivered credit courses. Hybrid courses, where a traditional approach is combined with Web components, are also quite common. Computer-based instructional methods may be particularly appropriate for learning disabled students. Carnagey (2001, 10) describes some advantages that online learning environments offer over traditional instruction for students with difficulty decoding or comprehending text or attention deficit problems:

- Students can adjust the pacing of learning sessions.
- Material can easily be presented in redundant or alternative formats and adapted for various learning styles.
- Students can clarify, rehearse and review supporting materials without interrupting the flow of class.
- Method and rate of communication may be transparent to others in the class.
- Asynchronous communication methods can offer more opportunities for peer collaboration.

The creators of Web instructional content can take important steps to insure that their products are pedagogically sound and accessible to a wide variety of learners. Universal Design for Learning (UDL) is a broad-based instructional strategy that provides a framework for meeting the needs of an intellectually diverse group of students, including the learning disabled. Universal design is a concept that originated in architecture. It encourages builders to remove barriers by designing structures to accommodate a wide variety of differently-abled users without the need for adaptation or specialized design. The premise of Universal

Design for Learning is that learning environments should be designed with such flexibility that students of widely varying abilities have a range of options available to them and can all benefit from the same program. The UDL approach to instruction accommodates different learning styles, provides cognitive supports for learners, and offers alternative forms of assessment.

According to Rose and Meyer (2002, 11), recent studies of brain function demonstrate that three distinct but interconnected types of neural networks contribute to learning in individuals:

- Recognition networks help learners to see patterns and to understand information, ideas, and concepts.
- Strategic networks enable learners to plan, execute, and monitor actions and skills.
- Affective networks permit learners to assign emotional significance and to engage with tasks and learning.

They point out “learners cannot be reduced to simple categories such as ‘disabled’ or ‘bright.’ They differ within and across all three brain networks, showing shades of strength and weakness that make each of them unique” (11). Rose and Meyer also suggest that learners’ capacities are defined by the interplay between their unique abilities and the tools that they use (41). Digital media, which can be adapted for maximum flexibility to suit various needs, are ideal teaching tools because they can be transformed for individuals and make learning accessible to a more diverse audience. For example, students can increase the size of text or slow down the speech pace of aural material. Text to speech programs can read material aloud for students with dyslexia.

A Universal Design for Learning framework proposes that educators strive for three kinds of flexibility described by Izzo and Murray (2003, 32):

- Providing **multiple representations of information** allows students to learn content in their preferred means. For example, placing course content on the web (and ensuring web accessibility) provides a visual avenue of access to information in addition to the traditional auditory form of classroom lecture.
- Providing **multiple means of expression** allows students to demonstrate mastery of course content in a variety of ways, such as allowing a student to take an oral exam instead of an exam that requires writing.

- Providing **multiple means of engagement** allows students more options to choose methods that support their interests and skill levels, such as allowing students to select topics of interest for final projects and allowing them to be creative in how their projects are presented.

### Instructional Techniques for Accommodating Learning Disabilities

The UDL model mandates a flexible approach to teaching, in order to accommodate a variety of student needs. By adopting specific instructional techniques that have been shown to be particularly effective for use with learning disabled students, instructors can accomplish this goal. Swanson's meta-analysis of 272 intervention research studies (2000, 23) reveals that the most effective form of teaching students with learning disabilities combined components of direct instruction (teacher directed lecture, discussion, learning from books) with components of strategy instruction (teaching ways to learn and study skills). The main components of this instructional model include:

- Sequencing
- Drill-repetition-practice
- Segmentation
- Directed questioning and responses
- Control of task difficulty
- Use of technology
- Teacher-modeled problem solving
- Small-group instruction
- Strategy cues

He notes that the components most linked to student achievement are control of task difficulty, use of small groups, and directed questioning. Some of these techniques are discussed in more detail here.

#### 1. Content structure and supports

##### Segmentation

Segmentation involves breaking an instructional task into smaller units and then synthesizing the parts into a whole. A text may be segmented into smaller units and presented along with an advance organizer, to help the student see the relationships of parts to whole. Using an outline format for Web page content (with appropriately numbered headings) can provide appropriate segmentation of larger content blocks and show relationships of parts to whole. Segmentation may also involve presenting several short activities in place

of one longer one. Breaking assignments into chunks that can be completed over a period of time also allows students with ADHD to complete them during the period when they can sustain attention.

Advance organizers, which help to orient students and focus attention at the beginning of a lesson, can perform any of the following functions: (1) state the concepts to be learned; (2) provide relevant background information; (3) explain task requirements; (4) introduce the goals or outcomes for the lesson. Advance organizers can take many forms, including written questions at the beginning of a unit of text, or a graphic organizer (Harrison 2003, 140). Graphic organizers are:

... visual and spatial displays designed to facilitate the teaching and learning of textual material through the use of lines, arrows, and a spatial arrangement that describe text content, structure, and key conceptual relationships ... Graphic organizers include semantic maps, semantic feature analysis, cognitive maps, story maps, framed outlines, and Venn diagrams (Kim et al. 2004, 105).

Researchers have argued that students with learning disabilities have strengths in spatial or visual modes of conceptualization and that visual displays of information, such as graphic organizers, may help these students to organize and recall verbal information, enhancing their reading comprehension (Kim et al. 2004, 106). Mastropieri (1997) also reported a substantial effect of illustrations on reading comprehension of students with learning disabilities. It appears that pictures that graphically display and organize text material; and mnemonic pictures, which are intended to facilitate memory of key vocabulary or important content information from text materials, are most useful.

The Web page shown in Figure 1 provides an example of a graphic/advance organizer used to introduce a tutorial about online searching techniques in *net.TUTOR*, Ohio State University Libraries Web-based instructional program. (<http://gateway.lib.ohio-state.edu/tutor/>)

##### Sequencing

Sequencing involves breaking down tasks and providing step-by-step prompts. Dividing a task into manageable chunks helps to control the difficulty level of learning new skills. Color-coding of instructions

Figure 1: Advance / graphic organizer used in net.TUTOR tutorial

net.TUTOR: Searching 101 - The Ohio State University Libraries

File Edit View Favorites Tools Help

Searching 101 > Overview - Key Ideas

net.TUTOR Home Tutorial Overview | Glossary | Links | Test | Help

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graph TD
    1((1: Prepare  
Identify key concepts, search terms)) --> 2((2: Decide  
Subject or keyword search?))
    2 --> 3S[3: Subject  
Match concepts to database subject list]
    2 --> 3K[3: Keyword  
Identify operators, phrases, word variants]
    3S --> 4((4: Limit  
To focus search results))
    3K --> 4
    4 --> 5((5: Refine  
To expand or reduce results))
  
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Begin the tutorial by clicking the first link, or select any page to review.

1. **Prepare:** Write a sentence describing your search topic, then analyze it to identify key concepts and any aspects (time period, geographic place, etc.) that will focus your search. Identify search words related to each concept.
2. **Decide:** Choose between keyword or subject searching, if both are available in the database. Subject searching will generally produce more focused results. However you must map your concepts to the subject vocabulary used by the database.
3. **Construct:** Build a keyword search statement (start simple). Select Boolean or mathematical operators to connect search terms, identify phrases, and organize complex search statements using parentheses. See this [concept map](#) for an overview.
4. **Limit:** Screen your search results by some variable (language, publication date, etc.). You can limit your initial search statement (pre-limit), or post-limit after reviewing results (recommended approach).
5. **Refine:** It's rare to get good results on the first try. If you get too many results, add new concepts or add limits your search. Too few results? Remove concepts that are not critical, remove any limits.

can help those with a visual sequencing disorder. It is particularly important to provide explicit directions. Harrison (2003, 141) indicates that:

Often students will not understand what various direction words—such as analyze, compare, criticize, define, discuss, evaluate, prove and summarize—actually mean in terms of completing the assignment. Providing a concise explanation of what the students are being asked to do is the surest way to promote their success in doing it. For example, instead of just asking the students to criticize a theory or incident, instruct them to, “give your judgment of both good points and limitations and provide evidence for each.”

### Scaffolds

The ERIC Thesaurus defines scaffolding as: “Temporary support or assistance, provided by a teacher, peer, parent, or computer, that permits a learner to perform a complex task or process that he or she would be unable to do alone—the technique builds knowledge/skills until learners can stand on their own, similar to scaffolding on a building” (ERIC Thesaurus 2004, <http://www.eric.ed.gov>). Masters (2002, 314) writes “The concept arose out of a consideration of Vygotsky’s theories in which he hypothesized that guided interactions with an adult or a more capable peer could assist children to develop at a higher level of operation.” The ultimate goal of scaffolding is to develop student independence through the gradual internalization of the processes that are encouraged

during scaffolded instruction. Provision of scaffolds also addresses student affective needs, providing encouragement and increasing motivation to learn. They are particularly important to students with learning disabilities, who may have a long history of failure at academic tasks, self-doubt of their abilities, and the belief that their efforts are futile.

Scaffolds can be integrated into online instructional materials or provided through person-to-person contact. Izzo and Murray (2003, 37) contend that:

Peer mentoring, cooperative learning, students sharing and discussing their notes in small groups or posting them to a common web site, are all strategies to integrate natural support for learning. In many situations, student-to-student interactions are a more effective teaching tool than even the most dynamic lecture. Offering both a choice of who students would like to work with and the type of product students can use to express their learning engages the affective networks, ultimately increasing the student's motivation to achieve.

Some types of scaffolds that can be integrated into online instruction include:

- examples of quality student work;
- explicit grading rubrics for projects;
- checklists, to-do lists; and
- cell charts, timelines and templates, such as guided notes, for organizing and recording important information.

Guided notes are the skeleton outline that contains the main ideas and related concepts of a lecture or reading, as well as space for students to complete their responses to lecture material. Several research studies have shown that achievement of students with and without mild disabilities improves with use of guided notes. Lazarus (1993) conducted a study of postsecondary students, providing guided notes that included main ideas, related terms and concepts, and numeric or symbolic cues that indicated the amount of information the students needed to locate and write. Scores on tests improved for students using this learning support.

## 2. Strategy instruction

A strategy is a tool, plan, or method used for accom-

plishing a task. A learning strategy is a set of steps to accomplish a particular task, such as taking a test, comprehending text, and writing a story (Beckman 2002). Strategy instruction breaks complex cognitive tasks into smaller steps.

The use of strategy instruction has been shown to be effective in promoting skills such as reading comprehension, listening comprehension, note taking, memory for content, essay writing, and effective test taking ... For strategy instruction to be successful, however, students must be explicitly informed of what strategies are being taught, when to appropriately use them, and why strategy use can facilitate learning success (Harrison 2003, 139).

Strategies are generally concise (no more than seven steps) and contain instructions that begin with a verb and a word directly related to the strategy. A mnemonic is often used to help the learner remember and follow the steps of the strategy (Bursuck and Jayanthi 1993, 184). Mnemonics improve short-term memory by linking new information to information that students already know, helping students to encode information so that it can be retrieved later. They are an effective method for enhancing recall by students with learning disabilities (Access Center 2003). Acronyms (words) or acrostics (sentences) are the most common type of mnemonics.

### Examples

When students are required to use advanced thinking skills, such as determining categories, comparing and contrasting, determining cause and effect, and problem solving, offering explicit strategies will aid the learning disabled students in the class. Minskoff and Allsopp (2003, 277–96) offer a number of good examples of thinking skills strategies.

**LID** is a strategy to help students remember the steps involved in comparing and contrasting:

**List** the items to be compared.

**Identify** similarities and differences.

**Draw** a graphic representation of the relationship (such as a Venn diagram).

Librarians can also construct and teach their own strategies specifically related to effective research skills. Here are several examples:

**PAW** is a strategy for keyword searching, reminding students that the most effective search strategy starts with a few terms and builds complexity gradually:

Perform a search in stages, searching first for important concepts or unique words.

Avoid long phrases, which are less likely to be found.

Watch results for new or alternate terms and incorporate them into your next search.

**BILS** is another research strategy to help students discover useful subject headings for searching in library databases:

Browse keyword search results.

Identify relevant record.

Look at subject headings.

Search using subject terms for more focused results.

### *3. Practice and directed questioning*

Effective instruction for learning disabled students includes guided and independent practice in both controlled and real-life situations until mastery is reached. "Controlled materials are ... relatively free of complex vocabulary and concepts. As controlled materials do not place any additional content demands on the students, they are conducive to initial learning of the strategy. Furthermore, these materials allow for initial success in the program, a factor important for student motivation" (Bursuck and Jayanthi 1993, 195). Guided practice using computer-based materials with feedback components can be very effective for this purpose. Online practice exams with immediate feedback are especially useful for reducing test anxiety experienced by many students with learning disabilities (Banerjee and Brinckerhoff 2002, 29).

For example, librarians might provide practice in Boolean search construction using a simple exercise before turning students loose in search engines or databases that contain a great deal of potentially distracting information on the screen, thus increasing the cognitive load for students learning a new task. For one example of a controlled practice exercise, see the *net.TUTOR* practice activity, "Searching 101: Using Operators" (<http://www.quia.com/pop/10975.html>).

Mastropieri (1997) indicates that "Students with learning disabilities typically exhibit substantial deficits

in reading comprehension, which may include problems not only in remembering the gist, facts, and details of text material, but also in interpreting and making inferences..." Questioning strategies, where the teacher asks process or content questions to help students focus on important ideas, can be an effective tool in assisting reading comprehension.

Directed questioning is useful when students are reading expository texts with especially difficult or new concepts. Ryder (1991, 611) notes that a directed questioning strategy "provides students with a purpose for reading and initiates a process whereby readers begin to monitor their comprehension as they interact with text concepts." The teacher provides content focused pre-questions to set an objective for reading before students read a section of the text. Use of prequestions has several advantages. "First, when text has a high conceptual load, the reader has opportunity to discard information not pertinent to the stated question. Second, prequestions improve students' recall of text information" (610). Teachers may also present questions following the text, which cue students to reflect on particular concepts.

Although this technique is most effective when performed by a teacher who is physically present in a classroom with students, it can be adapted to fit with online instruction in a manner that supports students with learning disabilities. If online group discussion is used, the teacher can use directed questioning in that forum. "Applying a strategy in a collaborative group situation reduces the cognitive effort necessary from each individual" (Ryder 1991, 611) and it allows each group member to observe and learn from others.

Utilizing asynchronous methods for student discussion whenever possible removes the pressure of instantaneous information processing in a course chat room, so that learning disabled students can have time to read and review information before responding. Real time discussion can be challenging for students with learning disabilities (as well as for many international students) because "students with slow processing speed may have difficulty 'jumping into the conversation' at appropriate times to express their views and inquiries" (Banerjee and Brinckerhoff 2002, 31-32).

### **Effective Web Design for Learning Disabled Users**

In addition to employing instructional techniques that

are effective for learning disabled students, instructors can also make their Web content more easily used by this audience and by the entire class. Rainger (2003, 3) identified some particular problems that may be experienced by dyslexic students, including slow visual object recognition and over-sensitivity to light. Also:

Dyslexic students commonly have problems with short term and working memory, structure and sequencing. This can have a huge impact on the accessibility of information, and more broadly the accessibility of information architecture. The effect of short-term memory problems and sequencing can mean an increase in the likelihood of a dyslexic student becoming lost in a hypertext structure.

Slem and Kane (2001, 5–7) studied use of Web-based resources to support learning in a college psychology course. Eighty three percent of students who self-reported having a learning disability were frequent users of Web resources in this course, while only 67 percent of others had a similar use pattern. The learning disabled students reported that use of Web materials increased their sense of control. Web-based learning resources perceived by students as most useful are highly organized, clearly identify key concepts within the text, and provide multiple interactive sample examinations with links back to content for review.

#### *Site Structure*

The use of a breadcrumb trail as a site navigation device helps to give the user a perspective of their location within the site's structure. Rainger (2003, 14–15) reports that:

Generally, it has been found that people make fewer navigational mistakes if the hierarchical structure of the site is broader rather than “deeper.” The reasoning is that “the deeper the level, the more a user has to rely on short-term memory” (Bernard, 2002). This means for people with short-term memory difficulties “deep” complex structures can be confusing as they have further to go (more links to follow) back or forward.

#### *Document Appearance and Structure*

In general, Web pages should have a consistent and

predictable screen layout and an uncluttered appearance to be easily usable by students with learning disabilities. Rainger (2003), Bohman (2004) and Rowland (2004) all provide helpful instruction on creating Web documents that are easy to read and comprehend. These resources will have the following features:

- left-aligned text (not justified);
- narrow column widths and wide side margins, to facilitate easier scanning;
- short, simple sentences (Microsoft Word will provide readability statistics);
- short paragraphs;
- bullets or numbers rather than continuous prose when possible;
- boxes for emphasis or to highlight important text;
- either bold text or a colored background to emphasize keywords and concepts; and
- headings and titles for paragraphs, which increases comprehension. In a study by Bransford and Johnson, participants who read passages with titles recalled approximately twice as many items and had higher levels of comprehension than a control group (cited in Rainger 2003, 9–10).

Rainger (2003, 5) reminds us of the need to provide printer-friendly documents, so that readers with dyslexia, who may take longer to read through large amounts of text, can read pages offline at their own pace.

#### **Use of Assistive Technology**

Students with learning disabilities often use adaptive technology, such as screen reading software. Hecker et al. (2002) found that use of assistive software allows students with attention disorders to reduce distractibility and to read with less stress and fatigue for longer periods. Thus it is important to create online learning resources that can be easily and clearly read using this technology.

- Use semi-colons, commas, or full stops after bullet points in order to separate each point.
- Number menu items to aid navigation.
- Don't write words purely in capital letters, as they may be read as single letters.
- Always punctuate abbreviations (e.g. US should be U.S.).
- Use alt attributes for images especially where they have functional uses (e.g., “link to homepage”).

Also use empty alt (alt="") attributes for presentational images that do not convey any information (Rainger 2003, 11–12).

## Conclusion

Although they comprise a relatively small part of the postsecondary population, the number of college students who acknowledge having learning disabilities is growing, as secondary schools provide more effective supports to enable them to move forward with their education. Recognizing and addressing intellectual diversity in the college classroom will benefit all of the students in the class, not simply those with disabilities. The Universal Design for Learning (UDL) approach asserts that individuals vary widely in ability and that instruction must address these differences to be effective. Segmenting instructional content into smaller chunks, using advance or graphic organizers, sequencing of tasks from easy to difficult, providing scaffolds to assist the learner as needed, presenting strategies that students can use to remember steps in a task, and using directed questioning to focus attention on important content are all important supports for learning disabled students that can be incorporated into online instructional materials. By utilizing a flexible UDL approach to designing Web-based instruction and incorporating these types of supports for students, librarians can create learning environments appropriate for the entire range of student abilities.

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