Universal Design for Individual Differences

Applied to instruction, the principles of universal design can guide the development of educational tools to accommodate the diverse needs of all students, including those with disabilities.

No two brains learn the same way. The winning essays of a Boston Sunday Globe contest in which students described how they learn ("Ten Students Share," 2000) revealed a wide range of personal learning styles.

The student essayists showed individual preferences for how they acquire information and the types of learning they most enjoy. One student described her use of "mental images," and another his reliance on "touching, doing, and moving" for learning. Still another explained drawing "mind maps," varying color for each topic and then recalling the maps when he needed the newly learned information. Other favorite learning strategies included writing definitions, making acronyms, participating actively in class, and practicing new skills.

These students' insights illustrate the unique nature of each person's learning style. Positron emission tomography (PET) studies have confirmed that brain activity occurs in roughly the same areas for most individuals performing a given task but that each individual has a unique signature of brain activity for that task (Meyer & Rose, 1998). Teachers have learned from experience that students' learning styles differ by various strengths, weaknesses, and intelligence types (Gardner, 1983). Each learner's unique preferences, abilities, and disabilities determine how he or she learns best.

Teachers are now facing classrooms of students with a wider range of diverse learning styles than ever before, mostly because of expanding class sizes and the inclusion of students with disabilities in mainstream classrooms following passage of the 1997 Individuals with Disabilities Education Act.

For 12 years, the Center for Applied Special Technology (CAST) has conducted research on ways to use technology to expand opportunities for diverse learners, including students with disabilities, and has found that the principles of universal design, drawn from architecture and product development, are useful for developing effective educational tools. Architects applying the principles of universal design create structures that accommodate the widest spectrum of users possible, including those with disabilities. In universally designed environments, adaptability is subtle and integrated into the design.

Designing for the divergent needs of "special" populations increases usability for everyone. The classic example is the ramped curb cut. Originally designed so that those in wheelchairs could negotiate curbs, ramped
curb cuts now ease travel for people using canes, pushing carriages, riding skateboards, or just walking.

Universal Design for Learning (UDL) (Meyer & Rose, 1998) extends these universal design principles to create a new paradigm for teaching, learning, and developing curriculum materials, and to the process changes old assumptions about learning and teaching in four key ways.

- Educators can now see students with disabilities along a continuum of learner differences rather than as a separate category.
- Teacher adjustments for learner differences can now occur for all students, not just those with disabilities.
- Curriculum materials can now be varied and diverse and include digital and online resources rather than just a single textbook.
- Curriculums can be more flexible and accommodate a wider range of learner differences. Instead of providing remedial help to students so that they can learn from a set curriculum.

The development of UDL learning tools and teaching strategies requires an understanding of the ways learners may differ. In developing UDL methods and materials, CAST has examined individual differences within a framework suggested by recent neurological research, such as the work of Richard Cytowic (1996).

CAST uses a framework of three spatially and functionally distinguishable brain systems: the recognition system that identifies patterns, the strategic system that generates patterns, and the affective system that establishes importance and fuels motivation. Each system is marked by a set of educationally relevant characteristics that vary among individuals. For each system in the learning brain, different media can flexibly accommodate specific kinds of learners.

**Recognition Systems**

Recognition systems constitute the part of the brain that identifies patterns, such as objects, voices, faces, letters of the alphabet, and words, as well as more subtle patterns, such as author style and nuance. Recognition processes occur in the back half of the brain— inclining the occipital, parietal, and temporal cortices—but not in any one place (Farah, 2000). For example, PET studies have shown that recognition of the letter A in text involves different processing areas for recognizing color, shape, orientation, and location. These processes occur simultaneously, in parallel processing.

Parallel processing allows for quick recognition of complex material. Learning to recognize color, location, orientation, or shape within a larger sensory disability, like blindness, both of which may limit learners in their ability to successfully acquire information from traditional technologies like text.

To adjust for individual recognition systems, the UDL framework develops curricular materials in many media so that learners can select one or more ways to approach the subject matter: Text, images with no text, images with text, voice, animation, video, or a sequence of sounds can effectively convey a series of events. Some patterns transcend media and can be taught in whatever medium most suits the learner. For example, when teaching about the Chinese dynasties, a teacher can adjust media according to learner needs because there is nothing inherent in the subject matter to suggest that one medium would be more appropriate than another. Different media options help students highlight, practice, and apply the pattern in various contexts.

Consider Patrick, a 6th grader whom teachers describe as "a great kid." A hard worker with a generally happy disposition, Patrick seems to enjoy school, although his teachers described his elementary and early middle school work as "classic dyslexic: atrocious spelling, missed vowels, disjointed thoughts." Patrick has received tutoring help and some special education, but he still has difficulty reading and conveying what he knows in writing.

At the beginning of middle school, Patrick faces a curriculum shift. With increasing frequency he will need to read for meaning and to convey clearly in written tests and essays his understanding of the material. Further, the reading material in middle school will be longer and more complex. Patrick's
teachers must find a way to help Patrick meet their curricular standards and continue to find school engaging.

Patrick’s dyslexia makes reading difficult. He has difficulty reading continuous text even after remedial help in decoding and reading fluency. The current draft of the Massachusetts English Language Arts Curriculum Framework (2000), however, specifies that 6th grade students must be able to “analyze several works about or by one author in order to enrich understanding of the author’s work” (p. 26). Because the standard addresses comprehension, Patrick’s teacher can structure Patrick’s assignments to focus on comprehension rather than on decoding.

Software that reads text aloud on request can augment Patrick’s decoding skills. Kurzweil’s Omni 3000, Arkenstone’s WYNN (What You Need Now), and CAST’s eReader are software tools designed to support learners of all ages who may lack the skills or ability to read text independently. Using a flat-bed scanner, users can scan text, such as a Harry Potter book, into the CAST eReader, which can then visually highlight and/or “read” the text using synthesized speech. This flexible reading tool enables Patrick to shift his attention from the process of decoding to the issues of author style, thus supporting his ability to meet the same curriculum standard as his peers.

Strategic Systems

Strategic systems constitute the part of the brain that generates such patterns as speaking, shooting a foul shot, reading a book, writing a paragraph, planning a trip, or taking steps (Fuster, 1997). These systems are situated in the anterior half of the brain, in the frontal lobes. Like the recognition systems, the strategic systems are divided among smaller subsystems that work in parallel. Knowing how to perform a task does not occur within a single process, but in a cluster of processes. Individual differences within the frontal networks account for much of the variation in students’ fine motor skills, physical coordination, planning, organizing, strategic thinking, and expression.

Learners differ dramatically in their ability to acquire and automate routines, such as forming letters, typing, spelling, multiplying, planning, organizing, monitoring progress, devising strategies, and seeking help when needed. Students with motor difficulties may have difficulty using a keyboard or mouse. Students with speech difficulties may be unable to present their ideas orally. Those with language and learning difficulties may find that they allocate so much energy and attention to the mechanics of producing written text that it is difficult to communicate effectively in that medium. Likewise, a brilliant musician may produce a merely adequate written paper but excel at composing a song in response to an assignment.

Using the UDL approach, multimedia and the Internet can bolster flexible learning supports and opportunities to practice skills. Feedback that is individualized, substantive, and relevant is difficult to automate on the computer, but students can use various tools to monitor their own learning effectively. For example, a student practicing word decoding can record herself reading the word, play the word being read aloud correctly, and compare it to her own recording. Drawing and other graphic tools can adjust to different learners’ strategic systems and help students generate ideas and visually organize their work.

Let’s reconsider Patrick’s case from the point of view of strategic systems. Patrick tends to get distracted and lose track of his goal while completing tasks, and he has difficulty monitoring his own work. The Massachusetts History and Social Science Curriculum Framework (1997) presents Patrick’s social studies teacher with this standard:

Students will acquire the ability to frame questions that can be answered by historical study and research; to collect, evaluate, and employ information from primary and secondary sources and to apply it in oral and written presentations. (p. 6)

Many students might use the Web to meet this standard, but Patrick’s difficulty with important strategic search skills, like planning and organizing, is likely to derail his research efforts. Spelling and writing errors may also interfere with accurate searching, and poor reading skills may make Web sites or text inaccessible or too cumbersome.
to navigate. Without careful attention to these potential barriers, Patrick and other students with disabilities continue to fall behind their peers.

To make the Internet more useful to middle school students with learning disabilities, CAST is researching and developing a suite of software tools called eTrekker. The software from this privately funded CAST project will provide a supportive environment in which students can plan, conduct, organize, and evaluate searches for information on the Internet. The eTrekker has several features designed to meet Patrick’s challenges.

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- The eTrekker software asks students to enter information about their projects—including names, due dates, and specific questions—to help guide the students’ searches. This information is visible throughout all phases of the research and helps students stay on task.

- The eTrekker makes a spellchecker, dictionary, thesaurus, and encyclopedia available to help students spell key words, check resources for additional key terms, and define unknown words.

- Working in conjunction with the eReader, the eTrekker provides a notepad for taking notes on information found during the search and text-to-speech capability for reading support. Patrick can focus on content without being slowed down by the reading process. Further, Patrick can keep track of his research by copying and pasting relevant information onto the notepad while the program keeps track of the information’s site of origin.

**The Affective Systems**

The affective systems are found in the core of the brain—in the cortical and subcortical structures usually associated with the limbic system—and are responsible for such feelings as craving sugar, fear, heights, or experiencing happiness (Damasio, 1994). How individuals allocate their attention depends on what attracts, motivates, and engages them. A task, book, or teaching approach may build competence and confidence in some students while frustrating and boring others. Students learn for many reasons, including positive feedback and fascination with the material. The reasons students do not learn include little feedback or encouragement, chronic failure and withdrawal of effort, inappropriate level of challenge, or lack of personal relevance of the material presented.

Just as other parts of the brain learn from practice, the affective systems learn patterns of emotional response from experiences over time. Past experience teaches us to repeat activities that give us pleasure or satisfaction and to avoid the ones that cause pain, boredom, or humiliation. Over time, experiences that do not engage learners can erode their willingness and ability to work and persist in school.

Because students learn for many different reasons, teachers need to have multiple approaches for engagement available. Again, technology can help, provide the necessary adjustability. A flexible use of media can support all learners’ interests by varying content and teaching materials. To account for different degrees of interest in the subject matter, teachers can provide varied content in a single Internet exercise, allowing students to pursue their unique interests within a structured framework. For example, in a mathematics exercise, students could select content according to their personal interests and work with numbers in the context of their choice.

How can a teacher design a curriculum for individual differences in affect and motivation? Let us look again at Patrick, who as a 6th grader is a healthy, happy, engaged preadolescent. The picture was less positive, however, when Patrick was entering 3rd grade. Recently identified with a learning disability, Patrick was behind his classmates in every subject. Frustrated by school, Patrick often acted out and was identified as the class clown by his peers. Even though his parents and teachers provided him with appropriate remedial support, Patrick was difficult to engage in the classroom. He had become used to failing and resisted situations that reminded him of it.

Early in the school year, Patrick’s class prepared for a field trip to visit Fenway Park and to meet some of the Boston Red Sox team members. His excitement was evident as the date of the trip approached. For the first time in a long while, Patrick was interested and engaged in classroom activities. For show-and-tell he brought in a foul ball that his father had caught for him the previous summer. His description to the class of the events of that day was eloquent and lengthy. He began counting down the days to the trip, and his teacher encouraged him to mark the days on the classroom calendar for everyone to see at the beginning of the school day.

When the class finally went on the trip, the teacher was amazed at Patrick’s extensive knowledge of baseball and his level of participation in the day’s events, so the teacher decided to use Patrick’s interest throughout the year to help him
stay engaged. As the year progressed, Patrick and his teacher created a Web site for the baseball information and projects Patrick had completed both independently and with his classmates. At the end of the year, Patrick felt a great sense of accomplishment and success.

Helping All Learners

As we face infinite variations in learning styles and performance levels in the classroom, understanding learner differences in the three brain systems helps us see that disabilities fall along a continuum of differences rather than constituting separate categories calling for separate kinds of teaching materials and methods. Understanding these three brain systems also helps us understand the specific kinds of flexibility needed to adapt to diverse students. Universal Design for Learning accommodates variations in background, learning styles, abilities, and disabilities by providing flexible materials and learning experiences that suit the learner and maximize his or her ability to progress.

New technologies, especially computers and the Internet, can augment and streamline a teacher's ability to give students timely, personalized, balanced, and varied attention. The UDL framework offers ways to adjust to the needs of all students, including those with learning disabilities, visual and auditory impairments, physical disabilities, and diverse learning preferences (Meyer & Rose, forthcoming).

Whether curriculum consists of text, sound, pictures, motion, or a medium not yet imagined, it must accommodate all learners and allow them the opportunity to succeed according to their personal learning styles. As one Sunday Boston Globe essayist with a learning disability noted, "Through harnessing your strengths and teaching yourself the methods that work best for you, you can do anything" (2000, p. M6).  

References


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