Assistive Technology, Universal Design, Universal Design for Learning: Improved Learning Opportunities

CHUCK HITCHCOCK
SKIP STAHL
National Center on Accessing the General Curriculum
Center for Applied Special Technology

This article addresses the benefits that are likely to derive from shifting focus to developing and implementing a universally designed curriculum. It considers the goals for learning, the learning materials, the instructional methods, and the learning assessments. Benefits are expressed in terms of improved access, participation, and progress in the general education curriculum. Some of the forces that support Universal Design for Learning (UDL) and possible barriers are addressed, as well as appropriate uses of technology within educational learning environments. Assistive Technology (AT), Universal Design (UD) and UDL are briefly defined and pointers to additional resources are included.

INTRODUCTION

David Rose, Co-Executive Director of the Center for Applied Special Technology (CAST), recently offered the following introduction to a series of recommendations that aligned the No Child Left Behind Act [NCLB, 2001] with the 1997 amendments to the Individuals with Disabilities Education Act [IDEA ’97]. His thoughts provide a fitting introduction for this paper.

The Secretary of Education recently released four principles for guiding the reauthorization of IDEA – principles that closely align the IDEA with the framework of No Child Left Behind. This emphasis on the alignment of special education with overall educational reform is important both for the education of students with disabilities, and for the education of all students.

In the past, the standards, curricula, and accountability systems of special education have been notably separate from the standards, curricula, and accountability systems of regular education. In recognition of the weaknesses inherent in this separation, the 1997 IDEA amendments called for evolutionary change: special education students must have access, participate, and make progress in the regular education curriculum, and be evaluated within its accountability systems. With the movement to higher standards and accountability that underlie NCLB, these advances must apply to students with disabilities as well.

But there is a major impediment to achieving high standards and accountability for special education students within the general curriculum – the general curriculum is simply not designed for those students. In fact, students with disabilities have generally not been included during any phase of their design, research, development, adoption, or validation. As a result, most general curricula are demonstrably ill-suited to achieve or measure results for students who have disabilities. Students find barriers rather than supports for learning, and teachers find tools that are too poorly designed for teaching all of their students effectively.

To achieve the Secretary’s goal of NCLB, and particularly to extend NCLB to include students with disabilities, the general curriculum must be strengthened. It must be strengthened by making it fully accessible to all students, and by including within it the research-based practices that will achieve results for students who have disabilities. Such a curriculum is universally designed.

A universally designed curriculum is one that has been designed, from the outset, to achieve such results. A universally designed curriculum is a curriculum that has been specifically designed, developed, and validated to meet the needs of the full range of students who are actually in our schools, students with a wide range of sensory, motor, cognitive, linguistic, and affective abilities and disabilities rather than a narrow range of students in the “middle” of the population. Such a curriculum is essential not only to align NCLB with IDEA, but to achieve the laudable goals of both. [Rose, 2003, p.1]

Universal design for learning (UDL) has much to offer
educators and their students. This manuscript was written with the hope that it will interest other educators in the UDL approach and that these educators may offer to extend the National Center for Accessing the General Curriculum's (NCAC) thinking about how best to apply the UDL principles and practices to improved access, participation, and progress in the general education curriculum for all learners – especially those with disabilities. Educators are encouraged to join NCAC as it continues to think about the tools, techniques, and content required to develop and implement such a curriculum. They are encouraged to help generate and test new solutions to the long standing problem of an inflexible and non-supportive curriculum at all levels of education.

**Barriers to Access and Learning**

Anyone who visits schools on a regular basis will easily discover barriers to access, understanding, skill development, strategy development, and performance. In many schools, the role of the special educator is to develop and help implement various accommodations and modifications to the curriculum to reduce its barriers so that it will better fit the needs of individual students. This is not to say that these barriers impede learning and progress for the majority of students. Nor is it implied that the barriers were erected with the purpose of doing harm to children and adolescence.

Other barriers are relatively new. Most new technologies that have been introduced to schools within the past 25 years lack the features that would make them usable by all students, especially those with sensory, cognitive, and physical disabilities. For example, the content of the World Wide Web is used more and more each day by educators and students, and it contains significant barriers even though most current browsers have been designed to be reasonably accessible. For the World Wide Web to be truly usable by all, the physical computer, the operating system, the browser, and the content that the browser renders must be designed to be accessible to all, right from the start.

Additional barriers exist outside of the school itself. Present policies and procedures for developing and obtaining materials appropriate for use by all students are archaic and inefficient. For example, publishers are just beginning to consider the manufacture and distribution of accessible digital versions directly to students in much the same way they do their print versions. At the present time they must depend upon independent third parties to render the printed books accessible. The current process ensures that there are no financial incentives to the publisher for facilitating the process of getting materials to students who need them, or for improving the quality of their original materials for students with disabilities.

Schools cannot get accessible versions of their curricular materials from the same sources as they obtain their regular materials. Instead, they must turn to other agencies and organizations that specialize in re-publishing accessible versions, or they must create them themselves. This process imposes a delay that results in materials arriving late, if at all, in classrooms.

Even when available, educators struggle to use accessible digital materials due to complexities in formats and technologies. One approach for educators is to determine a format that is appropriate for the student(s) and compatible with the existing classroom technology and then find a vendor that can supply it. Or, educators can accept the format provided to them, adapt their classroom technologies to that format, and then find training in how to use it effectively within their classrooms. Either of these is unnecessarily complicated, adds to the delay in delivery, and diminishes the quality of the content.

Some barriers have existed for so long, that most educators no longer even see them. Further, some educators have grown accustomed to viewing many barriers as obstacles to be overcome by those who are willing to try just a little harder. Unfortunately, many educators fail to see the difference between the types of learning challenges that improve learning opportunities for most learners while serving as significant barriers to learning and performance for so many others.

**Defining the Problem**

In addition to problems with educational materials, current thought about the purpose of special education may need to change. Traditional special education was designed to provide specialized educational services to achieve what too often was a set of goals that differed from those of general education. Today, special education services align the skills and abilities of students whom are perceived to be different than most learners within the existing general education curriculum. The student is at the center of defining the problem, although it is becoming apparent that the barriers that exist within the general education curriculum itself are what need to be examined and minimized (Hitchcock, Meyer, Rose & Jackson, 2002). To achieve this goal, materials, methods, and assessments must be designed from the start to be flexible and supportive of diverse styles and abilities.

**An Analogy**

To examine the problem from another perspective, consider what driving would be like without windshield wipers. Most of the time mobility goals could still be accomplished without difficulty, but not when it rained or snowed. For those individuals who needed to travel during inclement weather, accommodations might be developed — various devices and/or services that would help them...
overcome the problems associated with poor visibility. Individuals might call their local poor visibility travel assistance provider and request assistive technology service in the form of an expert who would perch on the roof and manually move a squeegee back and forth across the windshield. The luxury models might include a heat source to help melt ice and snow.

Following an inevitable history of medical disasters, automobile manufacturers might add handholds and straps on the hood or roof designed to secure the human support person and minimize the danger of a roll-off incident. A combination of various assistive devices and services would clearly serve to improve visibility and safety — at least for the driver and passengers within the car.

Another approach might be to require that all traffic slow to 10 miles per hour during rain or snow — to reduce the danger involved with driving under such conditions. Bumping into something might then be less consequential. This, too, would be considered an accommodation as it would not substantially alter the goal of reaching point B; it would just take a bit longer. Reduced speed and special devices and services would solve the problem for some, but not for all — especially for those who must commute 50 miles to work each morning. And imagine the inefficiency of such solutions with regard to time and cost.

An alternative solution would be for individuals to replace the usual drive to the office with a 10-mile drive to a co-workers home office on bad weather days. This approach does alter the goal of getting to point B and would therefore be a modification. By most standards, achieving 20% of the distance is not great, but it does imply some effort was made to achieve the goal. Unfortunately, the goal selected, normal distance traveled, is somewhat tangential to the more fundamental concern about individual's productivity on inclement weather days.

**UNIVERSAL DESIGN AND AUTOMOBILES**

A car that is universally designed considers the problems associated with rain and snow right from the start. Such a car has electric windshield wipers and a heater with a blower that directs airflow against the inside of the windshield to melt snow and ice. It might even include various controls for the air and rate of movement of the wipers depending upon the conditions. The controls provide the flexibility needed to cope with various driving conditions and differing personal requirements right from the start. Short of that, each is left to develop his or her own methods for overcoming the barriers associated with automobile travel during rain, snow, and ice conditions.

Today, the general education curriculum is quite similar to an automobile without wipers. It requires special accommodations, modifications, supports, and add-on devices to overcome the barriers in the goals, methods, materials, and assessments.

**A Universally Designed Car**

Seats slide and reshape to varied bodies; steering wheels may be adjusted for height; pedals can be adjusted in some cars; some automatic transmissions can be controlled manually; radios offer adjustments for volume, station selection, bass, treble, balance, and more. Controls for headlights, windshield wipers and cruise control are usually clustered around the steering column for ease of use.

So why do people have to pass vision and road tests to drive? Cars that are truly universally designed would include automatic navigation and safety controls usable by everyone. But cars, like books, function primarily in a fixed context and for cars, it may be a few years before Global Positioning Systems, object detection systems, embedded electronic road guide wires, and voice controls can provide reliable safety for drivers without vision or mobility. Then there will be a truly universally designed car.

**ASSISTIVE TECHNOLOGY**

Assistive technology is defined by IDEA '97 [2000]. The law defines assistive technology and the related terms assistive technology device and assistive technology service.

The term assistive technology means technology designed to be utilized in an assistive technology device or assistive technology service. Device and service are also defined:

1. Assistive technology device: The term assistive technology device means any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities [20 U.S.C. §1400(1)].

2. Assistive technology service: The term assistive technology service means any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology device [20 U.S.C. §1400(2)].

Where assistive technology is appropriate, it is especially important to provide supports for training, and recommendations for funding during the transition from high school to postsecondary education [Mull & Sitlington, 2003]. For many students, waiting until high school may be too late since such supports may be necessary for success in elementary, middle and high school and may determine what accommodations may be provided during high stakes testing.

The CAST Web site offers the following with regard to current and future uses of assistive technology:

Assistive technologies will always have a role in the education of learners with disabilities. Children with physical or language disabilities need properly designed
wheelchairs, adaptive switches to control devices, or speech synthesizers. Universal design for learning will not eliminate the need for personal assistive devices.

However, exclusive emphasis on assistive technologies places the burden of adaptation on the learner, not the curriculum. The idea that students must procure or "be prescribed" special individual tools whenever they cannot use standard curriculum undermines learning for everyone. Exclusively print-based tools and methods, uncaptioned videos and software, undescribed images and posters, create barriers for some learners and limit options for everyone.

The assistive technology model assumes that a printed curriculum is a given and provides tools to support individual access to it. Tools — such as a video enlarger — are not integral to the curriculum, but rather, are associated with the individual students who need them; they are simply a means to helping these students overcome barriers in the curriculum. The assumption that students must obtain individual tools in order to overcome barriers in an inflexible curriculum is inherently antithetical to UDL.

Universal Design for Learning looks not to the student but to the curriculum itself. The underlying assumption is that by using flexible media, options can be embedded within the curriculum so that adjustments may be made to meet the needs and preferences of each learner. This built-in flexibility reduces, but does not eliminate, the need for assistive technologies. Students with visual difficulties who access the computer via screen magnification will still need their tools. However, the role of assistive technologies and the way people view them will shift as UDL curricula become more available.

As the concept of UDL gains acceptance, people will understand that assistive technologies are tools like eyeglasses and personal digital assistants that enhance personal effectiveness; they do not relegate their users to a separate category such as "disabled." Already, some of these devices, once solely linked to disability, are working their way into the mainstream community. For example, speech recognition technology is applied in voice-activated cell phones, airline reservation systems, banking systems, and sometimes installed in automobiles.

**Universal Design**

The Center of Universal Design at North Carolina State University defines UD as 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. Seven basic principles are provided by the Center:

1. **Equitable Use:** The design is useful and marketable to people with diverse abilities.
2. **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.

3. **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.
4. **Perceptible Information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. **Tolerance for Error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. **Low Physical Effort:** The design can be used efficiently and comfortably and with a minimum of fatigue.
7. **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. (Center for Universal Design, 1997)

Numerous attempts have been made to apply the seven UD principles to learning and assessment, but they simply are not a good fit. Similar to curriculum and assessments that were designed without consideration for the needs of individuals with disabilities in mind, the foundational UD principles appropriate for architecture and possibly for computer hardware, software, media, and communication devices do not generally work well when applied to learning. They were not developed with learning in mind. It seems quite likely that the foundational UD principles will need to be extended to apply to education, the arts, selected technologies, communications, social environments, and more. UDL is one such effort.

**Universal Design for Learning**

Universal Design for Learning extends the concept of universal design to the field of education. It denotes the process of creating general education curricula (including the standards, materials, methods, and assessments of which they are comprised) that are conceived, designed, developed and validated to achieve results for the widest spectrum of students, including those with disabilities, without the need for subsequent adaptation or specialized design. Universal Design for Learning provides curricular flexibility (in activities, in the ways that information is presented, in the ways that students respond or demonstrate knowledge, and in the ways in which students are engaged) to provide appropriate support and challenge for a typically diverse spectrum of learners. UDL concepts are also used to individualize instruction.

Rose and Meyer (2002), authors of Teaching Every Student in the Digital Age: Universal Design for Learning, explain that that our students have many kinds of intelligence and many ways of learning. Further, they describe how specific techniques matched to the principles of Universal
Design for Learning can support diverse learners. For example, to support recognition learning, teachers should provide multiple, flexible methods of presentation. To support strategic learning, they should provide multiple, flexible methods of expression and apprenticeship. To support affective learning, teacher should provide multiple, flexible options for engagement. These three categories of support provide the foundation for the three principles of UDL. Methods for implementing the principles are described in the text which may be freely accessed online at http://www.cast.org/teachingeverystudent.

A Universally Designed Curriculum

Today, a UDL curriculum cannot be purchased. UDL goals, methods, assessments, and materials offer ways to think about planning, methods for developing appropriate goals that do not confound the ends with the means, ways to enhance learning with strategy instruction, ways to develop and obtain accessible learning materials that are usable by all students, and methods for providing assessments that are accessible and appropriate for all learners.

UDL is quite similar to defensive driving – it’s a way of thinking and acting. Most drivers don’t practice it all of the time but, more is better. It’s clearly not something that can be purchased unless a large SUV is considered a significant part of a defensive driving strategy. When UDL is practiced consistently, opportunities for improved outcomes are enhanced.

Assistive Technology, Universal Design, and Universal Design for Learning

The automobile analogy was not intended to imply that accommodations, modifications, and assistive technologies will be completely replaced by a universally designed curriculum. Where universal design is appropriate, it can be far more cost effective and efficient than retrofit solutions, add-on technologies, accommodations and modifications. Universal design may not always be appropriate or necessary, and other solutions may continue to prove useful in school environments.

Whether developers and publishers will agree on standards that might make universally designed products usable by all learners is one question which has yet to be resolved. Most software developers do not even consider accessibility, so denied access is often the norm. Microsoft has made significant progress in developing accessible operating systems and productivity applications, but Apple, SUN, and many software developers have created their own approaches. This may be fine if computer users plan to use the same operating system all of the time and a small number of applications. But where some accessibility is supported, navigation, content display controls, keyboard shortcuts, and other access features are often specific to a developer or even a specific application. Standards for accessible products could solve this problem, but, in the meantime, assistive technology applications that are usable and behave consistently when used to access various operating systems, applications, and content remain desirable and useful.

Typical assistive technologies include screen readers, refreshable Braille display, screen magnifiers, adaptive keyboards, voice recognition software and single switches. A new guide from the WGBH National Center for Accessible Media (NCAM) distinguishes between products that are directly accessible and those that are compatibly accessible and designed to be used with assistive technologies through various software hooks (Freed, Rothberg, & Wlodkowski, 2003).

Within the curriculum, the solutions to accessibility are typically dealt with using a combination of hardware and software. In some cases, this is completely appropriate since these can act directly upon the core content and activities of the general educational curriculum without undue accommodation or modification. In other cases, time and resources must be devoted to improving access, participation, and progress by means of extensively adapted materials.

In school environments today, assistive technologies, universal design, and UDL must co-exist, since no single solution provides all of the accessibility and supports necessary for learning.

Role of Technology

The use of technology provides clear advantages to those who wish to provide flexible, supportive, and adjustable learning and productivity experiences to all learners. Although learning with a computer may suggest a focus on short-term specific outcomes to some, others have focused on long-term outcomes where computers play an active role in people’s view of learning, content, and tasks. Keeping an eye on the transformational qualities of technology, how a classroom learning environment may evolve over time, will quite likely require a close look at the attributes of the teacher who is in charge. Those who are less didactic see the computer as a tool for accomplishing a predetermined end, believe that their students can succeed, and are willing to explore alternatives to current practice are most likely to successfully integrate technology into the curriculum (Labbo & Reinking, 1999). It seems likely that general and special educators with these same qualities will determine how best to implement UDL using both technology and more traditional solutions.

Effective Classroom Practices

Universal Design for Learning is not a replacement for effective classroom practices. Educators who are interested in learning about classroom practices designed to provide
support to individual learners within inclusive environments may be interested in overview documents that have been posted to the NCAC Web site. The selection of these classroom practices was based on reviews of effective practices known to be suited to inclusive learning environments [King-Sears, 1997]. The following documents will be supported with additional information related to UDL:

- Explicit Instruction,
- Differentiated Instruction,
- Curriculum-Based Evaluation,
- Peer Mediated Instruction and Intervention,
- Classroom Management, and
- Strategic Instruction.

**Curriculum Enhancements**

The following documents from the NCAC Web site provide information about a number of technology related curriculum enhancements that can support the implementation of UDL in the classroom:

- Anchored Instruction,
- Modified Text,
- Text-to-Speech,
- Manipulatives,
- Virtual Reality/Simulations,
- Technology Tools,
- Concept Maps, and
- Models.

In general, teachers who plan for individual differences from the start may have a natural inclination towards UDL. A recent study of special educators indicated that effective special education results from knowledgeable, reflective, and concerned responsiveness of a teacher to individual students. The study also noted that effective teaching did not result from a particular method or approach but from complex knowledge and concern that focused attention on academic, behavioral, emotional, and independence needs of students with disabilities [Stough & Palmer, 2003].

As the design of the curriculum is increasingly driven by external factors such as standards and high stake testing [Nolet & McLaughlin, 2000], it is necessary to closely examine the impact on general education methods and materials. It clearly makes sense to focus attention on agreed-to standards and goals, but the methods and materials that are employed may create additional barriers to improved access, participation, and progress within the general education curriculum for diverse learners. In addition, it is necessary to not lose sight of the importance of focusing on competency enhancement with individual students during consideration of the development and implementation of assessment and intervention strategies [Ysseldyke, 2001]. The role of special educators will continue to become more complex as they are required to provide remediation while supporting both skill and content learning. In time, it will become clear that a universally designed curriculum will extend the reach of general educators while providing opportunities to redefine the role of special educators [Hitchcock, 2001].

There are clear differences between traditional and emerging approaches that may be effective for improving learning opportunities for diverse learners within inclusive classrooms. The information in Table 1 may provide a starting point for discussions between special and general educators.

**Further Research Recommendations**

Much remains to be learned about the design of products and approaches that implement the principals and advantages of AT, UD, and UDL for improved learning and assessment outcomes. On the other hand, little of what is already known has been implemented on a consistent basis by educators and those who develop curriculum standards, methods, materials, and assessments. During this era of standards-based reform, the most pressing research questions pertain to what is known and needs to be known about aligning curriculum methods and materials to standards and how best to implement the multiple applications of AT, UD, and UDL to ensure improved learning opportunities for students within disabilities. A small set of useful research questions with four categories might include:

Regarding Curriculum Materials and Tools
1. What media are transformable, such as print to speech, in ways that promote understanding?
2. What types of information are best provided in multiple representations?
3. How can multiple media be used to effectively demonstrate learner skills and knowledge?
4. To improve learning, when should switch controls be built into software rather than added later using 3rd party software tools?
5. For whom does having choices and being (or feeling) in control make a difference?

Regarding Student Learning Activities
1. When using text-to-speech supports with synchronized highlighting, do learners track the text word by word?
2. When does improved access to information actually create barriers to progress and learning?
3. Can text-to-speech with synchronized highlighting lead to improved reading abilities?
4. What strategies should be embedded in digital text environments to enhance understanding?
5. How can we determine the right balance of challenges and support for individual students?
6. How should novelty be introduced to diverse learners to increase engagement?
## Table 1.
### Summary and Comparison of Traditional and Emerging Approaches to Improving Learning

<table>
<thead>
<tr>
<th>Topic</th>
<th>Traditional Approach</th>
<th>Emerging Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Learning Goals</td>
<td>(a) Often determined by education publishers. (b) Complex, indicating specific methods for achieving goals (e.g., write an essay about XYZ in cursive handwriting). (c) Different goals were used for students with disabilities.</td>
<td>(a) Goals are aligned to state standards and local goals. (b) Modified by local educators if necessary for small %age of learners. (c) Focus on a skill or knowledge and not the method for demonstration. (d) High expectations for all. (e) Apply to all learners.</td>
</tr>
<tr>
<td>2. Instruction</td>
<td>(a) Focus on frontal oral presentation with frequent directions for completing learning tasks. (b) Aims to meet needs of mid-50% of the class population. (c) Development of skills and knowledge are separated.</td>
<td>(a) Multiple modes of presentation with diverse abilities, interests, backgrounds always kept in mind. (b) Differentiated from the start for diversity. (c) Basic skills embedded in content learning tasks.</td>
</tr>
<tr>
<td>3. Curricula Content</td>
<td>(a) Fixed, single format and therefore inflexible and generally used for a narrow range of objectives. (b) Typically text with images. (c) Limited use of multimedia. (d) Usually has single topic focus.</td>
<td>(a) Flexible and accessible digital materials providing multiple views. (b) Multiple representations and/or transformable media. (c) Interdisciplinary orientation will be made possible by semantic markup of digital content.</td>
</tr>
<tr>
<td>4. Learning Activities</td>
<td>(a) One size fits all course requirements. (b) Usually written expression. (c) Content provided by lecture and textbooks. (d) High level of frustration for many individuals.</td>
<td>(a) Options provided up front. (b) Multiples ways to express and demonstrate learning. (c) Multiple content sources used for group projects. (d) Appropriate balance of challenge &amp; support.</td>
</tr>
<tr>
<td>5. Use of Time</td>
<td>(a) Fixed time limits for specific tasks and activities. (b) Day organized into rigid and brief subject area time blocks. (c) Many experience extremes of boredom or frustration.</td>
<td>(a) Flexible use of time with opportunities to complete work during and after school. (b) Day can be organized by staff with strong focus on achieving objectives.</td>
</tr>
<tr>
<td>6. Use of Technology</td>
<td>(a) Used for drill and practice for students who have “fallen behind”. (b) Used as method to overcome barriers that should be eliminated. (c) Limited use for research and expression.</td>
<td>(a) Used as a tool to enhance productivity, engagement and performance. (b) Used for research, organization, collaboration and expression. (c) Used to improve access, participation and progress.</td>
</tr>
<tr>
<td>7. Learning Tools</td>
<td>(a) Used as add-on assistive technology to gain partial access to inflexible media and information. (b) Usually not readily available when most needed.</td>
<td>(a) Used for discovery and to act upon accessible content to expose patterns and meaning. (b) Used to transform flexible content to preferred media.</td>
</tr>
<tr>
<td>8. Supports for Learning</td>
<td>(a) Heavy reliance on models of remediation and tutoring. (b) Adjustments, modifications and accommodations to the “real” content and activities.</td>
<td>(a) General and sped teachers work together in teams. (b) Supports and scaffolds built into the digital learning materials. (c) More Zone of Proximal Development = more glucose burning = more learning.</td>
</tr>
<tr>
<td>9. Assessment/Feedback</td>
<td>(a) Terminal assessment. (b) One size fits all approach. (c) Limited us of modification and accommodation although it is the approach of choice. (d) Used to motivate and classify students.</td>
<td>(a) Continuous and embedded feedback and assessment. (b) Provides critical information to guide selection of activities, content, and supports. (c) Motivation is intrinsic.</td>
</tr>
<tr>
<td>10. Learning Environment</td>
<td>(a) Competitive and isolating. (b) Must learn to live alone in a crowd while being constantly evaluated by both adults and peers.</td>
<td>(a) Cooperative and group achievement oriented. (b) Learners support each other within learning teams while working in flexible groups.</td>
</tr>
</tbody>
</table>
Regarding Instructional Strategies
1. How should various media be used by educators to effectively improve learning opportunities for diverse learning groups?
2. What strategies are best taught directly and which are best learned incidentally through experience and practice in a supported learning environment?
3. How can we best measure and apply the types and amounts of feedback required by individual learners?

Regarding Specific Disabilities
1. What are the critical media transformations [or multiple types] that must be available to support the needs of diverse learners?
2. What tools and supports will be required for diverse learners to participate effectively in demonstrating their skills, knowledge and strategies?
3. What positive interventions should be provided by computer software during learning activities to increase engagement and motivation?

CONCLUSION
In most aspects of our society human diversity is considered the norm; it is now time for this consideration to be applied to all aspects of instruction and learning. Applying the principles of UDL in educational practice will support the achievement of all students by providing: [a] appropriate goals for learning and performance, [b] flexible and supportive digital materials usable with new electronic tools for access and learning, [c] flexible and diverse methods while applying appropriate challenges and support, and [d] accessible and flexible assessments that measure what needs to be measured. Students, regardless of their strengths and weaknesses, deserve no less.

REFERENCES


Chuck Hitchcock is the Chief Education Technology Officer of the Center for Applied Special Technology (CAST) and Director of the National Center on Accessing the General Curriculum. Skip Stahl is Co-Director of the Universal Learning Center at CAST. This article was written with support from the National Center on Accessing the General Curriculum (NCAC), a cooperative agreement between CAST and the U.S. Department of Education, Office of Special Education Programs (OSEP), Cooperative Agreement No. H324HF000004. The opinions expressed herein do not necessarily reflect the policy or position of the OSEP and no official endorsement by the Department should be inferred. Address correspondence to Chuck Hitchcock, CAST, 40 Harvard Mills Square, Suite 3, Wakefield, MA 01880-3233. Email to: chitchcock@cast.org.