A Handbook on Universal Design for Learning and Accessible Technology

Proactive and Accommodative Instructional Strategies for Today's Teachers

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Teachers and related service providers understand that all learners are not created equal. Teaching methods with degrees of flexibility are necessary to meet the needs of a wide range of learners. Proactive curriculum design is also essential in light of limited resources in education and limited time and energy to create individualized accommodations. While teachers are aware of the pressing need to adapt their instruction, they have little time to plan or implement accommodations to meet the individual needs of the students. There are few guidelines and resources to help teachers with this.

Universal design for learning (UDL) anticipates the needs of diverse learners. Like differentiated instruction, UDL is concerned with learning content, learning process, learning products and the learning environment. UDL promotes strategies that allow learning standards to be achieved by students "with wide differences in their abilities to seek, hear, speak, move, read, write, understand English, attend, organize, engage and remember (ERIC/OSEP, 1998, p. 1). UDL applied to curriculum standards assists students with diverse learning needs who are expected to achieve general education learning standards, such as students with learning disabilities, slow readers, students with dyslexia, English language learners, students with emotional disturbances, students with attentional deficits, typical students with learning style variations, physically disabled students, students with sensory impairments, students with language impairments, and students with Asperger's syndrome.

Universal design for learning (UDL)
anticipates the needs of diverse learners.

Creation of the Maryland Technology Literacy Standards for Students (MTLSS) prompted the development of this handbook. These standards were created to help students achieve technological literacy by the 8th grade. Students who demonstrate technological literacy are able to use technology to access, manage, integrate, evaluate and create information. Students with disabilities often need to access technology to allow them to participate and make progress in general education. Instructional accommodations that employ assistive technology can help students with disabilities succeed without changing the content or conceptual difficulty of the curriculum. Universal design for learning promotes the use of digital technology because it often offers the flexibility needed to adjust for learner differences.

This handbook has been written to help educators understand UDL. An understanding of UDL is essential for general educators as well as special educators, given today's classrooms of diverse learners. This handbook offers three sections. The first section provides an explanation of UDL. The second section provides examples of UDL solutions, accommodations and assistive technology applied to curriculum. The third section lists assistive technology options across academic areas and learning skills.

Universal Design for Learning

UDL Defined

Simply put, UDL is the practice of embedding flexible strategies into curriculum during the planning process so that all students can access a variety of learning solutions. UDL places an emphasis on using digital technology, in addition to other strategies and materials that support diverse learners.

UDL and the Learners of Today

Schools, particularly in urban and large suburban areas, are more diverse than ever. Today's classrooms include students with different ethnic, economic, and language characteristics. Additionally, classrooms must meet the learning needs of students with impairments affecting mobility, vision, hearing, language, cognitive processing, and emotions.

In a classroom of diverse learners, there is no single method of instruction that can meet the needs of all students. Instead, multiple, flexible "pathways" are needed (Hitchcock, Meyer, Rose & Jackson, 2002). Instructional design must take into account "widely diverse learners in current classrooms and build in options to support learner differences from the beginning" (Hitchcock, Meyer, Rose & Jackson, 2002, p. 9). UDL recognizes that we all have learning strengths and weaknesses. Students need to be challenged and supported, and teaching using one methodology is no longer considered an acceptable instructional practice.

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UDL History

Universal design began as an architectural philosophy. Curb cuts and automatic door openers are examples of environmental designs that are universally practical. These modifications are critical for individuals with mobility impairments, but are also beneficial to others in the general public, such as parents with baby strollers. The concept of universal design has also been applied to web page designs, which enables users who are blind or deaf to access the Internet (Goodrich, 2004). More recently, universal design has been applied to education. UDL has entered the educational world at this point in time because the technology is more available to make it possible.

Universal design in education is premised on the writings of Vygotsky, a Russian psychologist who described three conditions for learning: recognition of information to be learned, strategies

for operating upon information, and learner engagement (Rose, 2001). According to Rose and Meyers (2002), Vygotsky's learning conditions are consistent with brain imaging studies of three broad cortical systems that are engaged during learning, which they term the recognition network, the strategic network, and the affective network. UDL strategies aligned with learning networks are described in Figure 1.

The Recognition Network: Strategies that support the recognition of information to be learned	Providing multiple examples Highlighting critical features Providing multiple media and other formats that offer background information
The Strategic Network: Strategies to process the information to be learned	Providing flexible models of skilled performance Providing practice with support Providing ongoing relevant feedback Providing flexible opportunities to demonstrate skill
The Affective Network: Strategies to promote learner engagement with the tasks	Offering choices of content and tools Providing adjustable levels of challenge Offering a choice of learning context Offering a choice of rewards

Figure 1. UDL strategies aligned with learning networks (Rose, 200; Rose & Meyer, 2002)

UDL and Curriculum

Curriculum is more than just a set of activities; it is a plan for achieving learning standards. UDL focuses on how curriculum is presented, how the curriculum is responded to, and the level of interaction within the curriculum (Goodrich, 2004). The UDL framework addresses adaptations across four areas: goals, materials, methods and assessments (Hitchcock, Meyer, Rose & Jackson, 2003). . UDL is based on the belief that curriculum needs to be "flexible to address differences proactively" rather than waiting for students to falter and then put strategies in place to remediate (Edyburn, 2003, p. 2). UDL embeds accessible features into instructional design; it frontloads flexibility, instead of relying only on after-the-fact accommodations. "UD is a potential solution to the relentless demand for curriculum modifications" (Edyburn, 2003, p. 2).

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UDL, however, does not propose to change the content of the curriculum, but broadens the curriculum to offer various avenues for learning (Goodrich, 2004). Likewise, the goal of UDL is not to "reduce all effort, but to reduce extraneous effort—effort that is unrelated, distracting, disabling—because it is expended in overcoming barriers and poorly designed pedagogies." (Hitchcock, Meyer, Rose & Jackson, 2002, p.15).

Curriculum, particularly in the upper grades, is often presented predominantly through textbooks and lectures. However, books and lectures are a one-size-fits-all model of instruction. Textbooks demand the immediate recognition of print and rapid comprehension of content. For students with reading disabilities as well as for English language learners who struggle with vocabulary, this presents a barrier to learning when scaffolds are not put in place to help them derive meaning from print. Likewise, lectures that rely only on verbal presentations can also serve as a barrier to some students. Because the nature of speech is so transient, lectures or any type of teaching that is presented verbally, requires quick auditory processing and recall. For students with language-based difficulties or memory deficits, this also presents barriers to achieving curriculum standards.

Traditional methods such as books and lectures by themselves are not adequately flexible to meet the needs of diverse learners. We need to move beyond the limitations of a single medium and the fixed nature of teaching methods. We need to design instruction to include strategies that are flexible to meet the needs of a wide variety of learners. For example, digitized textbooks not only allow books to be read aloud via a computer, but provide a link to dictionaries to check word meaning. Links can also be made to supplementary anchored text that provides useful background information.

UDL and Current Federal Mandates

UDL should not be regarded as one more thing a teacher has to deliver. Rather, it should be an integral component of curriculum design to improve student learning. UDL is compatible with current day educational reforms. It is consistent with No Child Left Behind, which seeks to strengthen curriculum and make it accessible to all students. UDL is also consistent with Individuals with Disabilities Education Act (IDEA), which seeks to ensure access, participation and progress for students with disabilities (Figure 2).

IDEA Tenets
• Access: Simply providing access to curriculum is not sufficient. What is important is the underlying learning that takes place. • Participation: Simply allowing a student to participate in general education is not sufficient. Flexible instructional methodologies are needed to help student learn how to learn. • Progress: For students with disabilities following the general education curriculum, learning standards are the same as for other students. What is imperative, however, is that assessments of progress are barrier free.

Figure 2. IDEA tenets of access, participation and progress (Hitchcock, Meyer, Rose & Jackson, 2000).

UDL and Differentiation

UDL is commensurate with concepts of differentiated instruction (DI). "Both seek to enhance student achievement by proactively designing learning environments and instructional materials in ways that allow all students to be successful," (Edyburn, 2003, p. 3). According to Tomlinson (2002), there are four classroom elements that must be taken into account to ensure differentiated instruction: content, process, product, and learning environment. UDL and DI have much in common in that both assert the importance of frontloading classroom strategies to meet the needs of a wide range of learners (Figure 3). UDL, while compatible with differentiated instruction, places a greater emphasis on using the technology that is now readily available.

Differentiated Instruction: Classroom Elements	Universal Design for Learning Examples
Modifying instructional content	Alternate representations of content (textbook, electronic versions)
Modifying instructional process	Teaching in multiple formats (lecture, PowerPoint slides, video)
Modifying instructional products	Multiple pathways for gathering info and keeping track of info, multiple pathways for action and expression, and assessment
Modifying instructional environments	Multiple ways of engaging students' interest and motivation

Figure 3. Differentiated instruction classroom elements aligned with UDL examples.

UDL and Assistive Technology

Assistive technology consideration is required under IDEA. IDEA requires that assistive technology (AT) devices and services be considered for all students when developing an individualized educational plan (IEP). The definitions of AT devices and services were added to the IDEA by the Education of the Handicapped Act Amendments of 1990. An AT device according to IDEA (1997) is defined as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities." AT services are described as "any service that directly assists an individual with a disability in the selection, acquisition or use of an assistive device". This definition is intentionally broad. Strategies are labeled "assistive technology" when they provide a method or material that is critical to an IEP objective for a specific student. For example, graphic webbing software (e.g., Inspiration™) helps many students organize information. Such software becomes assistive technology by its inclusion on a student's IEP to accomplish a stated IEP objective.

While AT devices are necessary for some students, AT does not build flexibility into the curriculum to benefit all students.

According to Hitchcock and Stahl (2003), AT will always have a role in the education of learners with disabilities. There will undoubtedly be students who require AT to overcome learning barriers. For example, students who cannot handwrite legibly will need access to keyboarding, and students with reading disabilities will need access to text that can be read aloud. AT is typically an add-on to a classroom to benefit an individual student. The exclusive emphasis on AT, in the absence of UDL, "may place the burden of adaptation on the learner, not on the curriculum" (CEC, 2001, p.84). AT devices are necessary for some students, but when AT is applied only to individual students in keeping with IEP requirements, it does not build flexibility into the curriculum to benefit all students. However, AT and UDL strategies work in concert with one another. Examples of this can be seen in the next section of this handbook entitled UDL Solutions and Accessible Technology: Accommodations and Assistive Technology. Lists of specific assistive technology options which support reading, writing, spelling, math, learning and studying can be found in the 3rd section of this handbook.

UDL and Accommodations

Instructional accommodations are forms of scaffolding that enable students to succeed without changing the content or conceptual difficulty of the curriculum. Accommodations may or may not employ assistive technology devices. Using "think aloud" strategies to encourage a student to analyze what he is reading is an example of an accommodation that does not utilize assistive technology. Using highlighter tape to mark key points in a text would be an accommodation that employs low tech assistive technology. Commercial books on CD as well as digital text imported into reading software would be examples of high tech assistive technology.

Good instructional accommodations enable students to succeed without changing the content or conceptual difficulty of the curriculum.

It is equally important to avoid inappropriate accommodations that undermine learning. Allowing a student with illegible handwriting to type his written work is an example of an accommodation that does not affect learning standards. However, if this student exclusively and consistently dictated all assignments to an adult, this would undermine the development of effective writing skills, such as spelling, punctuation, paragraphing and organizational skills.

Good instructional accommodations enable students to succeed without changing the content or conceptual difficulty of the curriculum. "Allowable scaffolds" to learning should not interfere with learning (Hitchcock, Meyer, Rose & Jackson, 2002). Curriculum is supposed to present challenges. Accommodations are not meant to lower standards (ERIC/OSEP, 1998).

Most accommodations are teacher add-ons to standard curriculum materials and methods. However, teachers have limited time available to prepare individual accommodations. According to Hitchcock, Meyer, Rose and Jackson (2002, p. 15), "The alternatives and options must be carefully embedded in learning goals in order to preserve true access to learning." What makes UDL different from accommodations is that UDL strategies for instruction are frontloaded. They are integrated into the overall design of curriculum instruction. By expanding the tools that are available, the tools fall more into the "least restrictive" domain rather than tools that make the student look and feel "different." As with assistive technology, accommodations work in unison with UDL curriculum planning.

Instructional modifications to the curriculum are not addressed specifically in this handbook. Instructional modifications result in changed outcomes or adjusted standards for students. For example, when students with cognitive disabilities are included in general education classrooms, it may be appropriate to modify the text by adapting it with picture symbols for limited readers. When such strategies result in changed outcomes or adjusted standards, this is not appropriate for students who are expected to achieve the learning content standards. They would, however, be appropriate modifications for students who are included in general education, but who are not being held to general education content standards. According to the Council for Exceptional Children (2001), guidelines for modifying curriculum for students with cognitive disabilities are not well developed at this time.

UDL and Assessment

Assessment is an important part of UDL. More often, assessment methods "appear to have been designed under the assumption that learners are relatively homogeneous" (Rose, 2000, p. 47). It is important not to confuse the learning objective with the means by which it can be expressed. To gauge student progress, assessment is important. However, it is imperative to separate the learner outcome from the skills required to demonstrate progress. Too often the method of assessing the goal's achievement does not reflect what the student is meant to learn. For example, for students with documented memory issues, a history test that requires the recall of historical names and dates may not really be evaluating the degree to

which the student understands the learning standard of comprehending the interplay of historical events.

Likewise, a student with dyslexia may not be able to read the directions or test questions. For example, accommodations involving talking text are needed to allow this student to hear the directions and questions and then express what he has learned without penalizing him for his reading disability. Giving the same test to all is neither fair nor accurate, given the needs of diverse learners. Giving tests without appropriate supports can result in flawed reflections of student learning.

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Too often, tests themselves impose barriers that have little to do with the knowledge being assessed. It is important for teachers presenting tests and quizzes to be sure that the test really is measuring what it is intended to measure for ALL students, and the design of assessment methods should be flexible to the needs of students. For example, teachers and curriculum designers should be clear on the content that is to be measured. Test questions should be simple with clear print using simple typefaces for students with visual perceptual difficulties or attentional deficits. Greater word and line spacing are helpful with shorter line lengths. Digitized versions of tests should be available to students who need to type their answers, and talking text should be available for students who need reading support for test questions.

UDL Solutions

When supports do not undermine the central learning goal, then it is reasonable to include them (Rose & Meyer, 2002). Digital technology makes UDL curriculum solutions possible. Technology offers the flexibility upfront that is needed to adjust for learner differences. For example, efforts are underway to establish national standards for creating and accessing digital instructional materials for students with disabilities. The National File Format project, coordinated by the Center for Applied Special Technology (CAST), under the direction of the Department of Education's Office of Special Education Programs (OSEP), is working to create standards that will encourage textbook publishers to create digital versions of textbooks. School districts will be able to purchase digitized textbooks and other materials that can more easily be accessed in classrooms. This is an example of proactive curricular design. Schools districts that purchase textbooks available on CD ROM then do not have to electronically scan chapters, and text can more easily be imported into reading software for students who need this type of support. Using digitized text with built-in reading and studying supports, students can highlight words, enlarge the type, increase the volume as needed, obtain support to decode difficult words, look up words that are not understood, and link to files that provide needed background information.

Shifting to a more universally designed curriculum cannot be accomplished overnight. It can only be accomplished by committed teachers willing to relook at their instructional strategies, and then begin to design instructional units in ways that provide more flexibility for all students. Increasing awareness of UDL principles is step one. District and school-level start-up strategies developed by Rose and Meyer (2002) are outlined in Figure 4.

District level strategies:	• Promote UDL from the top down, to include administrators and curriculum designers. • Provide information to schools on how to get the tools in place to work on UDL objectives (e.g., computers, special software, scanners, etc. • Develop training modules that focus on UDL one classroom and one curriculum unit at a time
School administration strategies:	• Develop a school plan to incorporate UDL • Identify instructional barriers to achieving UDL • Identify ways too overcome barriers using flexible technologies • Help teachers in the classroom embed UDL into curriculum units
Start up strategies at district and school levels:	• Start with a manageable curriculum unit • Identify the goals of the unit • Identify what students need to do to show mastery • Determine what the instructional barriers are for specific students • Determine what tools would help this • Determine how goals, methods and assessments can be adjusted

Figure 4. Strategies to promote the use of UDL in schools, adapted from Rose and Meyer (2002).

Getting Started

To help teachers redesign curriculum units so that they provide for the needs of all students, Rose and Meyer (2002) feel teachers should first analyze the needs of the students in their classrooms, then identify the learning barriers that apply to those students. Once this is done, teachers can then plan units of instruction using UDL solutions. Figure 5 provides examples of this. A blank template is provided in Appendix A or teachers can access templates on line at www.cast.org.

Universal Design for Learning: Planning Solutions

Date: September 2004
Curriculum Unit: Plant life cycles
Teacher: Mr. Jackson

Grade: 4
School: Lincoln E. S.

Curriculum Unit Methods and Materials	Challenges for Specific Students	UDL Solutions
Science text and supplementary handouts	**Anne Marie:** Poor reading skills **Alicia:** Limited English; difficulty comprehending vocabulary	Scan text into text-to-speech reading software with links to dictionary definitions in English and Spanish
Whole class presentation	**Alicia:** Limited English; difficulty comprehending meaning **Jake:** Attention deficits; misses critical information presented verbally	Provide a Kidspiration™ graphic organizer that pairs pictures with words Use graphics and pictures to present new information
Writing assignments	**Henry**: Poor handwriting legibility, limited written expression **Anne Marie**: poor spelling	Provide a portable word processor (e.g., Alphasmart) for written tasks Provide a word bank of key words Allow the student to use a personal spelling dictionary
Classroom observations and discussions	**Sasha:** Low confidence; reluctant to ask questions or contribute ideas	Share discussion questions in advance
Plant life cycle drawing	**Henry:** Poor handwriting and drawing legibility	Drawing software or provide a Kidspiration™ life cycle template for the student to fill in
Assessments	**Jake**: Attention deficits; misses critical information **Henry:** Poor handwriting legibility **Anne Marie:** Unable to read test directions and questions	Provide a PowerPoint presentation to reinforce critical information Write test in MS Word so that student can complete the test on the computer. Scan the test into reading software

Figure 5. UDL planning solutions. Form adapted from Rose and Meyer (2002).

In the next section of this handbook, there are practical examples of UDL applied to two curriculum units: 5th grade language arts and 8th grade social studies. These examples illustrate what teachers can do to plan instruction proactively, with more flexible methods and materials. UDL solutions are planned in advance and built into the curriculum. Accommodations and technology can be combined with UDL solutions in advance. When this occurs up front rather than after the fact, accommodations and assistive technology become an integral part of the curriculum and can be made available to a wide range of students with diverse learning needs.

UDL Solutions and Accessible Technology:

Accommodations and Assistive Technology

UDL Solutions
Example Applied to 5th Grade Reading, Writing, Language Arts
Historical Fiction

Unit Methods and Materials	Challenges for Some Students	UDL Instructional Solutions, Assistive technology options, and accommodations *(Enable students to succeed without changing the content or conceptual difficulty of the curriculum)*
Whole class presentation discussing plot in historical fiction	Student is distractible and misses information. Student has difficult processing verbal information. Student has difficulty comprehending meaning.	Use teacher proximity to prompt a student's attention. Use cueing gestures to alert student to key information, to new directions or to upcoming transitions. Use key words repeatedly. Use visual aids (picture cues, diagrams, mind maps, plot capture sheets, Kidspiration) to illustrate key points.
Historical novel	Student cannot understand word meaning. Student cannot read small text. Student cannot decode text with ease.	Provide reading previews to activate prior knowledge. Use PowerPoint to develop an overview of the content and new vocabulary. Scan book to convert the book to digitized text with text-to-speech reading software* and enlarge the font size (e.g., Kurzweil). Dictionary features help students obtain the meaning of unknown vocabulary. Provide time for repeated readings using reading software. Provide story mapping to reinforce story elements (e.g., plot, themes).

Literature circles	Student is reluctant to ask questions Student has difficulty formulating ideas in order to contribute to the discussion	Provide questions in advance to allow the student to prepare his or her response.
Historical research	Student has difficulty with organization. Student may not be able to abstract important content.	Provide a graphic web template to guide the research. Online encyclopedia with screen reader technology and spoken dictionary definitions.
Writer's Notebook	Student has labored handwriting and difficulties with legibility	Provide a notebook of fill-in-the blank sheets to limit handwriting. Provide a Writer's Notebook template for the student to type his responses.
Using a book to inspire writing	Student cannot outline and organize ideas. Student has difficulty with written language. Student struggles with spelling.	Kidspiration ™ or Draftbuilder™ templates to organize ideas prior to writing in electronic or hardcopy versions. Provide a written list of key vocabulary. Word processor with spell check. Talking word processor with word prediction options, (e.g.,CoWriter™).
Oral report	Student has speech difficulties. Student has difficulty presenting orally in front of peers.	The student develops and delivers an oral presentation using a PowerPoint template with preset topic areas or a KidPix slide show. The student prepares a poster or a diorama as an artifact from which to make her report.
Assessment	ESL student has difficulty with comprehension testing due to lags in English vocabulary	To reinforce new vocabulary, use a Kidspiration template that allows the student to link words with their definitions in electronic or hardcopy versions.

*The original text must reside with the electronic version that is being used as an accommodation for a student with print-processing disabilities.

UDL Solutions

Example applied to 8th Grade Social Studies:
Democracy: Political System of the People

Curriculum Unit Methods and Materials	Challenges for Some Students	UDL Instructional Solutions Assistive technology options and accommodations *(Enable students to succeed without changing the content or conceptual difficulty of the curriculum)*
Social Studies textbook	Student cannot see small text. Student cannot decode easily. Student cannot understand word meaning.	Use textbooks that are available in electronic format. Or use a high speed scanner to digitize text with text-to-speech reading software* with dictionary features (e.g., Kurzweil™). Use a graphic web to link vocabulary to definitions.
Supplementary Instructional reading materials	Student cannot see small text. Student cannot decode easily. Student cannot understand word meaning.	Make supplementary reading material available that is in electronic form, or prior to teaching this unit of study, scan all supplementary reading materials into reading software.*
Lecture/ whole class presentation on political systems	Student is distractible and misses information. Student has difficult processing verbal information. Student has difficulty comprehending meaning.	Provide a list of vocabulary definitions. Provide a hard copy of a graphic concept map of key lecture concepts developed with Inspiration™ software. Provide a text-based outline of key lecture concepts.
Research using primary and secondary sources of information on what happened at Lexington Green	Student has difficulty with organization. Student may not be able to abstract important content. Student cannot readily decode text.	Provide an Inspiration™ template with essential research questions for the student to complete electronically or in hardcopy. Online encyclopedia with reading software and spoken dictionary definitions. Provide keywords or websites addresses that will lead to sources of information. Use reading

		software to read on-line information.
Social Studies Journal	Student cannot handwrite legibly. Student had difficulty formulating and expressing ideas.	Allow the student to type journal entries and organize them on a student file by date. Provide a list of terminology and a set of questions to stimulate reflections.
Written report on key events and individuals in the American Revolution	Student cannot handwrite legibly. Student cannot outline and organize ideas. Student has difficulty with written language. Student struggles with spelling.	Inspiration™ template to organize key events and key individuals. Word processor with spell check. Talking word processor with CoWriter™ option. Key vocabulary written out in advance.
Completing worksheets (graphic organizers, tables, response continuums)	Student cannot handwrite legibly. Student may not be able to abstract important content.	Use worksheets that are created in electronic format (E.G., MS Word). Or prior to teaching this unit of study, scan all worksheets into OCR software and save this on the classroom computer or on a CD. Have a PowerPoint presentation available that the student can reread before completing the worksheet.
Map elements	Student cannot draw representationally.	Use an imported digitized photo of the targeted map area , overlay key map elements using a drawing program.
Develop a timeline of events	Student has difficulty with handwriting and using rulers	Use a drawing program, Timeliner™ software or Inspiration ™ to write and illustrate a timeline of events.
Oral report	Student has speech difficulties. Student has difficulty presenting orally in front of peers.	Student uses PowerPoint to develop and present the oral report.
Group project	Student has difficulty interacting with peers.	Assign a specific role to the student with clear parameters.
Studying	Student has difficulty outlining key concepts. Student has difficulty with memory for facts.	Use PowerPoint to review key chapter concepts. Provide a text-based outline of key lecture concepts.
Assessments	Student had documented memory deficits Student cannot decode test questions	Provide a key word list that includes correct and incorrect terminology. Adult reads the test questions to the student or a talking word processor

	Student cannot write legibly	is used to read the directions and complete the test. The test is created using MS Word and the student types his answers. The test is scanned into software that allows it to be completed on the computer (e.g., Kurzweil™, TestTalker).

*The original text must reside with the electronic version that is being used as an accommodation for a student with print-processing disabilities.

Assistive Technology Options

Assistive Technology Options

Assistive technology (AT) will always have a role in the education of some students with disabilities. There will undoubtedly be students who will need specific AT devices and services to overcome learning barriers. When technology is embedded as an integral part of a curriculum, this benefits all students. This same technology may be labeled assistive technology when it is included on a student's IEP. Conversely, highly specialized forms of technology, such as communication devices and dedicated software, may not benefit all learners, but will need to be implemented to meet the goals of the student's IEP.

Prior to making recommendations regarding low or high tech solutions, it is essential to understand a student's learning strengths and needs. When assistive technology decisions are based on a student's profile of needs, then AT tools can be put to good use. The following lists of no-tech strategies, as well as low and high tech AT tools must be carefully considered in light of the student's IEP goals and learning objectives.

No-tech strategies do not require an off-the-shelf or customized tool or device. Many of these teacher strategies are examples of differentiated instruction that when integrated into curriculum are in keeping with UDL. Low-tech strategies usually rely on some off-the-shelf or customized tools that do not require significant technical skills to operate. High-tech strategies usually require technical and/or computer skills. It is important that no-tech and low-tech strategies be considered before high tech options as no and low-tech options are more often "least restrictive." First consider strategies that provide the least amount of scaffolding, allow for as much independence as possible, and retain the learning content and conceptual challenges. While AT provides access to learning and can help students overcome learning barriers to participate in the general education curriculum, it does not guarantee progress. AT still needs to be combined with good teaching to ensure learning.

Methods and Materials to Support Handwriting and Keyboarding

No Tech Options:

- Worksheets magnified on the copy machine, or worksheet sections cut, separated and recopied/magnified to help students with handwriting difficulties
- Use highlighters to help frame sections of a worksheet
- Have the student write on every other line to increase legibility
- Reduce far point or near point copy work
- Allow single word or short answers
- Allow extra time on assignments
- Double grade papers for content and presentation to encourage neatness while crediting the student for appropriate content

Low Tech Options:

- Pencils of various widths to assist with pencil grasp
- Pencils with softer lead for students who have difficulty with pencil pressure
- Pencil grips and adapted pencil holders
- Pens with different grips
- Pens that provide a light as the student writes to help focus on the lines of the paper
- Laminated copy of the alphabet to guide letter formation
- Full page handwriting guides or sentence window cut-outs to help stay within a designated writing space (www.onionmountain.com)
- Place Wikki Stix™ on paper to form a physical baseline to help keep the student's writing within a designated space
- Clipboard to keep the paper from moving as the student writes
- Slant boards to angle the paper for students
- Letter and number stamps for young writers who cannot yet form letters and numbers
- Stencils for young writers who cannot yet form letters and numbers
- Customized signature rubber stamp for students who cannot write their name using cursive writing
- Magnetic letters and board for young writers who cannot yet form letters and numbers
- Selection of specially lined papers (raised lines, colored lines, extra space between lines, graph paper)
- Highlighters (permanent or erasable) to highlight key vocabulary or main ideas to reduce the need for recopying information
- Correction tape or correction fluid pens for students who have difficulty erasing
- Tape recorders for recording selected content lectures
- NCR paper notes or copies of peer notes
- Limited, strategic use of oral dictation to demonstrate mastery of content

- Provide lecture notes to the student in advance and require the student to highlight key points during the lecture
- Change the format of worksheets or tests to formats that require handwriting, e.g. multiple choice, cloze format, fill in the blank, match words to a word bank

High Tech Options:

- Portable word processors/text output devices as a writing alternative (e.g.,Alphasmart, Dreamwriter)
- Keyguards on a keyboard to help students with keystroke accuracy
- Slant boards for keyboards to help students with keystroke accuracy
- Enlarged adhesive letters on the keyboard to more easily locate keys
- Folding keyboard attached to a student's PDA for students who need a writing alternative that can be transported and downloaded at home and school locations
- Typing programs to teach touch typing or increase keyboard familiarity
- Accessibility options in computer control panels to adjust repeat rates, mouse speed, to assist with double click or click and drag
- Control panel changes to enlarge the cursor or change display options
- Create a document template for a student to set background color, font, bold text, text size and spacing features
- Screen magnifiers or magnification through computer zoom features for students with visual impairment
- Alternative access (mouthsticks, headsticks, scanning with switches, Morse code)
- Track balls or track pads for students who difficulty using a mouse
- Alternate keyboards for students who cannot access a traditional keyboard
- On-screen keyboarding for students who cannot access a traditional keyboard
- Keyboard shortcuts for (e.g., F7 to check spelling)
- Software with word pallets for young writers to structure simple sentences
- Talking word processors (with voice output) to help students process what they have written (e.g., IntelliTalk II, Write:OutLoud)
- Word prediction to help students with spelling difficulties, who can recognize correct spellings from a list of spelling options (e.g., Co:Writer)
- Outline/graphic organizing software to help students with prewriting and organization (e.g., Kidspiration, Inspiration)
- Interactive writing software to prompt reluctant writers
- Drawing or software with graphics to prompt reluctant writers
- Structured writing software to step students through the writing process (e.g., DraftBuilder)
- Allow alternate methods for reporting and making presentations (e.g., PowerPoint software)
- Worksheets scanned into text files to create digitized worksheets for students with illegible handwriting (e.g., Kurzweil, WYNN, TestTalker)

- Voice recognition (speech to text) software for students who cannot handwrite or use a standard keyboard, or who have severe spelling deficits, but who have adequate reading skills and understand the components of process writing.

Methods and Materials to Support Writing Traits

Six Trait Strategies Reference: Spandel, V. (2001). *WriteTraits: 6 Trait instruction and assessment*. Wilmington, MA: Great Source Education Group, Houghton Mifflin

No Tech Options:

To help students learn to generate ideas:

- Use pretend binoculars to teach "focus"
- Use literature that illustrates good ideas
- Teach students to discriminate intriguing, interesting ideas from irrelevant or overly-general ideas
- Help struggling writers gather-collect-list their ideas and select the best ones that provide focus and clarity
- Teach students how to ask questions to develop ideas

To help students organize their writing:

- Teach students to discriminate good leads from not-so-good leads
- Mix up the steps in a recipe. Reorder them and discuss the importance of good sequencing
- Have students sequence the events in a story
- Have students write 3 or 4 different endings and discuss which one is best and why
- Model a piece of writing that has sentences with unnecessary fillers.
- Teach students how to group ideas
- Replace "And then"; teach transition words

To help students learn to write for an audience and to strengthen their voice as writers:

- Read aloud from books that have a strong voice
- Match writings to their intended audiences (e.g., letter to a friend, business letter)
- Play "who's voice is it?" matching the voice of the text to popular characters from television
- Have students write an event from different perspectives e.g., (a house fire from the perspective of a child, an adult, a fireman)
- Attach a "voice" to people in photographs
- Write letters of complaint

To help students expand their choice of words:

- Word walls of favorite lively words
- Burying tired, overused words
- Read aloud from books with strong, powerful words
- Write a simple description of an object, then rewrite it with stronger words
- Write about a color but don't use the name of the color.
- Replace the verbs to make a paragraph stronger

To help students learn sentence fluency:

- Teach students how to combine short choppy sentences
- Find run-on sentences and fix them
- Have the students count the number of words in their sentences, and write the first word in each sentence to see if there is a variety of sentence beginnings.
- Teach a variety of sentence starters
- Teach connecting words such as "however", "therefore"
- Use early emergent books and rewrite them to improve sentence fluency.

To help students learn writing conventions: (Spelling, grammar, punctuation, capitalization)

- Teach conventions based on what kids need to learn given their age and ability
- Conventions need to be focused upon one at a time, at a minimum of 3 times per week, in short 15-minute lessons with repetition and practice.
- Teach basic editing symbols
- Don't ask students to edit all conventions at once
- Students below 4th grade need to revise one trait at a time. Struggling writers who are older than 4th grade should focus on only 2-3 traits at a time.
- Personal spelling dictionaries of commonly misspelled words
- In advance of writing, provide a list of key words for that writing assignment

More No and Low Tech Options:

- Use discussions to activate background knowledge
- Provide time for brainstorming prior to beginning writing
- Classroom charts that specify tasks to structure the writing process
- Daily in-class writing opportunities
- Provide extra time for writing assignments
- Provide models of what writing projects should look like
- Provide checklists to prompt the use of targeted writing traits
- Provide charts that post rules for punctuation, capitalization, spelling
- Teach proofreading and editing at the students' level of ability
- Use highlighters or colored pencils to focus on specific conventions (e.g., parts of speech, punctuation, capitalization)
- Peer editing or older student mentors
- One-to-one writing conferences to focus the revision of one or two traits at a time
- Prior to writing, the student dictates key ideas in the form of words or phrases to an adult who writes these on individual sticky notes. The student works with the adult to organize these and then writes independently.

High Tech Options:

- Outline/ graphic organizing software (e.g., Kidspiration, Inspiration)
- Structured writing software (e.g., Draftbuilder)

- Document templates that are structured for different writing tasks (timelines, who-what-where-when-how, paragraphing: main idea-supporting idea-details)
- Use thesaurus features to prompt the use of stronger verbs, adverbs, adjectives
- Talking word processors to provide feedback on what was written

Methods and Materials to Support Spelling

No Tech Options:

- Explicit spelling instruction based on analysis of spelling error patterns
- Daily reading to reinforce the spelling of high frequency words
- Mad minutes for practice spelling high utility words
- Practice proof reading for spelling errors
- Mnemonic techniques to retain word spellings

Low Tech Options:

- Word walls or words commonly misspelled on cards or organized alphabetically on a folder
- Personal spelling dictionary using alphabetized dividers or address books
- In advance of writing, provide a list of key words for that writing assignment
- Pocket dictionaries
- Electronic talking dictionaries and spell checkers
- Peer editing for spelling errors
- Double grade assignments with spelling factored in and out

High Tech Options:

- On-screen word banks of content vocabulary
- Word prediction software to help students with spelling difficulties, but who can recognize correct spellings from a list of spelling options (e.g., Co:Writer)
- Spell checking tools on computers (including right click on misspelled words in MS Word)
- Writing software that cues misspellings
- Automatic correction features in word processors
- Talking word processors to cue misspelled words

Methods and Materials to Support Reading

No Tech Options:

- Provide reading previews to activate prior knowledge and give students an overview of the content
- Teach previewing strategies (e.g., SQ3R, K-W-L, STAR)
- Have students independently read smaller amounts of text at a time
- After reading, have the student retell what was read to an adult or write a brief summary
- Provide extra time for completing reading assignments
- Teach strategic reading to locate main ideas
- Model metacognitive strategies (e.g., think alouds) to encourage students to analyze what they are reading
- Encourage the student to read with specific tasks to do as the student reads
- Provide chapter outlines to reinforce key ideas
- Provide story mapping to reinforce story elements (character-setting-problem-solution; who-what-where-when-how)
- Use teacher-student dialogue journals to check on understanding
- With expository text, have student keep a fact log

Low Tech Options:

- Full page color transparencies or acetate to increase visual contrast
- (www.seeitright.com)
- Color transparency strips as reading rulers (www.readinghelpers) to assist with visual tracking
- Enlarged print or text magnified via the copy machine to help students with severe spatial perceptual deficits or students with visual impairments
- Magnifier bars to help students with severe spatial perceptual deficits or students with visual impairments (www.onionmountain.com)
- Use a penlight to light up each word when reading to assist with visual tracking
- Sentence template cards with a cut out area to isolate one line of reading at a time
- Write unknown or new words on index cards and draw a picture to represent the meaning of the word
- Use sticky notes to flag text for key points or for information they do not understand
- Books on tape/CD with the accompanying text to promote reading skills
- Keypoints highlighted in the text using highlighter tape (www.onionmountain.com)
- Autosummarized versions of digitized text

High Tech Options:

- Speaking spell checkers or dictionaries to assist with word recognition
- Electronic **r**eading pens to read occasional single words the student cannot recognize
- Instructional software to remediate basic reading and comprehension skills

- Text scanned into a talking word processor so the student can hear and see the text as it is read
- Text imported from websites into a talking word processor so the student can hear and see the text as it is read
- Commercial books on CD or E- books with the accompanying text to promote reading skills
- Digital text imported into reading software (e.g., Kurzweil, WYNN, Read and Write Gold)
- Convert digital text to MP3 files for reinforcing reading comprehension at home

Methods and Materials to Support Math

No Tech Options:

- Reduced workload, e.g., solve every other math problem
- Minimize the number of problems per page
- Provide extra time to complete math tasks
- Peer or an adult reads the problem and records the student's answer

Low Tech Options:

- Number line
- Create math worksheets that have additional space between math problems for students with handwriting deficits
- Enlarged / magnified worksheets for students with handwriting deficits and visual impairments
- Graph paper to keep number problems lined up
- Math facts charts for students with memory deficits
- Calculators (with print out , large keys or speech output)
- Highlight math signs and instructions
- When solving math problems, have students highlight the numbers and key words
- Tape record answers to math problems, formulas, etc.

High Tech Options:

- Computer-based calculators
- Software which creates math worksheets for demonstrating math functions (e.g., MathPad, www.donjohnston.com)
- Instructional software to remediate math skills
- Software for writing higher level math problems (i.e., www Scientific Notebook)
- Graphing calculator with built-in keyboard for students who cannot handwrite text-based answers legibly

Methods and Materials to Support Learning and Studying

No Tech Options:

- Post assignments in the same location
- Provide time during class to copy down assignments
- Each week have one student responsible for logging in homework assignments and lecture notes into a class notebook which all students can refer to when absent or in need of clarification
- Break down assignments to include preparation items (e.g., study for quiz, read chapters, work on segments of long term assignments)
- Teachers sign-off in student's assignment book
- Provide phone numbers of students who are willing to explain assignments to a student
- Provide an outline for long range assignments
- Checklists of required work requirements
- Evaluation checklists
- Rubric and criterion checklists
- Individualized student contracts for completing assignments with reward choices
- Request or check homework completion at the same time each day during class
- Collect even unfinished assignments by the due date
- Call parents if more than 2 assignments are missing

Low Tech Options

To organize assignments:

- Picture reminders or picture schedules
- Pocket schedules or reminders
- Locker checklists of what needs to go home each day
- Electronic, multiple message voice output reminders
- Using a binder with sections for each subject
- Using a 12 section accordion folder
- Color coded subject folders
- The Monday (or Friday) assignment folder which is sent home with the assignments for the week ahead
- 4 pocket folders labeled as "Do", "Fix", "Turn in", Take home"
- Weekly NAT assignment sheets with 3 sections for each assignment:
  - **N**eeds: what is needed to work on the assignment
  - **A**ssignment: what the task is
  - **T**urn in: due date
- Do-Due worksheets which break down assignments into subtasks
- Use of Post-It Notes to flag important papers
- Tape record assignments
- Send work and assignments to and from home via fax machine
- The student calls home and leaves him/herself a reminder message
- End of the day list of things to do that night with an "I did it!" checkbox to reinforce success the next day

- Kitchen time (with bell) or TimeTimer (no bell, www.onionmountain.com) to help student gauge time for the completion of assignments

For studying:

- Use small post-it notes to cover answers on study sheets
- Use removable, reusable highlighting tape to highlight important information in a text
- Provide outlines of key points for studying; left justify the main ideas, and right justify the details so that the student can fold the paper in half lengthwise to use as a study guide
- Tape record key information for tests or key segments of text for students to review
- Students who are given copies of class notes as accommodations are responsible for reading them and highlighting key information
- Provide lecture notes with occasional blanks for the student to fill in
- Teach test taking strategies (e.g., use of clue words, smart guessing strategies, essay test strategies

For listening:

- For students with auditory processing deficits, present visual input along with auditory input (e.g.. video examples of concepts, overhead projector outlines of key ideas, close captioning on TV presentations)
- Use visual aids (picture cues, diagrams, mind maps) to illustrate key points
- Preferential seating
- Use teacher proximity to prompt students' attention
- Break directions into smaller steps or segments
- Use cueing gestures to alert student to key information, to new directions or to upcoming transitions
- Preteach vocabulary for new teaching units
- Audiotape verbally presented information for repeated presentation

For communicating:

- Provide questions in advance for students who are reluctant to interact
- During oral presentations, allow students to use alternate presentation methods (e.g., posters, slide handouts, photos, written outlines, multimedia presentation tools such as PowerPoint, website design tools)

High Tech Options:

- Send work and assignments to and from home via email attachment
- Call parents if more than 2 assignments are missing
- Digital voice recorders which record multiple reminder messages
- Electronic reminders using pagers or cell phone functions
- Electronic organizers or PDAs
- Personal amplification systems
- Graphic organizing software to breakdown assignments or to serve as a study guide (Inspiration)

- Software that allows a student to highlight key ideas in digitized text and then extract these for use as a study guide (e.g., Kurzweil, WYNN, Read and Write Gold)
- Allow students to use PowerPoint or other presentation methods
- Use on-line grade books to post student assignments

Appendix

UDL Planning Form

Forms adapted from Rose and Meyer, 2002

Universal Design for Learning: Planning Solutions

Date:
Curriculum Unit: Grade:
Teacher: School:

Curriculum Unit Methods and Materials	Challenges for Specific Students	UDL Solutions

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