



Universal Design in Education: Principles and Applications

DO-IT

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While courses, technology, and student services are typically designed for the average student, *universal design in education* (UDE) promotes the consideration of people with a broad range of characteristics in the design of all educational products and environments. UDE goes beyond accessible design for people with disabilities to make all aspects of the educational experience more inclusive for students, parents, staff, instructors, administrators, and visitors with a great variety of characteristics. These characteristics include those related to gender, race/ethnicity, age, stature, disability, and learning style.

Originally applied in the field of architecture and later to commercial products and information technology, universal design applications in education are relatively new. UDE provides a philosophical framework for the design of a broad range of educational products and environments. These include

- websites,
- educational software,
- instruction,
- curriculum,
- libraries,
- computer labs,
- science labs,
- registration options,
- student housing and residential life,
- other student services, and
- professional organizations.

Definition and Principles of UD

The term *universal design* (UD) was coined by the architect Ronald Mace, who challenged the conventional approach of

designing for the average user and provided a design foundation for more accessible and usable products and environments. Mace and other visionaries developed the definition of UD used by The Center for Universal Design at North Carolina State University: “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.” Universal design puts high value on *both* diversity and inclusiveness.

Experts working with the Center for Universal Design established seven principles for the universal design of any product or environment. Listed below are the principles of universal design, each matched with a guideline and an example of its application to an educational product or environment.

- *Equitable Use*. The design is useful and marketable to people with diverse abilities. An example of this principle being applied is museum information provided in several languages commonly used in the community, thus making the environment welcoming and inclusive.
- *Flexibility in Use*. The design accommodates a wide range of individual preferences and abilities. An instructor who provides multiple ways for faculty and students to interact is applying this principle.
- *Simple and Intuitive*. Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level. Software that gives clear, intuitive directions for use employs this principle.
- *Perceptible Information*. The design communicates necessary information effectively to the user, regardless of ambient conditions or



the user's sensory abilities. Captions provided on videos provide an example.

- *Tolerance for Error.* The design minimizes hazards and the adverse consequences of accidental or unintended actions. Software that gives guidance when an error is made is an application of this principle.
- *Low Physical Effort.* The design can be used efficiently and comfortably, and with a minimum of fatigue. Lab equipment that is easy to operate applies this principle.
- *Size and Space for Approach and Use.* Appropriate size and space is provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility. Lab equipment that is usable by students with a wide range of physical characteristics uses this principle.

Universal Design in Education (UDE)

Universal design has been applied to many educational *products* (such as computers, websites, software, textbooks, lab equipment) and *environments* (including dormitories, classrooms, student union buildings, libraries, distance learning courses). Unlike an accommodation for a specific person with a disability, the practice of UDE benefits all students, including students with disabilities who are not receiving disability-related accommodations from the school. The following sections show examples of how universal design can be applied in educational settings—to physical spaces, to information technology (IT), to instruction, and to student services.

Universal Design of Physical Spaces

An example of universal design is doors with sensors that make them automatically open for individuals walking with packages, those using wheelchairs, the elderly who experience weakness, parents pushing baby strollers, and workers using rolling carts to deliver products.

Universal design guidelines have been tailored to specific environments. For example, the Universal Smart Home Design has been described as “the process of designing products and housing environments that can be used to the greatest extent possible by people of all ages, abilities, and physical disabilities.”

For specific suggestions for creating welcoming, accessible, and usable spaces consult the *ADA Checklist for Readily Achievable Barrier Removal; Accessible Environments: Toward Universal Design* (Mace, Handie, & Place, 1996); and *The Accessible School: Universal Design for Educational Settings* (Bar & Galluzzo, 1999).



Universal Design of Information Technology

IT has the potential to level the playing field or further widen gaps in educational and career attainment between individuals who have disabilities (or are from other minority groups) and members of the majority. Design guidelines to assist computer manufacturers and software developers in creating products that are usable by a broad audience were developed by a group of professionals representing different stakeholder groups (Vanderheiden & Vanderheiden, 1992). Each guideline, listed below, is phrased as an objective followed by examples of how the objective might be achieved.



1. *Output/displays*, which includes all means of presenting information to the user: The design should maximize the number of people who can
 - not miss important information if they can't hear.
 - have a line of sight to visual output and reach printed output.
 - see visual output clearly enough.
 - not miss important information if they can't see.
 - understand the output (visual, auditory, other).
2. *Input/controls*, which includes keyboards and all other means of communicating to the product: The design should maximize the number of people who can
 - reach the controls.
 - find the individual controls/keys if they can't see them.
 - read the labels on the controls/keys.
 - determine the status or setting of the controls if they can't see them.
 - physically operate controls and other input mechanisms.
 - understand how to operate controls and other input mechanisms.
 - connect special alternative input devices.
3. *Manipulations*, which includes all actions that must be directly performed by a person in concert with the product or for routine maintenance; e.g., inserting disk, loading tape, changing ink cartridge: The design should maximize the number of people who can
 - physically insert and remove objects as required to operate a device.
 - physically handle and/or open the product.
 - remove, replace, or reposition often-used detachable parts.
 - understand how to carry out the manipulations necessary to use the product.
4. *Documentation*, with a focus on operating instructions: The design should maximize the number of people who can
 - access the documentation.
 - understand the documentation.
5. *Safety*, including alarms and other protections from harm: The design should maximize the number of people who can
 - perceive hazard warnings.
 - use the product without injury due to unperceived hazards or the user's lack of motor control.

Applications of these guidelines to IT have demonstrated that it is possible to create products that are simultaneously accessible to people with a wide range of abilities, disabilities, and other characteristics.

The World Wide Web Consortium (W3C), which develops and maintains protocols used on the web to insure interoperability, is committed to universal design. As expressed by its director, "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect." W3C's Web Accessibility Initiative (WAI) has developed guidelines and checkpoints for the accessible design of websites. In 2001, the U.S. Access Board adopted much of the work of the WAI when it developed minimum accessibility standards for IT designed, procured, and used by federal agencies as mandated by the 1998 amendments of Section 508 of the Rehabilitation Act of 1973. The Section 508 standards are used as guidelines by many states, educational institutions, and other organizations not directly covered by the legislation.

Many IT companies do not take the full spectrum of user diversity into account when they develop their products, unintentionally erecting barriers to their use by people with



disabilities and others. Nevertheless, during their procurement process, institutions can express the desire to purchase accessible IT and inquire about the accessibility features of specific products (e.g., captioned video compatibility with assistive technology used by people with disabilities). Once purchased, place computers for students in accessible locations and provide some adjustable tables and commonly used assistive technology.

Universal Design of Instruction

The Center for Applied Special Technology (CAST) has focused its efforts on universal design for learning (UDL), especially as it applies to technology-based curriculum and assessment. It defines UDL as, “a research-based set of principles that together form a practical framework for using technology to maximize learning opportunities for every student.” UDL is applied when curriculum designers create products to meet the needs of students with a wide range of abilities and learning styles and preferences. UDL draws on “brain research and media technologies to respond to individual learner differences. It reflects an awareness of the unique nature of each learner and the need to address differences.” UDL curriculum offers

- *Multiple means of representation*, to give learners various ways of acquiring information and knowledge;
- *Multiple means of expression*, to provide learners alternatives for demonstration of what they know; and
- *Multiple means of engagement*, to tap into learners’ interests, offer appropriate challenges, and increase motivation. (CAST)

In 1997, a meeting of researchers and product developers on universal design was convened by ERIC/OSEP Special Project funded by the U.S. Department of Education. Participants

stated “Publishers should prepare and teachers should select instructional materials that are supportive and inclusive of students who have wide disparities in their abilities to see, hear, speak, read, etc. (Orkwis & Mclane, 1998, pp. 3-4). The group recommended the following first steps for curriculum developers and teachers:

1. Provide all text in digital format.
2. Provide captions for all audio.
3. Provide educationally relevant descriptions for images and graphical layouts.
4. Provide captions and educationally relevant descriptions for video.
5. Provide cognitive supports for content and activities:
 - Summarize big ideas.
 - Provide scaffolding for learning and generalization.
 - Build fluency through practice.
 - Provide assessments for background knowledge.
 - Include explicit strategies to make clear the goals and methods of instruction.

Unfortunately, most educational software programs available today are not universally designed. Instead of including flexible features that provide access to students with disabilities, they erect barriers to the curriculum.

Universal design can be applied to all aspects of instruction—teaching techniques, curriculum, assessment—as indicated in the following guidelines. (For details, see *Equal Access: Universal Design of Instruction* at http://www.washington.edu/doit/Brochures/Academics/equal_access_udi.html.)

- *Class Climate*. Adopt practices that reflect high values with respect to both diversity and inclusiveness.



- *Physical Environments/Products.* Assure that activities, materials, and equipment are physically accessible to and usable by all students and that all potential student characteristics are addressed in safety considerations.
- *Delivery Methods.* Use multiple, accessible instructional methods.
- *Information Resources/Technology.* Assure that course materials, notes, and other information resources are engaging, flexible, and accessible to all students.
- *Interaction.* Encourage effective interactions between students and the instructor and assure that communication methods are accessible to all participants.
- *Feedback.* Provide specific feedback on a regular basis.
- *Assessment.* Regularly assess student progress using multiple, accessible methods and tools and adjust instruction accordingly.
- *Accommodation.* Plan for accommodations for students for whom the instructional design does not meet their needs.

Universal Design of Student Services

UD can be applied in order to make student services accessible and usable by all students. These services include computer labs, video and multimedia, libraries, recruitment and admissions, registration, financial aid, advising, career services, housing and residential life, tutoring and learning centers, and student organizations. When universal design is applied, services make everyone feel welcome, able to get to the facility and maneuver within it, able to access materials and electronic resources, and able to participate in events and other activities. Efforts should be made in the following areas. (For details, see *Equal Access: Universal Design of Student Services* at http://www.washington.edu/doit/Brochures/Academics/equal_access_ss.html.)

- *Planning, Policies, and Evaluation.* Consider diversity issues as you plan and evaluate services.

- *Physical Environments/Products.* Assure physical access, comfort, and safety.
- *Staff.* Make sure all staff are prepared to serve all students.
- *Information Resources/Technology.* Assure that publications and websites welcome a diverse group and that information is accessible to all visitors, and that technology within the service area is also accessible to everyone.
- *Events.* Assure that everyone feels welcome and can participate in events sponsored by the organization.

Universal Design of Physical Spaces

Universal design can be applied to physical spaces to assure that they are welcoming, comfortable, accessible, attractive, and functional. Specific considerations should be made for climate/aesthetics, entrances and routes of travel, furniture and fixtures, information resources/technology, safety, and accommodation. For example, in a universally designed classroom furniture is adjustable in height and can be easily arranged for different learning activities and groupings. A universally designed facility includes clear directional signs in large, high-contrast print.

When universal design is applied, individuals with and without disabilities can use the same entrances and travel the same routes. The climate is welcoming to everyone and aesthetic characteristics appeal to a broad audience when physical spaces are universally designed.

For specific applications of UDE that include instruction, distance learning, websites, projects, conference exhibits, presentations, and professional organizations, consult the DO-IT publication *Universal Design: Principles, Process, and Applications* at <http://www.washington.edu/doit/Brochures/Programs/ud.html>.



Resources

ADA Checklist for Readily Achievable Barrier Removal. <http://www.usdoj.gov/crt/ada/checkweb.htm>

Applications of Universal Design. <http://www.washington.edu/doit/Resources/udesign.html>

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Center for Applied Special Technology (CAST). <http://www.cast.org/udl/>

The Center for Universal Design. <http://www.design.ncsu.edu/cud/>

The Center for Universal Design in Education. <http://www.washington.edu/doit/CUDE/>

Electronic and Information Technology Accessibility Standards (Section 508). <http://www.access-board.gov/sec508/standards.htm>

Mace, R. L., Hardie, G. J., & Place, J. P. (1996). *Accessible environments: Toward universal design*. http://www.design.ncsu.edu/cud/pubs_p/pud.htm

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Vanderheiden, G. C., & Vanderheiden, K. R. (1992). *Guidelines for the design of consumer products to increase their accessibility to people with disabilities or who are aging* (Working Draft 1.7). Madison, WI: Trace Research and Development Center. http://www.trace.wisc.edu/docs/consumer_product_guidelines/toc.htm

Web Accessibility Initiative, World Wide Web Consortium. <http://www.w3.org/WAI/>

About DO-IT

DO-IT (Disabilities, Opportunities, Internetworking, and Technology) serves to increase the successful participation of individuals with disabilities in challenging academic programs and careers. This publication was developed with funding from the U.S. Department of Education, Office of Postsecondary Education (grant #P333A020044). However, the contents do not necessarily represent the policy of the Department of Education, and you should not assume their endorsement. For further information, to be placed on the DO-IT mailing list, or to request materials in an alternate format, contact:

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