Universal Design in Education: Principles and Applications

An approach to ensure that educational programs serve all students

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While courses, technology, and student services are typically designed for the narrow range of characteristics of the average student, the practice of universal design in education (UDE) considers people with a wide 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 and ethnicity, age, stature, disability, and learning style.

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

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

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 (CUD) at North Carolina State University: "the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities" (Story, Mueller, & Mace, 1998). Universal design puts high value on both diversity and inclusiveness.

A group of architects, product designers, engineers, and environmental design researchers at the CUD established seven principles for the universal design of products and environments (The Center for Universal Design, 1997). These principles of UD are listed below. Each is followed by an example of its application.

1. *Equitable use*. The design is useful and marketable to people with diverse abilities. Career services example: Job postings in formats accessible to people with a broad range of abilities, disabilities, ages, racial, and ethnic backgrounds.
2. *Flexibility in use*. The design accommodates a wide range of individual preferences and abilities. Campus museum example: A design that allows a visitor to choose to read or listen to the description of the contents of display cases.
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. Assessment example: Testing in a predictable, straightforward manner.
4. *Perceptible information*. The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. Dormitory example: An emergency alarm system with visual, aural, and kinesthetic characteristics.
5. *Tolerance for error*. The design minimizes hazards and the adverse consequences of accidental or unintended actions. Instructional software example: A program that provides

guidance when the student makes an inappropriate selection.

6. *Low physical effort*. The design can be used efficiently and comfortably and with a minimum of fatigue. Curriculum example: Software with on-screen control buttons that are large enough for students with limited fine motor skills to select easily.
7. *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. Science lab example: An adjustable table and work area that is usable by students who are right- or left-handed and have a wide range of physical characteristics and abilities.

Universal Design in Education

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

UD of Physical Spaces

UD can be applied to physical spaces to ensure that they are welcoming, comfortable, accessible, attractive, and functional. Specific considerations should be made for climate, entrances and routes of travel, furniture and fixtures, information resources and technology, and safety.

When UD is applied, individuals with and without disabilities can use the same entrances and of travel routes. The climate is welcoming and accessible for everyone.

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.

Another example of UD of physical spaces is doors with sensors that automatically open for individuals carrying packages, those using wheelchairs, the elderly who experience weakness, parents pushing baby strollers, and workers using rolling carts to deliver products.

UD guidelines can be tailored to specific environments. For example, Universal Smart Home Design is "the process of designing products and housing environments that can be used to the greatest extent possible for people of all ages, abilities, and physical disabilities" (Schwab, 2004, p. 24).

For specific suggestions for creating welcoming, accessible, and usable spaces consult the publication *Equal Access: Universal Design of Physical Spaces* (Burgstahler, 2007b). Additional information is located in the *ADA Checklist for Readily Achievable Barrier Removal* (Adaptive Environments Center, 1995), *Accessible Environments: Toward Universal Design* (Mace, Hardie, & Place, 1996), and *The Accessible School: Universal Design for Educational Settings* (Bar & Galluzzo, 1999).

UD of Information Technology

IT has the potential to level the playing field or widen the 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. Each

guideline, listed below, is phrased as an objective followed by examples of how the objective might be achieved.

1. *Output and Displays*. Includes all means of presenting information to the user. The design should maximize the number of people who can
   - hear auditory output clearly enough.
   - 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).
   - view the output display without triggering a seizure.
2. *Input and Controls*. Includes keyboards and all other means of communicating to the device. The design should maximize the number of people who can
   - reach the controls.
   - find the individual controls or keys if they can't see them.
   - read the labels on the controls or 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*. 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 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*. Focuses on operating instructions. The design should maximize the number of people who can
   - access the documentation.
   - understand the documentation.
5. *Safety*. Includes 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. (Vanderheiden & Vanderheiden, 1992)

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 ensure 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" (Web Accessibility Initiative, n.d.). 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 earlier 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 to 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 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. Once purchased, staff can place computers for students in accessible locations and provide some adjustable tables and commonly used assistive technology.

UD of Instruction

The Center for Applied Special Technology (CAST) focuses its efforts on universal design for learning (UDL), especially as it applies to technology-based curriculum. 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" (Rose & Meyer, 2002, Preface). When UDL is applied, curriculum designers create products to meet the needs of students with a wide range of abilities, learning styles, and preferences. The UDL curriculum "reflects an awareness of the unique nature of each learner and the need to address differences" by offering:

- *Multiple means of representation*, to give learners various ways of acquiring information and knowledge;
- *Multiple means of action and expression*, to provide learners alternatives for demonstrating what they know; and
- *Multiple means of action and 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, p. 13). 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. (Orkwis & McLane, 1998, pp. 14-15)

Unfortunately, most instructional software available today does not apply these recommendations. Instead of including flexible features that provide access to students with disabilities, they continue to unintentionally erect barriers to the curriculum.

Universal design can be applied to all aspects of instruction—teaching techniques, curricula, assessment—as indicated in the following guidelines. (For details, see the publication and video *Equal Access: Universal Design of Instruction* at *www.uw.edu/doit/Video/ea_udi.html*.)

- *Class Climate*. Adopt practices that reflect high values with respect to both diversity and inclusiveness.
- *Interaction*. Encourage regular and effective interactions between students and the instructor and ensure that communication methods are accessible to all participants.
- *Physical Environments and Products*. Ensure that facilities, 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 that are accessible to all learners.
- *Information Resources and Technology*. Ensure that course materials, notes, and other information resources are engaging, flexible, and accessible for all students.
- *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 whose needs are not met by the instructional design. (Burgstahler, 2007a)

UD of Student Services

UD can be applied to student services to make them accessible to and usable by all students. These services include computer labs, libraries, admissions, registration, financial aid, advising, career services, housing, tutoring and learning centers, and student organizations. When universal design is applied, everyone feels welcome, is able to get to the facility and maneuver within it, access materials and electronic resources, and 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 *www.uw.edu/doit/Brochures/Academics/equal_access_ss.html*.)

- *Planning, Policies, and Evaluation*. Consider diversity issues as you plan and evaluate services.
- *Physical Environments and Products*. Ensure physical access, comfort, and safety within an environment that is welcoming to visitors with a variety of abilities, racial and ethnic backgrounds, genders, and ages.
- *Staff*. Make sure staff are prepared to work with all students.
- *Information Resources and Technology*. Ensure that publications and websites welcome a diverse group and content is accessible to everyone.
- *Events*. Ensure that everyone can participate in events sponsored by the organization. (Burgstahler, 2007c)

Further Information About UDE

For more information about applications of universal design consult *www.uw.edu/doit/Resources/udesign.html* or *The Center for Universal Design in Education* at *www.uw.edu/doit/CUDE/*. The book *Universal Design in Higher Education: From Principles to Practice* published by Harvard Education Press shares perspectives of UD leaders nationwide. To receive a 20% discount visit the DO-IT website.

Resources

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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 such as those in science, engineering, mathematics, and technology. Primary funding for DO-IT is provided by the National Science Foundation, the State of Washington, and the U.S. Department of Education.

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