Introduction
Universal design (UD) is a complex approach requiring educators and students to challenge basic assumptions about the users’ performance envelope. In some ways, universal design is consistent with other human-centered models in that it requires students to explore and understand basic human function, but it differs significantly in other areas. The central goal of the universal design philosophy is the creation of products and environments that are appropriate and easy to use by the widest possible range of users. An important component of UD is the inclusion of users who are typically assumed to require specialized design and, as such, are separated or marginalized from mainstream users. People who experience moderate to severe functional limitations including cognitive, sensory, mobility, and dexterity impairments are included in UD’s target user description. Typical human-centered design educational content focuses on “normal” human function: information processing, reach ranges, biomechanics, and anthropometrics of statistical majorities. Little attention is given to the understanding of individuals who experience an interruption or limitation of “normal” function. These are the people who are truly in the majority, because anyone can think of a time when he or she felt tired or distracted or was injured or walked through a door with both hands full. It is in this area that universal design education is most challenging to students and educators. The realization that there is no “normal” user description requires designers and subsequently designs to be as flexible and dynamic as possible.

The UD approach has evolved from disability-centered concepts including Assistive, Adaptive, Barrier Free, and Transgenerational design. A comprehensive introduction to UD should include a description of this evolution as well as the important semantic distinctions between the approaches. A simple diagram illustrating this design continuum with design for the individual on the left-most extreme and design for all on the right extreme is a useful starting point for this discussion.
UD differs philosophically from its predecessors in that it is not strictly focused on accommodating disability. Assistive design targets an individual person and attempts to compensate for limitations and maximize residual function. Adaptive design transforms troublesome elements, usually with the addition of a third-party product. Barrier-free design is terminology reminiscent of the earliest accessibility legislations with disability and architectural overtones. Transgenerational design is a popular approach that has its basis in understanding aging. Of the available nomenclature, the term Universal design, most accurately conveys the design-for-all aspiration.

Because the UD approach emphasizes design for all, it has limitations that must be addressed as part of pragmatic design instruction. In many cases, design-for-all is an unattainable goal. There are often cases where it is not possible to accommodate users with severe limitations or extreme combinations of limitation and circumstance. In cases where it is not possible to provide the identical experience, an equivalent may be suitable. For example, a headphone jack may be required for a blind user to interface with an ATM. That feature allows other users to adjust auditory output to a suitable volume, block out background noise, and keep sensitive information confidential.

**The Systems Approach**

The systems-oriented approach of ergonomics is an effective foundation for UD instruction. Every interaction is analyzed in terms of the system in which it occurs. A system is defined as the combination of the user, the product, the task, and the environment in which it all takes place. The key contributors to performance within that system vary according to the circumstances, but they are always present in some proportion. This observation is important because it underscores the value of appropriate product, task, and environmental design. For the purposes of design education, the system can be quite simple and still effectively illustrate the principles. For example, to make a sandwich, the user has to maneuver around the kitchen, collect and assemble the ingredients, and clean up. In this fairly mundane activity there are dozens of person > environment, person > product interactions to observe. Is the user standing or sitting? How does that affect reach, range of motion, and line of site? What types of products does the user encounter: appliances, food-storage containers, packaging, tableware, and cleaning supplies? What are the environmental factors: floor space, floor surface, lighting, counter and cupboard height? The opportunities for design are astounding. As the complexity of the activity increases, so do the implications for design. Each of the designed elements of any system can be modified or optimized for efficient function under most circumstances.

In any system, the user is the element with the most potential for variation and the one the designer is least able to control. What is the user’s physical description, cognitive function, attention level, or experience level? Is there only one user, or are there multiple users? How would the sandwich task change if the user were a child? The systems approach helps to mitigate the fact that designers will never be able to anticipate all the users’ need all the time. It also counteracts the user’s tendency to take responsibility for poor performance with the
all too frequently heard “I’m just not as strong as I used to be,” or “I guess I’m not smart enough to work it.” The real opportunity for impact is on the analysis of the context in which people live and work, not strictly on the people themselves.

Another major benefit of the systems approach allows students to focus on parts of the interaction most interesting to them. In an assignment, a group of students are asked to analyze the activity of washing and drying a load of laundry. Together they break down the activity into subtasks; transporting clothes, loading/unloading machines, adding detergent, and activation. From here, individual students identify the design elements specific to a particular subtask and evaluate them. Some students choose physical product interface, some electronic, others, the overall configuration of the environment.

The result is enhanced interest in the content, as well as the potential to export UD content to audiences outside of product the design discipline; architecture, environmental design, engineering, and facility management, to name only a few. Issues pertinent to these design disciplines readily emerge when the entire context of an activity is analyzed.

**Principle Systems**

Recommended design interventions can be based on multiple, existing guideline structures, some of which overlap. Engineers, designers, and psychologists active in usability testing and guideline development have created various successful usability guideline structures that can inform the UD approach. A comprehensive review and application of these structures indicates some degree of central tendency and informs context appropriate solution selection. In the year 2000, there were 28 million people who were foreign born, 25 million people over the age of 55 and 53 million people with disabilities in the United States (www.census.gov). With so much variety in the population it is difficult to design products that perform well and are easy to use. To that end, experts in the fields of design, engineering, and psychology have developed principles and guidelines to serve as templates for better design. In 1988, Don Norman published *Seven Principles for Transforming Difficult Tasks into Simple Ones*, in 1990 Jakob Nielsen published *Ten Usability Heuristics*, in 1997 the Center for Universal Design published its *Seven Principles of Universal Design*, also in 1997 Ben Shneiderman published *Eight Golden Rules of User Interface Design*. The Norman principles and universal design principles apply primarily to products and components of the built environment. The guidelines from Nielsen and Shneiderman apply primarily to the design of multimedia and electronic interface. Significant differences in application notwithstanding, there are some critical similarities among these systems. They all assume diversity among the user population, including people who may be unfamiliar or inexperienced with a given product or people who may have physical or cognitive impairments. They recommend multiple, simultaneous strategies for accommodating that diversity, rather than a single one. They allow the user to customize his or her experience based on the situation, shifting the responsibility for performance away from the user and onto the product. Of further value is the exposure design students receive to design guidelines developed and used by complimentary disciples.
Conclusion

More and more designers are faced with the realization that the idea “normal” person is a myth and that all people have some form of limitation or variation that affect the way they interact with the world. While there is no practical way to design all things for all people, the core philosophy of universal design is sound and deserves consideration.

The ergonomic systems approach to design supports the goals of UD in multiple ways. Its emphasis on context distributes the responsibility for performance appropriately to all contributing factors, which minimizes people’s tendency to blame themselves. It provides a framework for visualizing different or multiple users. It functions within the tenets of established usability principle systems and moves from design for the individual toward design for all.
References

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